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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

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| IN RE: OIL SPILL BY THE OIL RIG *DEEPWATER HORIZON* IN THE GULF OF MEXICO ON APRIL 20, 2010 CIVIL | Docket No. MDL-2179<br>Section "J"<br>New Orleans, LA<br>Wednesday, October 9, 2013 |

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| IN RE: THE COMPLAINT AND PETITION OF TRITON ASSET LEASING GmbH, ET AL | Docket No. 10-CV-2771<br>Section "J" |

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| UNITED STATES OF AMERICA V. BP EXPLORATION & PRODUCTION, INC., ET AL | Docket No. 10-CV-4536<br>Section "J" |

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DAY 7, MORNING SESSION
TRANSCRIPT OF NON-JURY TRIAL PROCEEDINGS
HEARD BEFORE THE HONORABLE CARL J. BARBIER
UNITED STATES DISTRICT JUDGE

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# I N D E X

P R O C E E D I N G S

(WEDNESDAY, OCTOBER 9, 2013)

(MORNING, AFTERNOON SESSION)

(OPEN COURT.)

08:04:41 THE COURT: Good morning, everyone. Be seated. All
08:04:47 right. Let me make my announcement from our timekeepers.
08:04:57 According to them, we have, let's see, United States has used
08:05:02 7 hours and 49 minutes, has 37:11 remaining; BP has used 7 hours,
08:05:09 13 minutes, has 37:47 remaining.
08:05:15 Any other preliminary matters?
08:05:17 MR. BOLES: Yes, your Honor, if I may. Martin Boles for
08:05:19 BP and Anadarko. I would like to offer into evidence the exhibits
08:05:23 used in yesterday's cross-examination of Dr. Hsieh, which we
08:05:27 circulated last night and, to my knowledge, haven't been objected
08:05:30 to.
08:05:30 THE COURT: All right. Any objections? Hearing none,
08:05:33 those are admitted.
08:05:35 MR. BOLES: Thank you, your Honor.
08:05:36 THE COURT: Sure. Good. All right. Ms. Karis --
08:05:40 MS. KARIS: Good morning, your Honor.
08:05:42 THE COURT: -- you may resume. Dr. Zick, you're still
08:05:47 under oath. Okay?
08:05:47 THE WITNESS: Okay.
08:05:50 MS. KARIS: Heeding your advice from last week that we

don't have to use all of our time, I have attempted to cut some of this, so that's the benefit of carrying over Dr. Zick.

Good morning.

THE WITNESS: Good morning.

MS. KARIS: For the record, Hariklia Karis, we're resuming your cross-examination on behalf of BP and Anadarko.

CONTINUED CROSS-EXAMINATION

BY MS. KARIS:

Q. When we broke yesterday, we were talking about your EOS model and whether it overpredicts stock-tank barrels. You compared your EOS model to lab results that existed that contained a figure for stock-tank barrels both for single-stage flash as well as multistage flash, correct?

A. Yes.

Q. And there were four fluid samples that were tested at single-stage flash, correct?

A. Correct.

Q. And in each of those four instances, your EOS model overpredicted the shrinkage factor, correct?

A. No, that's not correct.

Q. Okay. Let's take a look at TREX 11495.1.1. And I realized I forgot my glasses, so one second. Before we look at this chart, would you agree with me that for all four of the multistage flash tests that were conducted, your EOS model overpredicted the stock-tank barrel figure?

08:07:34 A. Could you repeat the question?
08:07:36 Q. Sure. You talked about there being four samples that were
08:07:40 tested, correct?
08:07:40 A. Correct.
08:07:41 Q. And for multistage, or four-stage, which is the process that
08:07:46 you recommended -- or one of the processes that you recommended,
08:07:51 your EOS model overpredicted the shrinkage factor, as compared to
08:07:56 the lab tests?
08:07:57 A. By small amounts, yes.
08:07:59 Q. Okay.
08:08:07 THE COURT: Overpredicted, meaning predicted a greater
08:08:11 shrinkage than otherwise?
08:08:13 MS. KARIS: Correct.
08:08:14 BY MS. KARIS:
08:08:14 Q. And to be clear, Dr. Zick, by overpredicting, that results in a
08:08:19 large stock-tank barrel figure?
08:08:21 THE COURT: I heard it exactly opposite, that's why I
08:08:24 asked the question. Overpredicted the shrinkage to me means it
08:08:28 shrunk more. So it would be less stock-tank barrels. So you have
08:08:33 to clarify that.
08:08:35 MS. KARIS: Sure.
08:08:36 BY MS. KARIS:
08:08:37 Q. If you're overpredicting the shrinkage factor, what does that
08:08:41 result in with respect to stock-tank barrels?
08:08:44 A. That means more stock-tank barrels. The shrinkage factor as

used in the petroleum industry has a completely counterintuitive meaning. The shrinkage factor is the shrunken volume divided by the original volume. So the larger the shrinkage factor, really the less the fluid has shrunk.

THE COURT: Clear as mud now.

THE WITNESS: Exactly.

THE COURT: I will have to take your word for that, I guess.

MR. BROCK: Welcome to our world.

MS. KARIS: My feeling exactly, your Honor. A few weeks ago, this meant nothing.

BY MS. KARIS:

Q. So just to be clear, because I know it's counterintuitive, it remains counterintuitive to me, if your model overpredicts the shrinkage factor, that would result in more stock-tank barrels, correct?

A. Correct.

Q. Okay. And you agree that your EOS model overpredicts the shrinkage factor for all of the samples that were tested at four-stage flash, correct?

A. By small amounts, correct.

Q. And when you say by small amounts, approximately 3 percent, I believe, is what you said previously?

A. Yes, something like that.

Q. And so that would be a 3 percent overprediction of whatever

cumulative number exists, correct?
A. That would be assuming that the laboratory data was 100 percent reliable, which is not a certainty, by any means.
Q. But given that your EOS model is measured in part by its ability to predict the lab data, that's what you're aiming to achieve, match your model to the lab data, correct?
A. My attempt was to match my model to all 1,000 plus data points that were available, not just those four shrinkage factors.
Q. Okay. But at least with respect to that one variable, we agree that you are over what the lab data is, correct?
A. By small amounts, correct.
Q. I think we've established that. Let's move on, then. We don't need to go through the specific details of this chart.
Now, you're aware that there were multiple equation of state models that were created in connection with the Macondo oil spill, correct?
A. Yes.
Q. You created one?
A. Correct.
Q. Dr. Whitson created one?
A. Correct.
Q. And, likewise, BP created one in the summer of 2010?
A. I believe they may have created two, but I've seen one of them.
Q. And it's your belief that yours is the best of all of the equation of state models that exist, correct?

08:11:52 A. Overall, yes.
08:11:53 Q. Now, you're aware that the United States has multiple experts
08:11:58 in this case who were looking at the total volume of oil released
08:12:04 from the Macondo well, correct?
08:12:06 A. Yes.
08:12:06 Q. And you know who Dr. Dykhuizen is?
08:12:10 A. Yes.
08:12:11 Q. And Dr. Dykhuizen testified to this Court earlier this week.
08:12:16 Were you here when he testified?
08:12:18 A. Yes.
08:12:18 Q. And you know that although you believe your equation of state
08:12:22 model is the best, he did not use your model, correct?
08:12:26 A. Well, he did his modeling two years before I developed my
08:12:31 equation of state, so, correct.
08:12:33 Q. I understand. But he issued an expert report in March of this
08:12:38 year, correct?
08:12:41 A. Yes. But I believe that was based on his 2010 modeling, as far
08:12:46 as I know.
08:12:46 Q. And with the knowledge that you had an equation of state, he
08:12:52 relied on equation of state models done by Sandia Labs, correct?
08:12:58 A. I believe that's correct.
08:12:59 Q. And are you also aware of a different United States expert,
08:13:05 Dr. Pooladi-Darvish, who will be testifying here today, I believe?
08:13:09 A. Yes.
08:13:09 Q. And, likewise, although you believe your model is the best, he

did not use your model, correct?
A. As I understand it, his software was not capable of applying an equation of state directly.
Q. Are you familiar with the Vasquez-Beggs fluid correlation?
A. That's not something I've used, no.
Q. That's the model that Dr. Pooladi-Darvish used to predict fluid properties, correct?
A. I don't know.
Q. But you know at least that he, too, didn't use your model?
A. I am pretty sure that that's correct.
Q. And you're familiar with Dr. Kelkar?
A. I know the name.
Q. And he, too, is another expert for the United States who opined on quantification issues in this case, correct?
A. Correct.
Q. Now, he did use your equation of state analysis for only part of his opinions, correct?
A. I believe that's correct.
Q. You understand that he did a material balance analysis?
A. I am not sure of the details of all of his work.
Q. Do you know whether for his material balance analysis Dr. Kelkar, rather than using your equation of state, used the black oil tables that were created by BP in its -- in the equation of state model it generated in the summer of 2010?
A. That's possible, but I don't know the details of his work.

08:14:46 Q. You have no reason to question that Dr. Kelkar, in fact, used
08:14:59 BP's generated black oil tables, based on BP's composition modeling
08:15:06 from the summer of 2010, correct?
08:15:08 A. I don't know.
08:15:08 Q. Now, you created your equation of state model in part because
08:15:16 you found, in your view, that BP's model did not predict fluid
08:15:22 properties as accurately as you felt appropriate, correct?
08:15:27 A. That's correct.
08:15:27 Q. And you could not confirm during your analysis the underlying
08:15:35 basis for BP's 2010 equation of state model, is that correct?
08:15:45 A. I don't know. That question is rather vague. Could you put
08:15:52 that differently?
08:15:53 Q. Sure. The reason you didn't rely on BP's 2010 equation of
08:15:57 state modeling is because you couldn't confirm the underlying
08:16:01 process used by BP to generate that equation of state model,
08:16:05 correct?
08:16:07 A. I would say that's fair.
08:16:09 Q. And, in fact, it's your view you could not recommend any other
08:16:15 government expert use BP's model, correct?
08:16:21 A. Well, more or less, although that was because when I began work
08:16:32 on the project, not knowing exactly how BP had generated that,
08:16:39 their equation of state, having not put together a data set of the
08:16:45 laboratory data with which I could test their equation of state, I
08:16:49 had no way of knowing whether it was at all accurate or not.
08:16:55 The only thing I could tell from the results that I had

08:16:59 seen of it was that it wasn't predicting an extremely near-critical
08:17:05 fluid, and so I felt that it probably was not as accurate as it
08:17:09 should be. But I didn't know exactly how good or how bad it was at
08:17:15 that time.
08:17:15 Q. And as a result, you didn't feel like you could recommend to
08:17:21 any other government expert that they use BP's model? Those are
08:17:27 your words, correct?
08:17:28 A. Correct. At least not at the time.
08:17:30 Q. And certainly not at the time of your deposition either,
08:17:34 correct?
08:17:36 A. Well, I think -- when I recommended that BP's model not be
08:17:51 used, that was at the start of my own work. I don't think I ever
08:17:58 said after my work was done whether BP's model was -- would be
08:18:03 adequate or not. I didn't really go back and look at it, although
08:18:11 I did make some calculations and I do feel that my equation of
08:18:16 state does predict the data better than BP's. And so I would
08:18:22 recommend mine over BP's. But I don't think anyone asked me
08:18:26 afterwards whether BP's model would be unacceptable or not.
08:18:33 Q. Even at the end, after looking at BP's model, looking at all of
08:18:38 the other models, you felt your model was better and, nonetheless,
08:18:42 U.S.'s expert's didn't rely on it, correct?
08:18:46 A. Some experts did.
08:18:47 Q. That would be Dr. Kelkar for a limited purpose, correct?
08:18:51 A. Yes.
08:18:52 Q. Dr. Griffiths, were you here when he testified?

08:18:58 A. No, I don't think I sat through his.
08:19:03 Q. Do you know that Dr. Griffiths, likewise, did not use your
08:19:08 model which you believe was best?
08:19:09 A. I believe that's correct, but I am not positive.
08:19:14 Q. Let's talk now about the separation process. You testified
08:19:27 yesterday that it's your opinion that the oceanic separation
08:19:32 process is the most appropriate process to use, correct?
08:19:36 A. Yes.
08:19:38 Q. And to quote you, that's because that's how fluids would be
08:19:42 separated by the conditions they would encounter in the ocean,
08:19:46 correct?
08:19:46 A. Correct.
08:19:47 Q. And you believed it was important that whatever process is used
08:19:56 here, separation process, that it reflects the conditions
08:20:01 encountered in the ocean, to use your words, correct?
08:20:08 A. I probably said something like that.
08:20:10 Q. Now, in discussing your decision to move from the four-stage
08:20:25 recommendation that you initially had to the oceanic separator
08:20:30 recommendation that you disclosed in your rebuttal report, you
08:20:34 concluded that the oceanic separator method would be the most
08:20:39 efficient separator process, correct?
08:20:42 A. Correct.
08:20:42 Q. And by most efficient, what you mean is that results in the
08:20:49 highest shrinkage factor, correct?
08:20:54 A. Yes, that's correct.

08:20:55 Q. And, again, counterintuitive; by highest shrinkage factor, the
08:21:00 one you're now recommending, that results in the most stock-tank
08:21:05 barrels, correct?
08:21:07 A. That's correct.
08:21:07 Q. Now, I believe you testified yesterday when you were shown the
08:21:20 chart from BP's opening that single-stage flash results in the
08:21:28 lowest stock-tank barrels, correct?
08:21:31 A. Of all of the separation processes that have been proposed
08:21:36 here, yes.
08:21:36 Q. But you're also familiar with the differential liberation
08:21:42 separation process?
08:21:43 A. If you're talking about the differential liberation experiments
08:21:48 that were run by Pencor, yes, I am aware of those.
08:21:52 Q. Reservoir oil can be converted to stock-tank oil through a
08:21:55 number of processes, including differential liberation expansions,
08:22:02 correct?
08:22:03 A. I wouldn't say that that's exactly correct.
08:22:05 Q. All right. Let's look at 11490R.25.4. Do you recognize this
08:22:19 excerpt from the expert report of Aaron Zick? First, do you
08:22:27 recognize it?
08:22:27 A. Yes.
08:22:28 Q. And you see there where I've highlighted the sentence I just
08:22:33 asked you, "Reservoir oil can be converted to stock-tank oil
08:22:36 through any number of processes, including differential liberation
08:22:41 expansions." Correct?

08:22:44 A. Well, this is true in general.
08:22:47 Q. All right. Now, the differential liberation experiments
08:22:53 process, which you discuss at length in your report, that actually
08:22:57 results in lower stock-tank barrel figures, correct?
08:23:05 A. Well --
08:23:07 Q. Is it correct?
08:23:08 A. I would not call the residual from that experiment, from the
08:23:11 Pencor differential liberation experiment stock-tank oil.
08:23:15 Q. Okay. Let's look at 11491R.20.1. Again 11491R.20.1. Do you
08:23:32 recognize this chart?
08:23:33 A. Yes.
08:23:35 Q. And, again, this is from your report. Correct?
08:23:38 A. That's correct.
08:23:38 Q. And this is looking at relative volume versus pressure,
08:23:46 correct?
08:23:47 A. Correct.
08:23:48 Q. And the relative volume, is that stock-tank barrels?
08:23:52 A. No.
08:23:53 Q. Is that a conversion for stock-tank barrels?
08:23:57 A. Not really.
08:24:02 Q. Can you tell the Court what the .3 is on the far left where it
08:24:09 says "pressure over relative volume," right here, .3, which is
08:24:13 where you say the data plot is. There are dots for data to be
08:24:17 clear. This is from the lab tests, correct?
08:24:19 A. Yes.

Q. And then you've got Zick's EOS in the blue line and then you've got Whitson's EOS in the green line, correct?
A. Correct.
Q. And just tell the Court, right here, this .3, what is that?
A. That's the relative volume of the residual oil from this experiment. But I would not call that stock-tank oil because this experiment would -- mimics no process that the Macondo fluid would ever undergo. This is the type of experiment that is designed to see what would -- what residual oil would be left in the reservoir if you blew the reservoir down all the way down to atmospheric pressure, but that did not happen in this experiment or in this -- in the -- in what happened to the Macondo reservoir.
Q. So you believe that differential liberation figures do not represent what actually happened at Macondo, correct?
A. Not one the reservoir, not within the well. And this particular experiment doesn't apply to what happened outside of the well. So this experiment applies to nothing that happened at the Macondo reservoir.
Q. Okay. And now we're going to talk about what did happen at the Macondo reservoir. You concluded, based on the need to represent what actually happened, that the oceanic separator was the better process to use, correct?
A. Correct.
Q. You concluded that after initially advocating, however, for a four-stage process, correct?

08:26:22 A. Correct.
08:26:22 Q. And four-stage process is generally designed to be performed on
08:26:28 production platforms land based at ground level, correct?
08:26:36 A. Land based or on drilling platforms at sea, yes.
08:26:40 Q. And so the -- you didn't use the liberation process because
08:26:46 that's not what happened at Macondo, you told us, correct?
08:26:49 A. Well, technically a four-stage separation process or any
08:26:55 multistage separation process is a differential liberation process.
08:26:58 A single-stage separation is a differential liberation process.
08:27:03 All you mean by differential liberation is that after
08:27:09 each equilibration stage, all of the gas is removed and discarded.
08:27:15 The differential liberation experiment that you showed there
08:27:18 started with the first depletion pressure of 6,000 psi. That never
08:27:24 happened anywhere in the Macondo reservoir, so all of the rest of
08:27:27 the results from that experiment are completely irrelevant. The
08:27:33 differential liberations that occurred in the multistage separation
08:27:37 tests and the single-stage separation tests, those are legitimate.
08:27:43 But the additional differential liberation tests that you just put
08:27:50 up on the screen is totally irrelevant.
08:27:52 Q. We've moved away from the differential liberation. We're now
08:27:55 talking about the four stage.
08:27:56 A. Okay.
08:27:57 Q. Four stage, which was your initial recommendation, you agree
08:28:00 that that four-stage process is generally designed to be performed
08:28:04 at the surface on a production platform if it's land based, at

ground level? Those are your words, correct?
A. I may have said something like that. I don't recall saying anything about land based.
Q. Okay. We can pull up 228 at 14 to 25, just to see if this refreshes your recollection here. 228, lines 14 to 25 of Dr. Zick's deposition.
Do you recall being asked the following question, "Describe for me that four-stage process," and giving the following answer, "The first stage is -- well, the four-stage process is generally designed to be performed at the surface on a production platform if it's out in the ocean or, you know, it's a land-based well, just at the surface, you know, at ground level"?
THE COURT: Ms. Karis, that's a different question than what you posed to the witness.
MS. KARIS: I'm sorry.
THE COURT: You left out some of the words when you posed the question to the witness.
MS. KARIS: I apologize. Let me reask the question. Maybe I can clarify.
THE COURT: You left out about out in the ocean, you didn't pose that in your question.
MS. KARIS: I am happy to rephrase.
THE COURT: I think you should do that.
BY MS. KARIS:
Q. The four-stage process, that is for production platform that is

out in the ocean, the production platform is in the ocean and the four-stage process is at the surface, correct?
A. That's usually correct. Although I believe you could also set up separation equipment on the floor of the ocean. But I am not an expert on production operations, so I am not exactly sure.
Q. The production platform is what you're referring to there is in the ocean, not the water in the -- I mean not the oil in the ocean, correct?
A. Correct.
Q. Now, you just said you are not an expert in production operations, correct?
A. I wouldn't call myself an expert in that -- in those areas.
THE COURT: Let me ask a couple of questions, Ms. Karis, so I can understand.
MS. KARIS: Absolutely.
THE COURT: Dr. Zick, can you tell me, if you can tell me, what is the normal or customary manner or methodology that's used in the industry to perform this process?
THE WITNESS: Well, normally when an oil company produces oil, they would like to stabilize as much of the oil as possible in the stock-tank conditions. And so they will normally set up some sort of multistage separation process at the surface somewhere.
THE COURT: So that would be -- which of the methods you discussed, you've told us about, which method would that be with?
THE WITNESS: The four-stage separation process.

08:31:38 THE COURT: So from your testimony or from your
08:31:42 perspective, do I understand that the issue comes down to whether
08:31:46 that's the appropriate methodology for the Court to apply the
08:31:52 calculated stock-tank barrels or, instead, this oceanic
08:31:58 methodology, because we know that the oil escaped before it got to
08:32:07 the surface via a riser in this instance? Am I understanding that
08:32:11 correctly?
08:32:13 THE WITNESS: There are basically three choices: Those
08:32:15 two choices and then the single-stage choice. The single-stage
08:32:21 choice would not be used for production purposes. It's a simple
08:32:28 process, but very inefficient. I believe some of BP's experts have
08:32:33 applied the single stage.
08:32:35 THE COURT: I want to understand what your opinion is,
08:32:39 since you're testifying now. They'll testify, I'm sure.
08:32:42 THE WITNESS: My opinion is that either the oceanic
08:32:47 model, as I've proposed it, or the four-stage separation model,
08:32:52 either of those would be appropriate, depending on whether you
08:32:56 would like to mimic the behavior that the ocean might have imposed
08:33:03 upon the fluids or mimic the behavior that BP would have imposed
08:33:13 upon the fluids had they produced it in the normal fashion.
08:33:18 THE COURT: Okay. Go ahead, Ms. Karis, I'm sorry to
08:33:20 interrupt.
08:33:21 MS. KARIS: Thank you, your Honor.
08:33:22 BY MS. KARIS:
08:33:23 Q. To be clear, Dr. Zick, BP did not produce the Macondo well in

the normal fashion. That's not what actually occurred here, correct?
A. Except for the collection operations, that's correct.
Q. So the collection operations, that was what you would call the normal fashion. But with respect to what was released, that was not released in the normal production fashion, correct?
A. That's correct.
THE COURT: Which separation process did they use for the collection -- collected oil?
THE WITNESS: The two collection ships used multistage separation processes, but they weren't the four-stage process that BP had analyzed in the labs. They were simpler processes, I think two-stage separations followed by a cooling stage. They weren't -- they were almost as efficient as the four-stage process but not quite.
THE COURT: Okay.
BY MS. KARIS:
Q. I think that may have cured my next question, which is BP did not use the four-stage separation process, even for the collection amount, correct?
A. That's true. But the collection vessels I don't believe were designed to -- for long-term production purposes.
Q. Okay. Just to wrap this point up, neither in the conditions that actually existed was there the four-stage separation process used, nor in the collection was the four-stage process used,

correct?
A. That's correct. Although the separation vessels did use multistage separation.
Q. And by "multistage" I think you just said in two-stage separation process?
A. I think that's correct.
Q. Now, let's talk about your oceanic separator. Your ocean separator takes into account the pressures and the temperatures in the Gulf of Mexico that the hydrocarbons encountered, correct?
A. I believe that's correct. I used the same temperature and pressure profiles proposed by Dr. Whitson. He cited some, I don't know, database that he got those profiles from, and I had no reason to doubt that they were from the Gulf of Mexico.
Q. And while you take account of the pressures and the temperatures in the Gulf of Mexico that the hydrocarbons encountered, you do not take account the composition of the ocean, the water elements, correct?
A. That's correct.
Q. Now, when you're describing your ocean separator, you described the water phase interfering with the oil and gas phases to keep them isolated, correct?
A. That would be my physical interpretation of my mathematical model of the assumptions behind my mathematical model.
Q. So to be clear, the assumptions behind the mathematical model is you're using the water for purposes of keeping the oil and the

gas separated, correct?
A. Well, in my mathematical model there is no appearance of water at all, but it has certain assumptions to it. And to justify the assumptions of any mathematical model, you try to come up with some possible physical explanations. And one possible physical explanation is that the water keeps the oil and the gas isolated from each other.
Q. And so while your model doesn't necessarily use the water, an explanation that you took into account in reaching your opinions here is an opinion that you held that the water keeps the oil and gas separated while it's traveling through the Gulf, correct?
A. Whether I would call that an opinion or just a possible explanation.
Q. Whichever you want to call it.
A. I would call it a possible explanation.
Q. So you did account for the possible explanation and used the water for that purpose at least, correct?
A. Correct.
Q. Now, your ocean separator process does not take into account the solubility of the hydrocarbons in water, correct?
A. That's correct.
Q. You agree, however, that during the spill the hydrocarbons were interacting with the water?
A. Yes, that's correct.
Q. And you agree that when hydrocarbons interact with the

08:38:11 seawater, some of the hydrocarbons would dissolve into that
08:38:14 seawater, correct?
08:38:15 A. Yes, I think that's undeniable, but we don't know how long it
08:38:21 would take. And, furthermore, all hydrocarbon components have some
08:38:32 solubility in water. If you wait long enough, all of the
08:38:37 hydrocarbons that were spilled into the Gulf of Mexico would
08:38:40 dissolve in the water given the fact that the extent of the ocean
08:38:44 is infinite. And so I think that, for purposes of defining the
08:38:53 stock-tank oil, you need to either -- I mean, there's no clear-cut
08:39:01 line of deciding how much should you allow to dissolve because you
08:39:04 could dissolve all of it. So for purposes of defining the
08:39:08 stock-tank oil, I feel that you shouldn't take that solution into
08:39:13 account.
08:39:14 Q. Now, that's one area where you and Dr. Whitson disagree. He
08:39:18 accounts for the solubility and he does take that into account in
08:39:22 his conversion, correct?
08:39:23 A. Well, in a way. He selectively takes that into consideration
08:39:27 because he allows the hydrocarbons to dissolve from the -- from his
08:39:32 resulting stock-tank oil, but he doesn't allow the hydrocarbons to
08:39:36 dissolve from his separated gas. If he allowed the C1 to C3 to
08:39:45 dissolve from his separated gas, the remainder of that separated
08:39:49 gas would be a liquid at all of the conditions within the ocean,
08:39:53 and he doesn't add the volume of that liquid back into his
08:40:00 stock-tank oil. So he allows selective dissolution.
08:40:06 In fact, if you took the entire Macondo live fluid and

you removed all of the C1 and C3 to allow that to dissolve in the ocean, all of the remaining C4 plus would be a liquid at all conditions within the ocean including stock-tank conditions, and you'd end up with actually much more volume of resulting oil than you would get from either the four-stage separation or my oceanic separation process.

I just don't feel that taking into account the dissolution of hydrocarbons in the water is appropriate for defining the stock-tank oil.

Q. Now, Dr. Whitson will be here actually tomorrow to explain exactly what he did, and why he did or didn't account for certain dissolving of hydrocarbons; but you don't disagree that the process of hydrocarbons dissolving actually did take place? You don't disagree on that premise, correct?

A. I don't doubt that. I just don't know how long it took, and I would argue that any stock-tank oil that you put into the water, say, from the spill of a ship, would start to dissolve in the water right away.

Q. Okay.

A. And the remainder of the oil that didn't dissolve within some given timeframe, I would no longer call that stock-tank oil. You could call that weathered oil, you could call that oil-slick oil, but it wouldn't be the original stock-tank oil.

Q. Now, your oceanic separator, you're aware that not a single expert retained by the United States uses or relies on that

separator process, correct?
A. I am not sure if that's true or not. Dr. Kelkar may have considered it, but you would have to ask him.
Q. And Dr. Kelkar is coming today. But is it correct sitting here you are not aware of a single expert from the United States that relied on your oceanic separator, correct?
A. I don't know.
Q. Now, you testified yesterday that you were critical of Dr. Blunt for using the single-phase flash -- single-stage flash, correct?
A. Correct.
Q. Are you aware of what method Dr. Dykhuizen, on behalf of the United States, used in reaching his opinions in this case? Yes or no, are you aware?
A. I am not completely aware, no.
Q. If we can pull up Dr. Dykhuizen's testimony at 1469, lines 19 to 24. You were here when Dr. Dykhuizen testified, correct?
A. For part of his testimony, yes.
Q. And were you here when he was asked, "Did you use a particular type of flash process to convert your mass oil flow rates into a stock-tank barrel flow rate?" And he answered, "Yes, we did." And then he was asked, "What did you use?" And he answered, "We used a single-stage flash." Correct?
A. I wasn't here for that part of his testimony.
Q. So Dr. Dykhuizen, likewise, used, at least according to his

08:43:58 testimony, a single-stage flash, correct?
08:44:02 A. Apparently. But as I mentioned yesterday, when engineers are
08:44:06 asked to do a calculation and they have no idea what type of
08:44:15 production separation was used or would be used, they typically
08:44:23 have nothing better to assume than a single-stage flash. So I'm
08:44:27 sure that's why he used that method because --
08:44:31 Q. So --
08:44:32 A. -- he was not given a more realistic separation scheme.
08:44:38 Q. So you think after two years of working on this matter, three
08:44:43 years actually, Dr. Dykhuizen had no idea what type of production
08:44:49 separation process was used and that's why he used a single stage
08:44:54 separational process?
08:44:56 A. That's --
08:44:57 Q. Is that your testimony?
08:44:58 A. That's likely.
08:45:08 Q. Now, let's talk a little bit further about the single-stage
08:45:12 flash that Dr. Dykhuizen used and Dr. Blunt used. First, as an
08:45:17 initial matter, you agree that is the simplest method for
08:45:20 converting reservoir barrels to stock-tank barrels, correct?
08:45:24 A. Yes.
08:45:24 Q. And you agree that the total composition of fluid exiting the
08:45:34 ocean is the same as the composition in the reservoir, correct?
08:45:40 A. Correct.
08:45:40 Q. And so at the exit point, the composition of the oil and gas
08:45:50 together is the same as that composition was in the reservoir at

08:45:58 the bottom of the -- in the reservoir, correct?
08:46:01 A. The flowing composition, correct.
08:46:03 Q. Now, you're not adding or removing any components when you have
08:46:10 something called a constant composition flash, correct?
08:46:15 A. That's correct.
08:46:15 Q. And you have a constant composition flash of fluids between the
08:46:22 reservoir and the exit point at the sea floor, correct?
08:46:28 A. Correct. That would be for the flowing composition at every
08:46:35 point.
08:46:35 Q. Okay. And the constant composition flash is the same thing as
08:46:41 a single-stage flash, correct?
08:46:44 A. Not in the context that we've been talking about, because here
08:46:54 all of my testimony the term "single-stage flash" has been used
08:46:57 specifically for a constant composition flash at 60 degrees
08:47:03 Fahrenheit and one atmosphere. Within the well, the constant
08:47:08 composition flashes would all have been at the temperature of the
08:47:12 well and the pressure of the well. So we need to be careful to not
08:47:19 confuse the two.
08:47:20 Q. Okay. Well, are you familiar with something called a
08:47:26 pseudo-steady state?
08:47:27 A. Yes.
08:47:27 Q. And you believe that a pseudo-steady state is a very reasonable
08:47:33 approximation of the process that took place from the seabed to the
08:47:38 ocean surface, correct?
08:47:39 A. Correct.

08:47:39 Q. And by a pseudo-steady state you mean that the flowing
08:47:47 compositions between the two decks remain constant over time?
08:47:51 A. The overall flowing composition, correct.
08:47:53 Q. Where the composition of the fluids remains constant during
08:47:58 whatever period of time that is that's what is called a constant
08:48:02 composition flash, correct?
08:48:04 A. Well, not in this case, because in this case we have two
08:48:09 isolated streams that are flashed individually. The total flowing
08:48:17 composition between the two streams is constant, but the two
08:48:21 streams themselves are not in equilibrium with each other and so we
08:48:27 don't have a constant composition flash at any point between the
08:48:32 seabed and the ocean surface.
08:48:34 Q. Is it your opinion, to be clear, that whatever process is used
08:48:43 it is important, I think you said, for us to consider the real
08:48:49 world or circumstances in which those fluids traveled from the
08:48:56 reservoir up to stock-tank conditions, correct?
08:48:59 A. Yes.
08:49:29 MS. KARIS: Dr. Zick, I have no further questions.
08:49:34 THE COURT: Redirect.
08:49:41 REDIRECT EXAMINATION
08:49:42 BY MS. CROSS:
08:50:04 Q. Good morning, your Honor. Anna Cross on behalf of the United
08:50:07 States. Good morning, Dr. Zick.
08:50:09 A. Good morning.
08:50:10 Q. Just a brief questions. Ms. Karis asked you about a

08:50:14 differential liberation expansion test. Can you explain what the
08:50:18 Pencor differential liberation expansion test was?
08:50:21 A. Yes. In those experiments Pencor took the fluid starting from
08:50:28 its saturation pressure and lowered the pressure in increments.
08:50:35 The first pressure was -- first pressure below the saturation
08:50:40 pressure was about 6000 psi. And they equilibrated the fluid at
08:50:45 that pressure, and then they removed all of the gas from the PVT
08:50:51 cell; and then they lowered the pressure again for the remaining
08:50:56 liquid, re-equilibrated it, new gas would come out of solution and
08:51:01 then they removed all of that gas. And they continued the process
08:51:04 all the way down to atmospheric pressure.
08:51:08 That's the type of test that one normally performs on an
08:51:13 oil when they're trying to mimic some behavior that might occur
08:51:22 within the reservoir. As the pressure depletes below the
08:51:26 saturation pressure, gas comes out of a solution. And gas being
08:51:30 much more mobile within the reservoir would move away from the oil
08:51:37 and leave the oil left behind. Of course, in the Macondo
08:51:43 reservoir, it never dropped below the saturation pressure, so that
08:51:47 process would never occur within the reservoir.
08:51:52 Within the wellbore, the flowing compositions would
08:51:58 always be constant, so the differential liberation, which
08:52:02 continually changes composition every time you remove equilibrium
08:52:07 gas, it wouldn't apply there either.
08:52:12 Outside of the well, the pressures were all below
08:52:14 2000 psi or so, and so these -- the data that was collected that's

08:52:20 6000 psi down to 2000 would be irrelevant. And the problem with
08:52:26 using -- with trying to assign a shrinkage factor from the
08:52:31 differential liberation test is because this fluid was so near
08:52:35 critical that the first depletion pressure at 6000 psi almost half
08:52:40 of the fluid was gas, and so they removed and threw away half of
08:52:47 the hydrocarbons of the fluid before the remainder of the depletion
08:52:52 tests. So whatever relative volume resulted from the end of that
08:52:59 test is totally irrelevant for what happened in the -- to the
08:53:03 Macondo fluids as they spilled into the ocean.
08:53:05 Q. Does Dr. Whitson advocate use of the differential liberation
08:53:09 test as used by Pencor for this situation?
08:53:13 A. No. He even criticized Pencor for running that experiment in
08:53:16 the first place because of the fact that the fluids exhibited dew
08:53:22 points. That experiment is never normally run on a dew point fluid
08:53:27 to begin with.
08:53:28 Q. Let's turn to the collection vessels that you discussed with
08:53:30 Ms. Karis. Your testimony was that it was a two-stage separation
08:53:35 process followed by a cooling process; is that right?
08:53:37 A. I think that's right. I don't remember the details, but I did
08:53:40 look at that at one time.
08:53:41 Q. And can you compare the efficiency of a two-stage separation
08:53:45 process versus the efficiency of a single-stage separation process?
08:53:49 A. It's normally going to be much more efficient.
08:53:52 MS. KARIS: I am going to object to -- Dr. Zick has not
08:53:56 discussed the two-stage separation process or its efficiency as

compared to single stage as part of his opinion in this case. It's not part of the scope.

MS. CROSS: Your Honor, it was elicited during cross.

MS. KARIS: I think the Court asked him.

THE COURT: It was elicited by me. So I guess I'm the culprit here.

MR. BROCK: We have a rule of not objecting to the Court's questions.

THE COURT: Okay. I'll sustain the objection.

MS. KARIS: Thank you.

THE COURT: To my comment, to my questions.

BY MS. CROSS:

Q. Dr. Zick, you presented your oceanic separation analysis in rebuttal; is that right?

A. That's correct.

Q. And if that -- the formation volume factors from your oceanic analysis were applied to any of the flow rate calculations that are presented here today, what would happen to those flow rate calculations?

A. Well, for anybody who used a single-stage assumption for their flow calculations, you would increase the results that they got, the number of stock-tank barrels that they predicted by about 13-and-a-half to 14 percent.

Q. And if you used a four-stage separation versus a single-stage separation, what impact would that have on the flow rates

08:55:16 calculator?
08:55:16 A. You would increase their single stage results by about
08:55:20 11 percent.
08:55:22 Q. Thank you.
08:55:22 A. And that's true whether you use my equation of state or
08:55:28 Dr. Whitson's equation of state, because regardless of the equation
08:55:34 of state, they both predict about 11 percent more stock-tank oil
08:55:38 from a four-stage process relative to a single-stage process, and
08:55:43 about 13 to 14 percent more stock-tank oil from my oceanic process
08:55:49 than from a single-stage separation.
08:55:54 MS. CROSS: Thank you, Dr. Zick. No further questions.
08:55:56 THE COURT: Okay. Thank you. You're done, sir.
08:55:59 THE WITNESS: Thank you.
08:56:00 THE COURT: The government can call its next witness.
08:56:35 MS. ENGEL: Good morning, your Honor, Bethany Engel for
08:56:38 the United States. We call Dr. Mohan Kelkar.
08:56:42 THE COURT: Okay. I know there's a *Daubert* motion --
08:56:45 MR. BOLES: Yes, your Honor.
08:56:45 THE COURT: -- which I have read. I am going to deny it.
08:56:49 My understanding is that the real dispute is whether Dr. Kelkar
08:56:55 should use 12 microsips or 6 or some other number, and I just think
08:57:01 that's an issue for cross-examination. I don't think there's any
08:57:05 issue of his general methodology, it's just whether he's using the
08:57:11 correct inputs or not. Correct factual data or not.
08:57:17 MR. BOLES: Thanks, your Honor.

MS. ENGEL: Thanks, your Honor.

THE DEPUTY CLERK: Raise your right hand.

(WHEREUPON, MOHAN KELKAR, WAS SWORN IN AND TESTIFIED AS FOLLOWS:)

THE DEPUTY CLERK: If you would take a seat. And if you'll state and spell your name for the record, please.

THE WITNESS: Mohan Kelkar, M-O-H-A-N, and the last name is K-E-L-K-A-R.

MS. ENGEL: May we proceed, your Honor?

THE COURT: Yes.

VOIR DIRE EXAMINATION

BY MS. ENGEL:

Q. Good morning, Dr. Kelkar.

A. Good morning.

Q. Please introduce yourself to the Court.

THE COURT: Do you --

MS. ENGEL: Is that better?

THE COURT: Is there any way to put it on the other side, inside of the lapel? Is it on?

MS. HIMMELHOCH: It's not on, your Honor.

THE COURT: Oh, that's a good reason.

MS. ENGEL: That's my first problem. How is that? Better? I think I'm all set.

THE COURT: That's a lot better. Thank you.

BY MS. ENGEL:

08:58:29 Q. Dr. Kelkar, please go ahead and introduce yourself to the
08:58:32 Court.
08:58:32 A. My name is Mohan Kelkar. I'm currently professor of petroleum
08:58:36 engineering at the University of Tulsa. And I've been teaching
08:58:39 petroleum engineering for the last 30 years at the University of
08:58:43 Tulsa.
08:58:44 Q. Please summarize your involvement in this case.
08:58:47 A. I was retained by DOJ in April of 2012 to determine the total
08:58:54 amount of oil which is released as well as the rate calculation on
08:58:59 the last day before the well was shut-in.
08:59:01 Q. Prior to your expert work in this case, did you have any
08:59:06 involvement in the Macondo spill?
08:59:08 A. I was hired by Mineral Management Services in June of 2010 as a
08:59:17 part of Flow Rate Technical Group, and in that capacity I was asked
08:59:21 to calculate the inflow performance relationship for the reservoir
08:59:27 which was used as an input in another group which was working at
08:59:32 the same time called Nodal Analysis Group.
08:59:36 Q. We'll turn back to your work in this case in a few minutes, but
08:59:39 I want to go over some of your educational and professional
08:59:43 background first.
08:59:43 What are your professional degrees in, Dr. Kelkar?
08:59:45 A. I have a BS in chemical engineering and a master's in petroleum
08:59:49 engineering and also Ph.D. in chemical engineering.
08:59:52 Q. Did you have a particular specialization within those fields?
08:59:55 A. For my Ph.D. I worked on the multiphase flow in bubble column

reactors, and since that time, I have concentrated on reservoir description and reservoir modeling, as well as worked in the area of multiphase flow.

Q. Can we have D-21651, please. You stated a few moments ago you've been a faculty at Tulsa's Petroleum Engineering School for about 30 years. When did you become chair of the Petroleum Engineering Department?

A. I became chair in 2002.

Q. And do you have a particular specialty within the field of petroleum engineering?

A. So in the last 30 years I've worked in reservoir modeling and reservoir characterization, and I also have worked in the production optimization.

Q. What are some of the classes that you've taught --

THE COURT: Ms. Engel, it still sounds kind of low to me. Can you put that thing where the microphone faces the inside of your lapel, is that possible? I think that would be better.

MS. ENGEL: Sure.

THE COURT: Let's try that.

MS. ENGEL: How is that?

BY MS. ENGEL:

Q. So what are some of the classes you've taught over the years, Dr. Kelkar, that are relevant to the work that you did in this case?

A. I have taught courses in rock properties, fluid properties.

I've taught courses in reservoir engineering, which includes well test analysis. I have taught courses in production engineering and also integrated reservoir modeling.

THE COURT: What's the last thing?

THE WITNESS: Integrated reservoir modeling.

BY MS. ENGEL:

Q. Do you have any other professional experience that's relevant to your work in this case?

A. I had a consulting company I founded about 20 years ago. And in that capacity, I have done a lot of the reservoir modeling work all over the world where I have built reservoir models and predicted the performance and associated uncertainty in those reservoirs.

Q. Can we have D-21652, please. Have you received any honors in recognition of your professional work?

A. I have been a Distinguished Speaker for the Society of Petroleum Engineers between 2007 and '8. I was given Distinguished Faculty Member award by Society of Petroleum Engineers in 2009. Became Distinguished Member in 2010, and I served on the SB International Board of Directors between 2011 and 2013.

MS. ENGEL: Your Honor, the United States offers Dr. Mohan Kelkar as an expert in petroleum engineering and reservoir modeling.

THE COURT: All right. Other than the issue raised in your *Daubert* motion, do you have any questions as to his

qualifications?

MR. BOLES: Only what we can raise on cross-examination.

THE COURT: We will accept him as an expert in that field.

MS. ENGEL: Thank you, your Honor.

DIRECT EXAMINATION

BY MS. ENGEL:

Q. Dr. Kelkar, did you prepare an expert report in this case?

A. I did.

Q. Can we see TREX 11549R, please. Is this your expert report?

A. It is.

Q. Did you also write a rebuttal report in this case?

A. I did.

Q. Can we have TREX 11550R, please. And is this your rebuttal report, Dr. Kelkar?

A. It is.

Q. Do you adopt your expert report and rebuttal report as your expert testimony to the Court in this case?

A. I do.

MS. ENGEL: Your Honor, we offer Dr. Kelkar's expert and rebuttal reports, TREX 11549R and 11550R into evidence.

THE COURT: Any other objections?

MR. BOLES: No, your Honor.

THE COURT: Without objection, those are admitted.

BY MS. ENGEL:

09:03:41 Q. Let's move to D-21653, please. Dr. Kelkar, you mentioned at
09:03:47 the beginning of your testimony that you were asked to calculate a
09:03:50 cumulative oil spilled from the Macondo well. Did you form an
09:03:54 opinion regarding the cumulative amount of oil spilled?
09:03:57 A. I did.
09:03:57 Q. What is that opinion?
09:03:58 A. I calculated that amount of oil spilled four-and-a-half to 5
09:04:04 million barrels.
09:04:04 Q. What methodology did you use to reach that conclusion?
09:04:08 A. I used the material balance technique.
09:04:11 Q. And did you also form an opinion regarding the oil flow rate
09:04:15 from the Macondo well on the last day of the spill?
09:04:17 A. I calculated the rate to be 54,000 barrels per day through the
09:04:23 choke line, and I validated that also by calculating the flow
09:04:27 through the kill line.
09:04:28 Q. You mentioned briefly earlier that, prior to your expert work,
09:04:32 you had some limited involvement as a member of the Flow Rate
09:04:37 Technical Group Reservoir Modeling Team; is that right?
09:04:38 A. Yes.
09:04:38 Q. What do you mean by "limited involvement"?
09:04:41 A. As I mentioned that in June of 2010, I was hired by Mineral
09:04:47 Management Services to calculate the inflow performance
09:04:51 relationship so that that could be used as an input for another
09:04:56 group. And I did that work in one-week period.
09:05:00 Q. Did you calculate a cumulative flow as part of your work for

the Flow Rate Technical Group?
A. I did not.
Q. When you prepared your expert report in this case, did you have more data available to you than you did in 2010?
A. I did.
Q. What additional data did you have available?
A. I had the raw data which was given to me, but I didn't have a lot of BP internal reports, which became available after that point. The well was shut-in in July of 2013 and there was a lot of pressure information that was available at that time. So significant amount of granularity was added in the data set after I had finished the work on FRTG group.
Q. What do you know by "additional granularity"?
A. Because I could only look at the raw data, but I didn't have a better understanding about what it all meant and a significant number of internal documents with BP actually provided me with that information.
Q. Did you have to use a formation compressibility value for purposes of your Flow Rate Technical Group work?
A. I did.
Q. And what data did you use to obtain that compressibility value?
A. I did a value of 6 microsips.
Q. How did you obtain that value?
A. I looked at the Weatherford report and I calculated the average of the three values.

09:06:23 Q. Why did you use that Weatherford Lab data at that time?
09:06:27 A. Because I am not a rock mechanics expert and I just used
09:06:33 whatever the data was available at that time.
09:06:34 Q. Did you have any other documents discussing compressibility
09:06:38 available to you at that time?
09:06:39 A. I did not.
09:06:40 Q. Let's turn to your opinion regarding the cumulative oil
09:06:45 released from the well. Can you please explain for the Court,
09:06:48 generally speaking, what a material balance analysis entails?
09:06:51 A. Material balance technique is a method where you actually
09:06:54 measure the initial pressure and the final pressure and you
09:06:59 understand the mechanisms by which oil can be produced, and by
09:07:03 knowing the pressure difference and the different mechanisms and
09:07:06 their contributions, we can calculate the amount of oil released.
09:07:11 THE COURT: You're talking about the pressures in the
09:07:13 reservoir?
09:07:14 THE WITNESS: Pressures in the reservoir, yes.
09:07:17 BY MS. ENGEL:
09:07:18 Q. Have you prepared any demonstratives to explain further what
09:07:20 you just described?
09:07:20 A. I have.
09:07:21 Q. Could we see D-21601, please. D-21601. Dr. Kelkar, what are
09:07:50 we talking about here?
09:07:51 A. So it shows you the three mechanisms by which oil can be
09:07:54 produced. So one of the mechanisms by which oil can be produce d

is the expansion of oil as the pressure is reduced. And if you can click on the expansion, it shows you that as the pressure is reduced, the oil expands and, of course, some of the oil is going to come to the surface.

There is also another mechanism, which is the compaction, and if you click on the compaction, as the pressure is reduced, the formations get compacted from the formations above, and of course like a sponge, some of the oil will come out of the reservoir as a result of compaction.

And the third mechanism by which the oil can be produced is aquifer, which is the underlying water. And if you can click on that. The underlying water moves up as the oil is produced, and it pushes some of the oil to the surface.

Now, I am just showing those three mechanisms in isolation. In reality, you will see some kind of a combination of these three mechanisms by which the oil is produced. So if you click on the combination, it shows you that you normally have expansion of oil, compaction of the formation and the aquifer moving up, which results in some of the oil produced.

Q. Can we look at D-21654, please. So then how does a reservoir engineer typically perform a material balance analysis?

A. So traditional material balance is really used to validate what we have calculated using volumetric analysis. Normally our first attempt in calculating the oil in place is always based on some boundary of the reservoir and the volume. And then we start

09:09:42 producing the reservoir, we measure the amount of oil produced.
09:09:47 And we try to constrain our oil in place by using the amount of oil
09:09:52 produced. So we use as an input the amount of oil produced, which
09:09:56 is measured quite accurately, and then we calculate the initial oil
09:10:00 in place.
09:10:01 Q. Did you perform this traditional material balance analysis to
09:10:06 form your opinions in this case?
09:10:07 A. I did not.
09:10:08 Q. Can you describe to the Court how you performed your Macondo
09:10:11 analysis?
09:10:11 A. The difficulty in Macondo was that we did not know how much oil
09:10:15 was produced. As a matter of fact, we were calculating the amount
09:10:18 of oil spilled using an initial estimator oil in place. So the
09:10:25 traditional material balance uses correction for volumetric
09:10:30 analysis. In this case, we had to rely on the volumetric oil in
09:10:34 place to determine the amount of oil spilled. And as a result of
09:10:38 that, there is an inherent additional layer of uncertainty when we
09:10:43 carried out this particular analysis.
09:10:45 Q. Can we have D-21601 again, please. And what are we seeing here
09:10:55 in the last portion of this demonstrative?
09:10:57 A. I think if you could click on the formulas, it shows you the
09:11:02 difference between the traditional material balance versus what
09:11:05 happened in the *Deepwater*. So if you click on the traditional
09:11:08 material balance, it shows that we normally know how much collected
09:11:13 oil is, and then we calculate how much oil in place is based on

that information.

THE COURT: Oil in place before or after the spill?

THE WITNESS: At the beginning. At the beginning. So we use actually how much oil is produced, we know what the initial pressure is, we know what the final pressure is. So using that information, we tried to determine how much there was at the start before we started producing.

And if you click on the *Deepwater* spill, you can see the problem here is that we don't know how much oil was produced, so we had to make an assumption about the original oil in place. And using that information, we calculate the oil released. So as a result of the reverse process we used here, there is more uncertainty in our material balance analysis than what it would involve in the traditional calculations because there was one more unknown in these calculations.

BY MS. ENGEL:

Q. Could we have D-21656.

THE COURT: Let me ask a couple of question, try and understand this. You're not -- for this material balance methodology, does it in any way involve estimating what oil was in place in that reservoir before any oil was released or produced to how much oil was left after the well was capped or sealed?

THE WITNESS: Right.

THE COURT: And just figuring out the difference? I'm trying -- go ahead with.

09:12:52 THE WITNESS: So in a traditional material balance where
09:12:53 actually we actually put the well on production and we measure how
09:12:58 much oil is produced, we use that information to determine how much
09:13:02 there was to begin with, that's a traditional calculation. In this
09:13:07 calculation --
09:13:08 THE COURT: Explain that to me. How does knowing what
09:13:11 was produced tell you what was there originally?
09:13:14 THE WITNESS: I think we have --
09:13:15 THE COURT: Until you've produced oil, obviously, that
09:13:17 would tell you.
09:13:18 THE WITNESS: Right. Well, by the way, the amount of oil
09:13:22 in place is not the same as amount of oil produced, because we only
09:13:26 produce a fraction of it; typically about 20 to 30 percent. So
09:13:30 when we use the material balance, we calculate amount of oil in
09:13:34 place and then we use some kind of recovery factor to determine how
09:13:38 much ultimately we will produce. So it's just a fraction of it.
09:13:41 But I think that this equation on the screen which will
09:13:46 explain what the traditional analysis does.
09:13:49 So you have certain amount of oil produced, and the
09:13:53 equation, like in the case of Macondo, is quite simple, that you
09:13:58 have the amount of oil produced, you have total compressibility,
09:14:03 which is comprised of different mechanisms which play a role in
09:14:06 determining the oil produced. And we know the difference in the
09:14:10 initial pressure and the final pressure. So we use this equation
09:14:14 and then we can calculate the original oil in place.

09:14:17 Our purpose of traditional material balance analysis is
09:14:21 to reduce the uncertainty in oil-in-place calculations, which we
09:14:27 had determined based on some simpler methods before, which is the
09:14:31 volumetric analysis.
09:14:32 So in Macondo, what we did is we simply rewrote the
09:14:37 equation by moving the oil production on one side and everything
09:14:39 else on the other side. And the different colors essentially is
09:14:44 indicating the uncertainty we have with respect to different input
09:14:48 parameters. And because we didn't have an opportunity to correct
09:14:52 for our oil in place, we have a lot more uncertainty with respect
09:14:56 to oil in place. And then we, of course, have some uncertainty
09:15:00 with respect to compressibility.
09:15:02 THE COURT: So where do you get the information in the
09:15:04 Macondo calculation for the original oil in place?
09:15:08 THE WITNESS: Okay. So the original oil in place is
09:15:10 calculated based on geophysical data, geological data. So BP had
09:15:16 run the seismic surveys and they had also had some better
09:15:21 understanding of the geology, so based on that information, they
09:15:25 had determined what is the pessimistic scenario, what's the
09:15:30 optimistic scenario and what is the 50th percentile, which is right
09:15:33 in the middle. So because we didn't have any oil-in-place
09:15:37 calculation based on material balance, we had to rely on that
09:15:39 information.
09:15:40 THE COURT: Okay.
09:15:43 BY MS. ENGEL:

09:15:44 Q. Dr. Kelkar, you mentioned an extra layer of uncertainty that
09:15:48 results as part of rearranging the calculation. Does that extra
09:15:53 layer of uncertainty invalidate the methodology or the results?
09:15:57 A. It doesn't invalidate the methodology, it just tells you that
09:16:01 there is an additional caution we are to exercise when we are using
09:16:06 this equation.
09:16:07 Q. What additional information did you use to validate your
09:16:12 analysis?
09:16:13 A. So after I did the material balance calculation, I also
09:16:16 calculated the rate on the last day to ensure that my rate
09:16:22 calculations were within the ballpark figure compared to what --
09:16:27 how much oil was produced or how much oil was spilled.
09:16:30 I also looked at the productive index calculation, which
09:16:35 is the value at the productivity of the well on the last day before
09:16:39 the well was shut in. And I compared that value with the log and
09:16:44 the core data, and I found that the results were consistent.
09:16:48 Q. So is the material balance method a tool that you typically use
09:16:53 in your reservoir characterization work?
09:16:55 A. I think the reservoir engineer will use all of the tools at his
09:16:59 or her disposal in building a reservoir model. And material
09:17:04 balance is one of the simpler tools we can use to bound that
09:17:10 certainty in oil-in-place calculations. So, yes, it is quite
09:17:14 commonly used.
09:17:15 Q. Is material balance the only way to determine oil production
09:17:18 from a reservoir?

09:17:19 A. It is not.
09:17:20 Q. What are some of the other tools available to you?
09:17:23 A. So you can use, for example, reservoir simulation as a way to
09:17:28 calculate the reservoir performance. And the advantage you have
09:17:33 with a reservoir simulation is that there is some additional
09:17:37 dynamic data which you can use in understanding the reservoir
09:17:43 behavior.
09:17:43 So, for example, material balance will not be able to
09:17:46 incorporate the rate information. Material balance may not be able
09:17:51 to incorporate the pressure information which is available between
09:17:54 the initial and final conditions. And that's the kind of data
09:17:57 which can be utilized in reservoir simulation analysis.
09:18:00 Q. Why didn't you use a tool like reservoir simulation to evaluate
09:18:08 discharge in this case?
09:18:08 A. Part of the reason was that because there were already two
09:18:12 experts which the government had, Dr. Pooladi-Darvish and
09:18:16 Dr. Griffiths, who were already doing that type of work.
09:18:18 Q. Did any other expert in this case approach the problem using a
09:18:23 material balance methodology?
09:18:24 A. Dr. Blunt from -- who is a BP and Anadarko expert.
09:18:28 Q. And did Dr. Blunt perform what we see here as the traditional
09:18:33 material balance analysis?
09:18:35 A. No, he did not.
09:18:36 Q. Did the uncertainties, then, that apply to your modified
09:18:39 material balance also apply to Dr. Blunt's analysis?

09:18:42 A. It does.
09:18:43 Q. I want to talk to you a little bit more in detail about some of
09:18:48 the inputs, following up on Judge Barbier's questions. Could we
09:18:53 have D-21657, please.
09:18:58 Now, we've already described the primary inputs to the
09:19:01 analysis, but what was -- what sources of data did you rely on to
09:19:05 derive those inputs?
09:19:06 MR. BOLES: Your Honor, if I may interrupt. It's pretty
09:19:09 clear here that from the second to the last bullet point that
09:19:12 counsel is about to ask Dr. Kelkar to talk about internal BP
09:19:17 e-mails discussing rock compressibility. And that's beyond the
09:19:22 four corners of Dr. Kelkar's report. It's absolutely clear,
09:19:26 there's three footnotes in his report where he gives the only
09:19:29 source for his opinion on -- it's not even an opinion, but for his
09:19:35 value of rock compressibility, and that's a single document, a
09:19:38 presentation by Dr. Merrill. None of the e-mails that I believe
09:19:42 are about to be asked about were cited in the report.
09:19:46 MS. ENGEL: We are not quite there, your Honor, actually.
09:19:48 But to address the issue, Dr. Kelkar has a pretty lengthy
09:19:52 considered list, he looked at a lot of materials, including all of
09:19:55 these additional documents that Mr. Boles is referring to.
09:19:58 MR. BOLES: There are several thousand documents listed
09:20:01 in his consideration materials; I don't think that qualifies as the
09:20:05 definition of a four corners.
09:20:07 THE COURT: Well, it's not -- as I understand it, this is

not a different opinion, this is just additional information that he says he believes validates the numbers that he used, correct?

MS. ENGEL: That's right, your Honor.

THE COURT: And it's no different than an expert, which all of the experts do, sitting in court and listening to the testimony and then are asked did you sit in and did you hear this, does that change your opinion or whatever. So I am going to overrule the objection.

MS. ENGEL: Thank you, your Honor.

BY MS. ENGEL:

Q. I actually want to talk first to you -- well, let's talk a little bit about the input. We obviously covered some of it already, but aside from these internal BP e-mails and modeling runs, what else did you rely on to derive your inputs?

A. So I looked at BP's predrill reports and the post drill report, which were useful in calculating the amount of oil in place. I also looked at some of the internal BP e-mails, and I looked at Dr. Hsieh's testimony.

Q. Dawn, could we have D-21658, please. I want to talk first about original oil in place. How did you derive your original oil-in-place values?

A. So I looked at BP's predrill technical assurance memo, and in that particular memo at the end -- judge already asked me this question -- that effectively there were three values which were reported in that predrill technical assurance memo, which is P10,

09:21:46 P50 and P90, which presented basically the optimistic value, the
09:21:53 value which were right in the middle, so there's a 50 percent
09:21:57 chance it could be higher and lower, and then the pessimistic
09:22:00 value.
09:22:00 I picked the value which were right in the middle. And
09:22:03 part of the reason I picked that value is because in the predrill
09:22:07 memo, BP had also predicted what type of reservoir thickness they
09:22:14 will observe when they drilled the well, and that predicted about
09:22:17 90 feet of thickness. And when the well was drilled, the thickness
09:22:22 turned out to be very close to that value, and that gave us more
09:22:26 confidence in picking that P50 value.
09:22:30 So I started from that particular value, but then I
09:22:34 corrected that value for formation volume factor because the fluid
09:22:41 properties were, of course, collected after the well was drilled,
09:22:44 the porosity value was measured and the oil saturation was measured
09:22:49 after the new well was drilled. So I corrected for those three and
09:22:53 came up with 137 million barrels.
09:22:56 Q. Let's take a look at TREX 5246.2, and I believe this is the BP
09:23:04 predrill technical assurance memo you were just referring to?
09:23:08 A. That is correct.
09:23:08 Q. Could we have the first callout, TREX 5246.16.1.
09:23:17 Dr. Kelkar, is this the table that you were just
09:23:19 referring to that you pulled these P90, P50 and P10 values from?
09:23:24 A. That is correct. And I started from 181 million barrels, and
09:23:30 "STOIIP" represents basically stock-tank oil initially in place.

So that's what STOIIP represents.

So essentially BP predicted 181 standard million -- standard barrels, million barrels, and I corrected for that value using new formation volume factor which was observed, and also corrected for the porosity and oil saturation.

Q. You've used the term "formation volume factor" a couple of times, and Judge Barbier heard from Dr. Zick on that already. But can you just refresh us quickly on what formation volume factor is?

A. Formation volume factor tells us that if you take a barrel of reservoir oil and bring it to the surface, what is the conversion from barrel of reservoir oil to the barrel of oil in the surface. And there are two processes which, of course, determine that. One is the shrinkage, because some of the gas which is dissolved in oil gets released. And one is the expansion, because the pressure is smaller at the surface compared to the pressure at the reservoir conditions. So it combines basically both of these effects, and it's accounted for in the formation volume factor calculation.

Q. And what formation volume factor did you use to calculate your original oil in place of 137?

A. So in my original report I used 2.14, which was coming from BP's compositional model, and then in rebuttal report I also addressed some of the oceanic separations from Dr. Whitson and Dr. Zick.

Q. Let's stick with your initial report for the moment and take a look at TREX 9732. We can go straight to the first callout, which

09:25:19 is .1.1. Is this the document that you've been referring to as
09:25:25 BP's black oil tables?
09:25:26 A. Yes.
09:25:26 Q. Can we have the second callout, 9732.11,12.1.
09:25:39 Dr. Kelkar, do you see here the FVF value of 2.14 that
09:25:43 you used?
09:25:44 A. I do.
09:25:44 Q. Where is it?
09:25:45 A. That is the value I used for initial reservoir conditions.
09:25:48 Q. Is it that highlighted yellow portion at the bottom of the
09:25:52 page?
09:25:52 A. It is.
09:25:53 Q. We can take that down.
09:25:55 THE COURT: Go back to that chart before, I think it's
09:25:59 the chart before. Or the demonstrative before. Can you go back?
09:26:14 MS. ENGEL: Oh, to -- what would you like to see?
09:26:17 THE COURT: What you had on the screen before.
09:26:22 MS. ENGEL: That is --
09:26:24 THE COURT: No, not that one. You had something in
09:26:29 between.
09:26:29 MS. ENGEL: We had TREX 5246 in between, which was the BP
09:26:34 predrill report.
09:26:36 THE COURT: Yeah, that's it. I just had a question. So
09:26:41 you essentially used their 181 number and then did some type of
09:26:46 correction that you described to get to the 137?

09:26:49 THE WITNESS: That is correct.
09:26:50 THE COURT: Now, I noticed -- is that called stock-tank
09:26:56 oil in place?
09:26:57 THE WITNESS: Stock-tank oil initially in place.
09:26:59 THE COURT: Initially in place. So that's a measurement
09:27:04 in stock-tank barrels, not reservoir barrels?
09:27:08 THE WITNESS: That is correct. And what BP did to come
09:27:11 to that number is they made an assumption about some formation
09:27:16 volume factors. So typically when oil companies are doing these
09:27:19 calculations, they only can determine the reservoir barrels based
09:27:23 on the seismic data and the geology, so they have to make some
09:27:27 assumptions about the formation volume factor.
09:27:30 So what BP had done was using a value of 1.46 as the
09:27:36 formation volume factor to convert reservoir barrels into
09:27:40 stock-tank barrels. But it turned out that when the well was
09:27:44 drilled, the Macondo fluid was a lot lighter than what they
09:27:48 assumed, so you have to correct for that value. So the assumptions
09:27:54 they had made at the beginning turned out to be that the fluid was
09:27:57 actually a better quality in Macondo than what was originally
09:28:01 assumed.
09:28:02 THE COURT: Better quality meaning what?
09:28:05 THE WITNESS: So when you have an oil which is -- has a
09:28:09 high formation volume factor, it has a high compressibility and you
09:28:12 probably are going to recover more oil out of a volatile oil type
09:28:17 of reservoir than a typical black oil.

09:28:21 BY MS. ENGEL:
09:28:21 Q. And is this STOIIP term used interchangeably with "original oil
09:28:28 in place"?
09:28:29 A. It is.
09:28:29 Q. In your experience as a reservoir engineer, what is the purpose
09:28:32 of predrill technical memo like we're looking at here?
09:28:35 A. So normally the predrill memo is very important because a lot
09:28:39 of economic decisions are made based on these type of predrill
09:28:43 memos. Ultimately when you're drilling very expensive wells like
09:28:48 the one in Macondo, you have to know do you have enough oil to be
09:28:52 produced so that it can justify, first, drilling the exploration
09:28:57 well then and eventually exploiting the reservoir.
09:29:02 Q. Why did you decide to use data from this report in your
09:29:05 analysis?
09:29:06 A. The reason was that BP had already done the analysis of seismic
09:29:11 data and the geological data. They obviously had drilled other
09:29:15 fields in the same areas. And, further, that when they drilled the
09:29:21 well, the thickness which was predicted in the predrill memo turned
09:29:24 out to be correct. So there was a lot of confidence in this
09:29:29 information.
09:29:30 Q. Dr. Kelkar, did you also calculate a lower value for original
09:29:35 oil in place?
09:29:36 A. I did use 110 million barrels.
09:29:39 Q. And how did you derive that value?
09:29:41 A. So the 110 value came about because it was reported in many

09:29:47 public reports. In addition to that, Dr. Merrill had also used 110
09:29:54 million barrels in all of his simulation work. So I wanted to use
09:29:59 that value and I wanted to determine how that value came about, so
09:30:03 I started with this 181 million barrels, which is listed here, and
09:30:08 then I used the single-stage formation volume factor, which is
09:30:14 2.35, and if you divide, correct for that formation volume factor,
09:30:20 you arrive at 110 million barrels.
09:30:22 Q. Holding all else constant, would a higher value of original oil
09:30:28 in place increase or decrease the cumulative oil produced?
09:30:31 A. It will increase.
09:30:32 Q. We can take that down. Did Dr. Blunt criticize your original
09:30:38 oil-in-place calculation?
09:30:39 A. He did.
09:30:39 Q. On what basis?
09:30:41 A. Two reasons: I think one he said is that because I did not
09:30:47 consider the geology and geophysics and the connectivity in the
09:30:54 reservoir; and also that I had used the wrong formation volume
09:30:58 factor.
09:30:59 Q. Can we look at D-21659, please. Now, Dr. Kelkar, how do you
09:31:08 respond to that first criticism of Dr. Blunt's that you didn't
09:31:12 consider geology in your calculation?
09:31:14 A. Well, I did consider the geology and geophysics, because I had
09:31:18 used BP's report and they had already incorporated the geophysics
09:31:22 and geology. So normally when you calculate the P10, P50, P90, you
09:31:28 do use some threshold cutoffs to determine how much oil is

connected, so I believe that that information was already incorporated.

Further, when you look at this chart and you look at the reservoir barrels, not stock-tank barrels, you find that my estimate was not significantly different than Dr. Blunt's or BP was using in their own simulation results.

Regarding the formation volume factor values, Dr. Blunt used a single-stage separation, and as Dr. Zick discussed in the morning, I believe that it was more appropriate to use a multistage separation in the calculation of the formation volume factor than a single-stage separation.

Q. So how do you get from the total reservoir barrels that we see in this chart to original oil in place?

A. You simply take this number and you divide it by the formation volume factor and you calculate the stock-tank barrels.

Q. Can we see D-21660, please. So if the to the number -- I'm sorry.

Has any other expert in this case used a formation volume factor of 2.14?

A. Yes. I think Dr. Emilsen, who is BP's Phase One expert, also had used 2.14 formation volume factor, which came from BP's original PVT tables.

Q. Can we see TREX 7401, please.

THE COURT: Is that roughly equivalent to a shrinkage factor of 50 percent?

09:33:15 THE WITNESS: (WITNESS NODS HEAD IN THE AFFIRMATIVE.)
09:33:16 THE COURT: The same thing, right?
09:33:18 THE WITNESS: Yes.
09:33:19 BY MS. ENGEL:
09:33:19 Q. Is this Dr. Emilsen's Phase One report?
09:33:22 A. Yes.
09:33:23 Q. Can we have callout 7401.30.1. Is this the section of
09:33:29 Dr. Emilsen's report that you're referring to?
09:33:31 A. Yes. I think you can see the highlighted portion where he had
09:33:35 also used 2.14.
09:33:37 Q. What value did Dr. Blunt use in his material balance analysis
09:33:41 for formation volume factor?
09:33:43 A. He used three different values because he looked at three
09:33:47 different PVT reports, which were provided as a part of the oil
09:33:57 fluid analysis. So he didn't use a single value, but all of the
09:34:00 three values he used, which were in the range of 2.27 to about
09:34:05 2.35, where it came from a single-stage separation.
09:34:07 Q. What is your expert opinion about Dr. Blunt's decision to use
09:34:11 that range of formation volume factors that came from single-stage
09:34:15 separation?
09:34:15 A. As I discussed in my rebuttal report, I believe that both
09:34:24 Dr. Whitson and Dr. Zick's analysis that the oceanic separation is
09:34:31 the most appropriate method to calculate the formation volume
09:34:35 factor is the correct one, and I would prefer to use that over
09:34:41 single-stage separation.

09:34:41 Q. Did Dr. Blunt's formation volume factors represent what would
09:34:46 be commonly used in the industry?
09:34:48 A. It would not be. And as Dr. Zick discussed in the morning, oil
09:34:54 companies have a vested interest in producing the most oil from the
09:34:58 reservoir, and the reason is oil is much more valuable commodity
09:35:02 than gas. So when they bring the oil to the surface, they would
09:35:06 try to use multistage separation so that oil production is
09:35:10 maximized and gas production is minimized. So multistage
09:35:15 separation is the process which any company will use when producing
09:35:19 oil.
09:35:19 Q. Can we have D-21660, please. Do you have any other criticisms
09:35:31 of Dr. Blunt's calculation of original oil in place?
09:35:34 A. So Dr. Blunt also uses connectivity calculation based on well
09:35:41 test analysis, and as I discuss in my rebuttal report, his well
09:35:48 test analysis actually ignores a significant amount of pressure
09:35:51 data in his calculations.
09:35:53 Q. What's the importance of that pressure data that Dr. Blunt
09:35:58 ignores?
09:35:58 A. I think that anyone who has done well test analysis will tell
09:36:03 you that early data, either just before the shut-in or just after
09:36:07 shut-in, can be very critical in determining the reservoir
09:36:10 properties. And he ignores about 10,000 seconds of data in his
09:36:17 analysis.
09:36:17 Q. Let's move on and talk about the next input to the material
09:36:21 balance analysis, which is total compressibility. Can we have

09:36:24 D-21661, please. And what is total compressibility again?
09:36:32 A. So the total compressibility is a weighted average of the
09:36:36 compressibility of oil, water and the formation.
09:36:40 Q. And I want to focus just on your formation compressibility
09:36:44 values this morning. What value did you use in your analysis?
09:36:47 A. I used 12 microsips.
09:36:50 Q. And what did you rely on for that value of 12?
09:36:53 A. I looked at a significant number of internal documents which BP
09:37:00 had, as well as Dr. Hsieh's testimony.
09:37:02 Q. Could we look at D-21600, please. And if I could have my ugly
09:37:11 assistant Mr. O'Rourke help me put this up on the board here.
09:37:23 MR. BOLES: Your Honor, while they are switching to the
09:37:25 demonstrative, if I may just for the record, now that we're
09:37:28 specifically at this evidence, just note the objection that
09:37:33 these -- all of these BP e-mails are beyond the scope of the expert
09:37:37 report that was supposed to disclose not just opinions but his
09:37:40 basis for his opinions. And he specifically cites on pages 27 and
09:37:45 28 at footnotes 37 and 41 the sole basis for his use of 12
09:37:53 microsips, and that's a single PowerPoint and not these e-mails.
09:37:57 And, similarly, in his appendix, and this is in the
09:38:00 original report, page 45, footnote 58, again, the sole basis cited
09:38:08 is the PowerPoint and not these e-mails.
09:38:10 THE COURT: My understanding is this is in evidence in
09:38:16 one fashion or another?
09:38:18 MS. ENGEL: I believe that most --

09:38:20 THE COURT: I know I've seen some of these before.
09:38:22 MS. ENGEL: Yes, we've been through some of the
09:38:24 documents.
09:38:25 THE COURT: I don't know if I've seen them all.
09:38:27 MS. ENGEL: I don't know if we've seen them all yet
09:38:31 either, your Honor, but we will go through them and I can lay the
09:38:33 foundation.
09:38:33 THE COURT: All right. Overrule the objection.
09:38:38 BY MS. ENGEL:
09:38:38 Q. So, Dr. Kelkar, what is this demonstrative, D-21600, that we're
09:38:44 looking at?
09:38:45 A. I think this demonstrative actually discusses the process by
09:38:50 which a conclusion or consensus was reached at why 12 microsips
09:38:57 value is the most appropriate. And I just want to emphasize that
09:39:01 the e-mails here which are discussed here are not unusual in the
09:39:06 sense that when you are working on a reservoir modeling project, it
09:39:13 is not unusual to find that there is an uncertainty with respect to
09:39:18 certain input parameters. And when there is an uncertainty with
09:39:22 respect to certain input parameters, different people from
09:39:26 different experience gather together and they discuss the issue,
09:39:30 and they come to some reasonable conclusion.
09:39:33 I've been involved in many reservoir modeling projects
09:39:36 where I didn't have the expertise in a particular parameter, and I
09:39:42 talked to other people from other disciplines with other expertise
09:39:46 and came to the right conclusion about what value should be used.

09:39:52 THE COURT: Could you move that microphone just a -- you
09:39:55 can push it back from you, whatever is more comfortable for you.
09:39:59 Not too far away, need to be right in the middle, but not too
09:40:03 close. I'm getting word that if you get too close, it kind of
09:40:07 muffles your voice. People are listening elsewhere, too, in the
09:40:11 courthouse, okay?
09:40:12 THE WITNESS: Okay.
09:40:12 THE COURT: Okay. Thank you.
09:40:14 MS. ENGEL: Balance out a little bit.
09:40:16 THE WITNESS: Is it better?
09:40:17 THE COURT: Don't go in the opposite direction, then
09:40:22 you'll be too soft. Then I'll get a different type of complaint.
09:40:25 All right. Let's try that.
09:40:27 BY MS. ENGEL:
09:40:27 Q. Who are the discussions here in this demonstrative among?
09:40:30 A. I think these discussions are between the reservoir engineers
09:40:36 and rock mechanics expert within BP.
09:40:39 Q. Did you rely on the documents in this demonstrative in forming
09:40:44 your expert opinion?
09:40:45 A. I did.
09:40:46 Q. Now, what is your understanding of what was happening during
09:40:51 the Macondo response action during this period from about July 6 to
09:40:56 July 15th?
09:40:57 A. The well was shut-in on July 15th, and there was an issue
09:41:03 related to well integrity. And a lot of the simulation work,

09:41:07 and which I do cite to because I think that the article which I do
09:41:13 cite to is really conclusion of all of this information. And that
09:41:19 simulation work was important to understand the well integrity.
09:41:22 So there was a discussion about what is the most
09:41:24 appropriate input which needs to be used in the simulation, and
09:41:28 this particular set of documents relate to the compressibility
09:41:33 value.
09:41:34 Q. Let's take a look, first, at the discussions that occurred on
09:41:39 July 6. Could we have TREX 8771, please, and go directly to the
09:41:43 callout .1.1. Dr. Kelkar, please explain to Judge Barbier what
09:41:49 we're looking at in this e-mail.
09:41:51 A. So this is an e-mail from Kelly McAughan, who is a reservoir
09:41:57 engineer, to Steve Willson, who is a rock mechanics expert, and you
09:41:59 can see that from the e-mail what she is saying is that other REs,
09:42:05 or reservoir engineers, were questioning our pore volume
09:42:10 compressibility, or PVC, being too low at 6 microsips.
09:42:17 Q. And could we move to TREX 8774, please, and go to callout .1.1.
09:42:29 A. And this is an e-mail response back from David Schott who is
09:42:35 also another reservoir engineer, and he is talking about analog
09:42:39 wells like Santa Cruz. And what he is saying in his e-mail is that
09:42:43 the sidewall core data is conservative because of the way the
09:42:48 grains are aligned, so we should not strictly confine to the
09:42:52 sidewall data at Macondo.
09:42:54 And just for reference, that the core samples which were
09:42:58 collected from Macondo were sidewall cores because they are

09:43:03 cheaper. You drill the well and you just take the cores from the
09:43:06 side of the hole. Whereas, if you take the whole core, then you
09:43:10 have to stop drilling, then take a core sample to the surface, and
09:43:14 that is more expensive. So a lot of companies would prefer to take
09:43:19 sidewall core data than the whole core data. And what he is
09:43:23 talking about is that in general the sidewall core values may not
09:43:27 be representative, so we have to somehow correct for it.
09:43:30 Q. Let's see the next callout, 8774.1.2. What are we seeing here?
09:43:38 A. This is the e-mail from the rock mechanics expert, Steve
09:43:43 Willson to Kelly McAughan, again, and the other reservoir
09:43:47 engineers, including Bob Merrill who is the person responsible for
09:43:52 reservoir simulation.
09:43:53 And what he is talking about is the sidewall core samples
09:43:59 again, that what we did at Macondo was take a sidewall cores,
09:44:06 rotary sidewall cores that's what RSWC stands for, and which you
09:44:11 correctly point out, has some inherent biases. So, again, we have
09:44:15 rock mechanics here who is talking about the fact that based on
09:44:18 some analog wells that are some inherent biases in the sidewall
09:44:22 cores.
09:44:22 Q. Let's move to the next e-mail chain from July 6, TREX 8772, and
09:44:27 look at the first callout .1.1. Dr. Kelkar, what is this e-mail?
09:44:35 A. And this e-mail is from a simulation engineer Schott to Kelly,
09:44:42 and what he is saying is that, again, based on some of the other
09:44:45 analog wells that the sidewall to the whole core needs an upgrade
09:44:51 based on Isabela, which is another place where the whole core

09:44:55 sample was taken.
09:44:56 Q. You used the term "analog well," what is an analog well?
09:45:00 A. Analog wells are the wells -- are the reservoirs which are used
09:45:05 when you want to complement some of the missing information from
09:45:09 the existing reservoir.
09:45:09 Q. Let's move to the final e-mail chain from July 6, 8770.1.1.
09:45:21 What are we looking at here, Dr. Kelkar?
09:45:23 A. This is an e-mail from, again, from Kelly McAughan to other
09:45:27 engineers talking about what type of upgrade is required for
09:45:33 adjusting the rock compressibility. And since other reservoirs, if
09:45:38 you require an upgrade from 10 to 20, that means you have to
09:45:41 increase also the value at Macondo by a factor of two.
09:45:45 Q. Now, let's take a look at what BP said on July 7th, which is
09:45:49 the next series of exhibits discussed in this demonstrative,
09:45:54 D-21600.
09:45:56 Let's have, first, TREX 8775.1.1. What's your
09:46:02 understanding of this e-mail, Dr. Kelkar?
09:46:04 A. This is an e-mail from a rock mechanics expert to simulation
09:46:08 engineer and the reservoir engineer. And what he is talking about
09:46:12 is that based on some of the work he has done that you could argue
09:46:18 for a very high compressibility, and Isabela and Santa Cruz
09:46:23 comparison, which is the analog wells, would put you at 15
09:46:27 microsips. So he's, again, giving some guidance in terms of what
09:46:32 is the appropriate compressibility that 15 could be a reasonable
09:46:35 value, with 20 as an upside and five as a downside.

09:46:41 Q. Let's look at the next e-mail exchange which is TREX 8776.1.1.
09:46:46 What are we looking at here, Dr. Kelkar?
09:46:48 A. I think what you see in this e-mail is some consensus is
09:46:52 emerging as to what is the most appropriate value to be used. And
09:46:56 what Kelly McAughan is saying is that what about 6, 12, and 18; 6
09:47:01 being the low value, 12 being the middle, and 18 being the high
09:47:05 value. And both Steve Willson and Bob Merrill agreed to that type
09:47:14 of estimation.
09:47:14 Q. Let's move along the timeline now and talk about what BP was
09:47:19 doing on July 8th. TREX 8777.1.1, please. What is this document,
09:47:30 Dr. Kelkar?
09:47:31 A. So this is an e-mail from Kelly McAughan to some of the other
09:47:35 engineers talking about the fact that we use the help of rock
09:47:40 mechanics expert and we went from 6 microsips to 12 microsips and
09:47:46 because in other analog wells, the teams did the same thing. They
09:47:50 used the factor of two when they went from sidewall cores to whole
09:47:54 core data.
09:47:55 Q. Let's take a look at TREX 10841, please. Can we blow that up?
09:48:10 Do you recognize this document, Dr. Kelkar?
09:48:12 A. I do.
09:48:13 Q. What is it?
09:48:14 A. It is a document which was prepared by Bob Merrill. And what
09:48:19 this document represents is what type of reservoir response you
09:48:24 would get when the well is shut-in, so it's trying to predict what
09:48:27 type of reservoir pressure increase we will expect to see if the

09:48:32 well was shut-in.
09:48:32 Q. Let's go to callout 10841.22.1. Dr. Kelkar, what's your
09:48:41 understanding of what we see here in this callout?
09:48:44 A. Well, what this document is showing is that when Dr. Merrill
09:48:49 was using this simulation results, obviously he was concerned on
09:48:55 certainty with respect to different parameters. And the two
09:48:57 parameters he was concentrating on was the aquifer, underlying
09:49:03 aquifer, and he assumed that the most likely value to be 3.8 times
09:49:07 the size of the oil reservoir. And he also considered the rock
09:49:12 compressibility between 6, 12, and 18, where 12 being the most
09:49:16 likely value.
09:49:18 Q. Turning to the next callout, 10841.23.1.
09:49:23 THE COURT: Excuse me. Can you back up a second? Is it
09:49:31 your understanding that the highlighted numbers were highlighted on
09:49:35 the original slides?
09:49:36 THE WITNESS: Yes.
09:49:37 THE COURT: That's not something you added?
09:49:38 THE WITNESS: No, no.
09:49:41 THE COURT: All right, go ahead.
09:49:41 MS. ENGEL: Thank you, your Honor.
09:49:43 BY MS. ENGEL:
09:49:44 Q. The callout, which is .23.1, and does this callout reflect what
09:49:48 you just described to Judge Barbier?
09:49:50 A. Yes. That you saw on the next slide it says explicitly that
09:49:53 the most likely values are 3.8 times the size of oil reservoir as

09:50:00 1 the aquifer size and 12 microsips.
09:50:02 2 Q. So now, we're up to July 9th on the timeline. Let's take a
09:50:07 3 look at TREX 9324.1.1.
09:50:19 4 MS. ENGEL: Just to clarify, your Honor, in the last
09:50:20 5 exhibit that we were looking at in those callouts, the highlighting
09:50:23 6 is ours, we added the highlighting. The bold was on the original
09:50:27 7 document.
09:50:28 8 THE COURT: Wait, go back. Show me what you're talking
09:50:31 9 about.
09:50:32 10 MS. ENGEL: Sure. 10841.22.1. So we here added the
09:50:39 11 highlighting for you.
09:50:40 12 THE COURT: The yellow highlight, yes. I meant -- I
09:50:42 13 don't know what term I used, maybe I said highlighting, but I meant
09:50:45 14 the bolded numbers. The bolded numbers were in the original?
09:50:49 15 THE WITNESS: Yes.
09:50:50 16 THE COURT: Okay.
09:50:50 17 BY MS. ENGEL:
09:50:51 18 Q. So now can we go 9324.1.1. Dr. Kelkar, this is an e-mail from
09:50:59 19 Kate Baker to Marjorie Tatro at Sandia with a copy to Paul Tooms,
09:51:05 20 Kent Wells, and James Dupree. There is an attachment here called
09:51:09 21 SIWOP Master Pack. Do you know who Kate Baker is?
09:51:13 22 A. She was a consultant to BP.
09:51:15 23 Q. And what about the individuals on the cc line?
09:51:19 24 A. They were some executives to BP. I don't know exactly who they
09:51:25 25 were, but they were some executives within BP.

09:51:27 Q. And do you know what the attachment to the e-mail is?
09:51:30 A. Again, this goes back to the discussion about what will happen
09:51:35 during the shut-in of the well. So prediction of the pressure data
09:51:39 during the shut-in of the well.
09:51:41 Q. Let's take a look at TREX 92 -- I'm sorry, 9324.3, the third
09:51:49 page. Is this the attachment to the e-mail?
09:51:51 A. Yes.
09:51:52 Q. Let's go to TREX 9324.16. What is your understanding of what
09:52:01 Bob Merrill is presenting to the government in this July 9th
09:52:05 PowerPoint entitled "Reservoir Depletion"?
09:52:08 MR. BOLES: If I may, one more time, note the objection.
09:52:11 I objected earlier to the e-mails. I hadn't anticipated that this
09:52:13 also would be added, so I am just going to make a general objection
09:52:16 to things outside the scope of the expert report being relied on.
09:52:21 THE COURT: All right.
09:52:22 MS. ENGEL: Your Honor --
09:52:23 THE COURT: Overruled.
09:52:25 BY MS. ENGEL:
09:52:28 Q. So go ahead, Dr. Kelkar. What is your understanding of what
09:52:31 Bob Merrill was presenting to the government in this PowerPoint?
09:52:34 A. I think this is the same presentation which was -- I referred
09:52:38 to before which is, again, trying to predict the response of the
09:52:43 reservoir during the time of shut-in. And so what he is trying to
09:52:47 calculate here is that how much reservoir has depleted over 86 days
09:52:53 so that he can predict the response of the pressure when the well

09:52:56 is shut-in.
09:52:57 Q. Can we have the first callout, which is 9324.17.1. Now, did
09:53:05 this callout contain the work that you just described?
09:53:08 A. Yes. And if you look at the results here, what this results is
09:53:13 showing you that if you varied the baseline values. So, for
09:53:19 example, if you change the compressibility of 12 to 6 to 18, which
09:53:23 is the range, then the reservoir pressure would have depleted
09:53:27 differently. So if you use 6, the reservoir would have depleted
09:53:32 200 psi more. If you use 18, the reservoir would have depleted 100
09:53:37 psi less.
09:53:38 And same thing with the aquifer. If you had no aquifer,
09:53:42 the reservoir would have depleted by 800 psi. If you had 14 times
09:53:47 the size of an aquifer compared to 3.8, the reservoir would have
09:53:52 100 psi more pressure. So again, this is just a sensitivity of
09:53:56 what would have happened to the reservoir based on different input
09:54:00 parameters.
09:54:00 Q. So now, we're up to July 15th on the timeline. What is your
09:54:05 general understanding of the events happening on July 15th?
09:54:08 A. July 15th was the day when the well was shut-in around
09:54:13 two o'clock in the afternoon.
09:54:14 Q. Let's take a look at TREX 9320 and go to the first callout
09:54:20 .1.1. What is this document, Dr. Kelkar?
09:54:25 A. This is an e-mail which is written by Tony Liao who actually
09:54:30 was doing most of the work related to PROSPER, which is one of the
09:54:35 commercial softwares, which actually calculates the pressure up in

the wellbore. And he is writing an e-mail to different BP people.

And what he is talking about is the comparison between the pressure which was observed in the well after the well was shut-in with the model predictions. And this is very important because there has to be an assurance that the well has maintained integrity. So if you can show that the buildup pressure in the well is consistent with what's observed, then your model is reasonable and there is a well integrity.

So I think this is a reference to about first three hours after the well was shut-in.

Q. Did Dr. Liao use a compressibility value of 12 microsips in this modeling?

A. Well, Dr. Liao did not really model this, but Dr. Merrill used 12 microsips. And I think he is comparing the results of what Dr. Merrill had predicted with what was observed.

Q. Thanks for that clarification. Let's look at 9320.17.1, please. And is this one of the pressure buildup cases you mentioned?

A. Yes.

Q. And the value highlighted there in yellow is 12 microsips?

A. Yes.

Q. Let's look at the last callout which is 9320.25.1. What are we looking at on this chart, Dr. Kelkar?

A. So what this is showing you is the wellhead pressure. WHP stands for wellhead pressure, so this is the pressure in the

09:56:09 capping stack. And then on the X axis there is a shut-in time.
09:56:12 And this is a comparison between what was observed at the well
09:56:18 compared to what was predicted in the models. And there were two
09:56:22 models; one, was the simulation results which was done by
09:56:25 Dr. Merrill, and there were other models which were OLGA, and this
09:56:30 is a different software, which was also used to predict increase in
09:56:34 the pressure.
09:56:34 And I think if you refer back to the e-mail, what
09:56:38 Dr. Liao is saying that we are in a good place. And essentially
09:56:42 saying that whatever pressure we had predicted in the well was
09:56:46 consistent with what was observed.
09:56:50 Q. You can take that down. Dr. Kelkar, why did you decide it was
09:56:54 appropriate to rely on all of these documents we've just reviewed
09:56:57 in reaching your conclusion that 12 microsips was the appropriate
09:57:00 value for compressibility?
09:57:02 A. I think the main reason was that the simulation exercise which
09:57:07 was done in this particular effort was related to the well
09:57:12 integrity, and BP had every reason to use the most appropriate
09:57:18 values in their simulation. And they had used the 6, 12, and 18
09:57:25 microsips as the possible range of compressibility, and I thought
09:57:30 that since they had used those values, I should also stick to those
09:57:34 three values. So I considered the sensitivity with respect to 6
09:57:37 and 18, but I used the most likely value to be 12, based on the
09:57:43 discussion.
09:57:43 And as I refer back, you know, this is not unusual. When

09:57:46 you don't have an expertise, you rely on other people to provide
09:57:49 you with expertise. And I think all of these documentations
09:57:53 clearly told me that 12 microsips is the most appropriate value to
09:57:57 be used.
09:57:58 Q. In the course of your review of all of these BP documents that
09:58:01 we just looked at, did you ever see any reference to 12 being used
09:58:05 as a worst case or that it should only be used as a worst-case
09:58:10 scenario?
09:58:10 A. I did not see any reference.
09:58:11 Q. You mentioned earlier that you also relied on the testimony of
09:58:16 Dr. Paul Hsieh to re-enforce your opinion that 12 microsips is the
09:58:20 appropriate value for compressibility. What was it in Dr. Hsieh's
09:58:23 testimony that supports your selection of 12?
09:58:25 A. In Dr. Hsieh's testimony there was a phone call which Dr. Hsieh
09:58:31 had with Kelly McAughan, I think same person we referred to in
09:58:37 these documents, and she had asked Dr. Hsieh to use 12 microsips as
09:58:42 a compressibility value.
09:58:43 Q. And I believe you said a moment ago that you also used values
09:58:47 of 6 and 18 microsips in your analysis. Why did you select those
09:58:53 values?
09:58:53 A. For the same reason. Those are the values which were used by
09:58:56 Dr. Merrill, so I didn't see any reason not to use those values in
09:59:00 my analysis as well.
09:59:01 Q. And what did those 6 and 18 values represent in your analysis?
09:59:06 A. That's just a range of uncertainty I considered with respect to

09:59:10 formation compressibility.
09:59:13 Q. So what is your analysis of the 6, 12, and 18 range tell you
09:59:17 about the sensitivity of the material balance calculation to
09:59:19 compressibility?
09:59:20 A. So the amount of oil released can be quite sensitive to
09:59:23 formation compressibility, and the values can vary over a great
09:59:28 deal depending on what formation compressibility you use.
09:59:31 Q. Does that sensitivity apply equally to Dr. Blunt's material
09:59:38 balance analysis?
09:59:38 A. It does.
09:59:39 Q. Let's look at D-21663, please. Did Dr. Blunt consider any
09:59:45 uncertainties or sensitivities in formation compressibility in his
09:59:49 analysis?
09:59:49 A. He did not.
09:59:50 Q. Did he -- I'm sorry. Let's go to D-21664, please. This is the
10:00:00 final element of the material balance analysis pressure drop. How
10:00:05 did you derive the initial reservoir pressure you used in your
10:00:08 calculation?
10:00:08 A. I used the initial pressure data based on BP's post drill
10:00:14 information.
10:00:14 Q. And how did you calculate -- I'm sorry, what value did you use
10:00:18 for initial reservoir pressure?
10:00:20 A. I used 11,856.
10:00:23 Q. How did you calculate the final reservoir pressure that you
10:00:26 used?

10:00:27 A. I used the pressure buildup, which was available on the day of
10:00:32 shut-in, and over 17 days after the well was shut-in. So I used
10:00:38 the Mead method to calculate the average pressure and that turned
10:00:42 out to be 10,396 psi.
10:00:44 Q. What does this Mead method entail?
10:00:48 A. It's a method by which you can fit a rectangular hyperbole to
10:00:54 the pressure data, and then one of the parameters which comes out
10:00:58 of it is the average pressure.
10:01:02 Q. Did you validate your calculation of average pressure or final
10:01:06 pressure using that Mead method?
10:01:08 A. I did. And I used two literature data sets, and I fitted the
10:01:15 data where conventional well test was done, and I compared the
10:01:19 average pressure from those two literature data sets with what I
10:01:22 obtained from the Mead method. It turned out to be that the
10:01:25 comparison was reasonable.
10:01:27 Q. Why did you decide to use the Mead method to get your final
10:01:33 reservoir pressure?
10:01:33 A. The reason I used that method is because one of the most
10:01:37 important pieces of information in conventional well test analysis
10:01:41 is the rate. You have to know what is the rate at which the well
10:01:45 was flowing prior to shut in. And we had a lot of uncertainty with
10:01:50 respect to rate information, so I used the method which did not
10:01:54 rely on the rates.
10:01:56 Q. Can you look at D-21665, please. Did Dr. Blunt calculate final
10:02:06 reservoir pressure using the Mead method?

10:02:07 A. He did not.
10:02:08 Q. What did he do differently?
10:02:10 A. He used some type of parameter estimation, which he fitted the
10:02:17 data with five parameter model, and one of the parameters which he
10:02:21 calculated was the average pressure. But he did not consider the
10:02:27 fluid changes which were taking place prior to shutting in the
10:02:31 well, and he also ignored the first 10,000 seconds of the pressure
10:02:37 buildup data in fitting his model.
10:02:41 He did calculate the reservoir permeability as part of
10:02:47 his calculation, but he rejected it, and instead he relied on
10:02:52 Dr. Gringarten's value in his calculations.
10:02:54 Q. You mentioned the term "conventional well test analysis" or
10:02:58 "traditional well test analysis" a minute ago. Is what Dr. Blunt
10:03:02 did a traditional or conventional well test analysis?
10:03:05 A. Not by -- if you look at any standard well testing books.
10:03:12 Q. Do you have any other criticisms of Dr. Blunt's calculation of
10:03:16 final reservoir pressure?
10:03:18 A. One of the things which he did not use in his calculation is
10:03:23 that he did calculate the average pressure, but we also had the
10:03:28 average pressure data available from Dr. Gringarten, but he chose
10:03:32 not to use those values.
10:03:34 Q. So Dr. Gringarten also calculated final average reservoir
10:03:37 pressure on behalf of BP and Anadarko?
10:03:39 A. He did.
10:03:39 Q. And did he use bottom hole pressures that he received from

10:03:44 Dr. Blunt to make that calculation?
10:03:45 A. Essentially, both of them used the same bottom hole pressure
10:03:50 data during the shut-in.
10:03:51 Q. Can we have D-21666, please. So using those bottom hole
10:03:58 pressure that he got from Dr. Blunt, did Dr. Gringarten, then,
10:04:02 calculate a final average pressure that was different from
10:04:05 Dr. Blunt's?
10:04:06 A. He did. And if you look at this particular chart, you can see
10:04:10 that Dr. Gringarten calculated the value between 10,364 and 10,460.
10:04:19 The value I calculated was 10,396 which is right in the middle of
10:04:23 what Dr. Gringarten had calculated.
10:04:26 Dr. Blunt's values are significantly higher than
10:04:30 Dr. Gringarten's, as well as mine.
10:04:33 Q. And what's the significance of that difference of Dr. Blunt
10:04:37 having higher average pressures?
10:04:39 A. Higher average pressure means less oil released.
10:04:44 Q. So if Dr. Blunt had used either your value or Dr. Gringarten's
10:04:48 value, he would calculate a higher amount of oil spilled?
10:04:52 A. Yes, he would.
10:04:53 Q. Is Dr. Gringarten more of an expert in pressure buildup
10:04:59 analysis than Dr. Blunt?
10:05:00 A. Yes, he is.
10:05:01 Q. Now, let's bring all of these inputs to the material balance
10:05:06 analysis back together. Can we see D-21668, please. Remind the
10:05:13 Court of what cumulative discharge you calculated using your

10:05:17 methodology?
10:05:17 A. I calculated the value between four-and-a-half to
10:05:20 five-and-a-half million standard barrels.
10:05:22 Q. Do you have any opinion about whether these values are
10:05:25 conservative?
10:05:25 A. I believe these values are conservative, because unlike
10:05:30 Dr. Merrill who did consider the influence of water influx, I do
10:05:35 mention about the water influx but I did not explicitly include the
10:05:40 influence of water influx.
10:05:41 Also, my lower end of the value, which is 110 million
10:05:44 standard barrels of oil in place is based on single-phase formation
10:05:48 volume factor, so it tends to be a lot more conservative.
10:05:51 Q. You were in the room this morning when counsel for BP asked
10:05:55 Dr. Zick why you hadn't used an FVF from his EOS calculation in the
10:06:00 material balance, correct?
10:06:01 A. Yes.
10:06:02 Q. Do you know what FVF, formation volume factor Dr. Zick
10:06:10 predicted?
10:06:10 A. Yes, I do.
10:06:11 Q. What values were those?
10:06:12 A. I think they were in the range of 1.96 to 2.05.
10:06:17 Q. And if you had used those formation value factors calculated by
10:06:22 Dr. Zick in your analysis, what would be the effect on your
10:06:25 cumulative oil released?
10:06:26 A. The amount of oil released will increase.

10:06:29 Q. Can we have D-21669. Now, you testified earlier that you
10:06:36 looked at sensitivity of your material balance calculation to
10:06:39 changes in formation compressibility. Did you analyze that
10:06:43 sensitivity to any other inputs?
10:06:46 A. I considered the sensitivity in my rebuttal report to the
10:06:50 formation volume factors, because at that time I had the reports
10:06:54 available from both Dr. Whitson and Dr. Zick and the oceanic
10:06:59 separation analysis. So although I started with the value of 2.14,
10:07:05 which was in the BP's table, I also looked at Dr. Whitson's values
10:07:11 which were between 2.08 and 2.14, and Dr. Zick's value which were
10:07:16 in the range of 1.97 and 2.04. And if you use those values, you
10:07:21 will increase the amount of oil released.
10:07:24 Q. Did Dr. Blunt consider changes in formation compressibility --
10:07:29 I'm sorry, formation volume factor in his analysis?
10:07:32 A. He did. I mean, he used three different values corresponding
10:07:37 to three different lab reports. But all of those three lab reports
10:07:42 were based on single-phase separation.
10:07:45 Q. Did Dr. Blunt apply formation volume factors calculated by
10:07:50 either Dr. Whitson or Dr. Zick?
10:07:52 A. He did not.
10:07:53 Q. And would the changes in formation volume factor affect
10:07:57 Dr. Blunt's material analysis the same way that they affect yours?
10:08:00 A. Yes.
10:08:01 Q. So what's wrong with Dr. Blunt's assumption that single-stage
10:08:05 separation should be used for formation volume factor?

10:08:08 A. Well, I believe that the oceanic separation which both
10:08:13 Dr. Whitson and Dr. Zick discusses is much more appropriate,
10:08:17 because once the oil is released into the ocean because of the
10:08:20 density differences between oil and gas phases, the gas will tend
10:08:24 to move faster than oil. And as gas moves through the ocean, it
10:08:31 will release some of the oil. And as oil moves separately, it will
10:08:34 release some of the oil. So that process is much closer to
10:08:37 multistage separation then single-stage separation.
10:08:41 Q. Let's turn, now, to your consideration of the potential impact
10:08:45 of aquifer support. Could we see D-21670, please. So this concept
10:08:51 of aquifer support, is that the same as what you showed Judge
10:08:55 Barbier in the animation at the beginning of your testimony?
10:08:58 MR. BOLES: Your Honor, if I may object. Judge Shushan
10:09:01 has entered an order saying that Dr. Kelkar, because he did not
10:09:05 include anything about aquifer support in his initial report, other
10:09:09 than to say what he's already said, which I didn't object to, that
10:09:14 not including it is conservative. When Dr. Kelkar in his rebuttal
10:09:20 report tried to add new analysis about the effect of an aquifer,
10:09:25 Judge Shushan in Record Document 10477 said on page 9 that,
10:09:32 "assumptions and analysis regarding the existence of an aquifer is
10:09:36 not proper rebuttal opinion for Dr. Kelkar."
10:09:40 MS. ENGEL: Judge Shushan did, in fact, strike certain
10:09:43 portions of Dr. Kelkar's report on aquifer. She left other
10:09:47 portions in, and those portions include language that says, "We did
10:09:50 not explicitly consider the impact of an aquifer in our analysis,

however, we did state in our report that our predicted results are conservative because influence from an aquifer would increase the amount of oil released." That's as far as we're going with Dr. Kelkar right now.

MR. BOLES: Then I will withdraw my objection for the time being.

THE COURT: Thank you.

BY MS. ENGEL:

Q. Dr. Kelkar, go ahead and tell us what you evaluated in terms of how the existence of an aquifer, if there was one, could affect your cumulative oil release.

MR. BOLES: Your Honor, I'm sorry, I have to object again. It sounds like what she's doing is asking for explicit quantification or other characterization of what an effect of an aquifer would be. Again, in his opening report, which we don't object to and which he's already testified to, Dr. Kelkar said his analysis is conservative because he's not taking into account the effect of an aquifer.

Now, counsel is seeking, apparently, to elicit testimony about what the effect of an aquifer is, and that was what was specifically ruled out by Judge Shushan's orders.

THE COURT: I -- I don't know --

MR. BOLES: I can bring you up the page.

THE COURT: Yes, send the page up.

MS. ENGEL: Again, your Honor, all I'm eliciting from him

10:10:59 is whether the existence of an aquifer would increase or decrease
10:11:04 the amount of oil spilled, and that is language that's explicitly
10:11:08 in his report.
10:11:09 THE COURT: Why don't you just ask him that question?
10:11:11 MS. ENGEL: Sure.
10:11:12 BY MS. ENGEL:
10:11:12 Q. Dr. Kelkar, would the existence of an aquifer, if there were
10:11:17 one, increase or decrease the amount of original oil -- I'm sorry,
10:11:20 the cumulative amount of oil spilled?
10:11:22 A. The amount of oil will increase when there is an existence of
10:11:26 an aquifer.
10:11:27 Q. Okay. Thank you. And did Dr. Blunt consider the impact of an
10:11:43 aquifer in his material balance analysis?
10:11:45 A. He did not.
10:11:45 Q. Did he make any assumptions about an aquifer?
10:11:50 A. He assumed that there is no aquifer support.
10:11:52 Q. We can wrap up the discussion of your material balance
10:11:57 analysis, now, by talking about some of the pros and cons of the
10:12:00 method that you mentioned earlier.
10:12:02 Can we have D-21671, please. What are some of the
10:12:08 advantages of a material balance methodology?
10:12:10 A. I think the material balance method is simple to use. The
10:12:16 questions are relatively simple, and it doesn't rely on dynamic
10:12:21 information, like flow rates and the pressure data. So the amount
10:12:23 of inputs which are required for material balance are easy to

obtain. But --

Q. What are -- go ahead.

A. But the same advantages you have with the material balance technology can also become limitations, because it is a static method and it doesn't account for any gradients. It doesn't account for any variation in the reservoir properties. It doesn't account for any variations in the pressure in the reservoir. So the advantages can become disadvantages because some of the dynamic data, which can be available, cannot be incorporated in material balance calculation.

And in this particular case, because we didn't know how much oil was produced, it adds on a layer of uncertainty in material balance calculations.

Q. Is Dr. Blunt's material balance analysis subject to those same limitations?

A. They are, it is.

Q. And what did you do to decrease the uncertainty associated with your own material balance calculations?

A. As I mentioned before, I calculated the rate on the last day before the well was shut in to ensure that there is a consistency. And I also looked at the productivity index value to make sure that it's consistent with the core and the log data.

Q. Did Dr. Blunt perform any additional calculations or analysis to decrease the uncertainty associated with his material balance calculations?

10:13:48 A. He did not.
10:13:49 Q. Let's switch gears now and talk briefly about the calculation
10:13:53 you performed of the flow rate on the final day of the spill.
10:13:57 Could we see D-21672, please.
10:14:03 Dr. Kelkar, please describe just briefly the analysis you
10:14:07 performed of the flow rate on July 15th.
10:14:08 A. I used an industry standard software called PROSPER to do these
10:14:13 calculations. I included all of the different components --
10:14:19 THE COURT: Excuse me one second. How much more do you
10:14:21 have to go?
10:14:22 MS. ENGEL: I would say ten, 15 minutes.
10:14:25 THE COURT: Why don't we go ahead and take a morning
10:14:28 recess, it's almost 10:15, and come back.
10:14:32 THE DEPUTY CLERK: All rise.
10:14:33 (WHEREUPON, A RECESS WAS TAKEN.)
10:24:43 (OPEN COURT.)
10:33:47 THE COURT: Please be seated, everyone. Before you begin
10:33:51 again, Ms. Engel, I still -- I am still getting people in the other
10:33:57 room saying they are having trouble hearing you. I think you're
10:34:01 naturally soft-spoken, which is part of the issue, I guess, but I
10:34:05 don't know if you can move that anywhere else or speak up a little
10:34:07 louder or whatever.
10:34:10 MS. ENGEL: I will try to do that, your Honor.
10:34:12 THE COURT: That's a little better. The witness is
10:34:13 coming across fine.

10:34:15 MS. ENGEL: He is the important one; you don't need to
10:34:17 hear what I have to say. Could we -- may we proceed?
10:34:21 THE COURT: Yes.
10:34:21 BY MS. ENGEL:
10:34:22 Q. Could we go to D-21672, please. Dr. Kelkar, right before the
10:34:29 break, I asked you to describe briefly the analysis you performed
10:34:33 of the flow rate on July 15th.
10:34:36 A. Yes. So what I did is I used an industry standard software
10:34:42 called PROSPER and I calculated the rate by accounting for all of
10:34:46 the resistances between the pressure gauge and the bottom of the
10:34:51 ocean. I accounted for two-phase flow, I accounted for all of the
10:34:55 pipes, all of the equipment in between the two points, and I
10:34:59 determined the rate to be 54,000 standard barrels per day.
10:35:04 I also validated my calculation by considering the flow
10:35:07 to the kill line, which turned out to be 53,200 standard barrels
10:35:13 per day.
10:35:13 Q. Does PROSPER require you to input information about the
10:35:17 reservoir fluid?
10:35:17 A. Yes.
10:35:18 Q. And what reservoir fluid information did you use in your
10:35:23 capping stack calculation?
10:35:24 A. I considered three possibilities. I considered BP's fluid
10:35:29 model, I considered Dr. Whitson's fluid model and also considered
10:35:35 Dr. Zick's fluid model in my calculations.
10:35:37 Q. What was the difference that your modeling showed when you ran

10:35:41 Dr. Zick's versus Dr. Whitson's equation of state?
10:35:46 A. Dr. Whitson's model gave me a rate which is about half a
10:35:50 percent less than Dr. Zick's model.
10:35:52 Q. Is your capping stack analysis described in more detail in your
10:35:57 expert report, which is TREX 15549R?
10:36:00 A. It is.
10:36:00 Q. And how does your capping stack analysis of flow on the final
10:36:04 day relate to your calculation of the cumulative oil discharged?
10:36:08 A. There is really no direct relationship, but as I said before,
10:36:14 that if I had predicted 2,000 barrels and I had calculated
10:36:19 5 million oil spilled, then, of course, there would not have been a
10:36:22 consistency. So I think the fact that I calculated 54,000 barrels
10:36:26 per day, and if I look at a typical decline in the well, there is a
10:36:31 consistency between what I predicted the rate to be versus how much
10:36:35 cumulative oil discharge I calculated.
10:36:37 Q. Can we move to D-21675, please. Dr. Kelkar, do you have any
10:36:47 criticisms of the analysis performed by any other BP or Anadarko
10:36:50 experts?
10:36:51 A. So I read also Dr. Gringarten's report, who calculated the flow
10:36:57 rate over 86 days. And the fundamental premise Dr. Gringarten
10:37:03 makes is incorrect, and what he does is that he assumes that the
10:37:08 bottom hole pressure is known. And we have no measurement of the
10:37:13 bottom hole pressure.
10:37:14 The only information Dr. Gringarten has is the BOP
10:37:18 pressure, and he has to know the rate before he can calculate the

10:37:22 bottom hole pressure. But he assumes certain rates, calculates the
10:37:27 bottom hole pressure, and simply then forgets the fact that even
10:37:31 though the rates are changing, his bottom hole pressure also needs
10:37:35 to change. So effectively he decouples the wellbore from the
10:37:39 reservoir in his analysis.
10:37:43 Q. Can we have D-21676, please. Does this demonstrative describe
10:37:56 the decoupling that you just mentioned?
10:37:58 A. Yes. So he first calculates the -- he assumes the rate, then
10:38:03 he calculates the bottom hole pressure and then he keeps on
10:38:06 adjusting the flow rate to match the pressure data. But to account
10:38:11 for the changes in the flow rate, he doesn't really recalculate the
10:38:14 bottom hole pressure. So essentially he simply takes the wellbore
10:38:19 away from the reservoir and only matches the pressure which he
10:38:22 assumes to be given, but in reality, it's not given, because he has
10:38:26 to calculate that using the BOP pressure. So that's a fundamental
10:38:30 problem with his analysis.
10:38:31 Q. Can we have D-21678, please. Dr. Kelkar, to wrap up, could you
10:38:41 please summarize your primary opinions in this case for Judge
10:38:45 Barbier.
10:38:45 A. So the two primary conclusions are the amount of oil spilled in
10:38:49 the range of four and a half to five and a half million barrels
10:38:52 over 87 days. The rate on the last day is 54,000 standard barrels
10:38:58 through choke line, which I validated also by calculating the flow
10:39:02 rate through the kill line.
10:39:04 MS. ENGEL: Thank you, Dr. Kelkar, we have no further

questions.

MR. BOLES: So, your Honor, I'm a little entangled here.

THE COURT: That's okay. Take your time. You might want to move that mic up a little bit on your tie. Men have a big advantage of that thing hanging right down their neck, you know, we can clip it to, you know.

MR. BOLES: Is that a good position?

THE COURT: I think so.

CROSS EXAMINATION

BY MR. BOLES:

Q. Good morning, Dr. Kelkar.

A. Good morning.

Q. Martin Boles on behalf of BP and Anadarko for the cross-examination.

MR. BOLES: May I proceed, your Honor?

THE COURT: Yes.

BY MR. BOLES:

Q. Dr. Kelkar, in the material balance calculation of cumulative flow that you've done, you have three basic variables that go into it, correct?

A. Three basic inputs, yes.

Q. And one of them is compressibility?

A. That is true.

Q. Let's talk about rock compressibility. You don't have an opinion as to -- that the number for rock compressibility for the

10:40:57 Macondo reservoir is 12 microsips, do you?
10:41:00 A. No. I think I just used the range between 6 and 18.
10:41:03 Q. So in terms of choosing 12 as between 6 and 18, you described
10:41:12 that in your deposition as a guess?
10:41:15 A. That's the best guess, yes. Educated guess.
10:41:20 Q. Best educated guess?
10:41:22 A. I don't consider that term to be pejorative really. I mean,
10:41:28 you can sit in the oil company's offices, and the executive vice
10:41:32 president will ask a young engineer when they're presenting a case
10:41:35 for drilling a well, what's your best guess, and you say, well,
10:41:39 this is how much oil we will produce and they will make a decision
10:41:42 based on that. So the word "best guess" does not necessarily mean
10:41:47 it's like playing roulette in Las Vegas. I mean, it is a guess
10:41:51 which is based on informed decisions.
10:41:57 Q. And it's not based on your analysis of the rock compressibility
10:42:03 data, is it, sir?
10:42:05 A. I am not a rock mechanics expert, no, I don't; I am not a rock
10:42:09 mechanics expert.
10:42:10 Q. My question was actually a little different. Your decision to
10:42:13 use 12 microsips is not based on your analysis, the rock mechanic
10:42:21 measurements on the actual samples of Macondo rock?
10:42:25 A. No, I mean, as I mentioned to you before that I am not -- if
10:42:28 you are asking the question did I rely exclusively on certain type
10:42:33 of information, I think I looked at all of the information which
10:42:36 was available and I reached that conclusion. So I am not

10:42:41 second-guessing anyone and I am not a rock mechanics expert, so...
10:42:46 Q. Well, you're second-guessing the data, aren't you?
10:42:51 A. I am not second-guessing expertise, let me put it that way. I
10:42:55 think essentially the e-mails which we showed today show that the
10:42:59 consensus was reached with respect to the compressibility the day
10:43:05 before the well integrity test was conducted. So I am just
10:43:08 assuming that same range is applicable in my analysis. So I
10:43:13 consider the entire range between 6 and 18 as a possible value of
10:43:21 rock compressibility.
10:43:22 Q. So it's reasonable to use six microsips as the number for rock
10:43:28 compressibility in the material balance calculation?
10:43:31 A. I think that any value between 6 and 18 can happen, yeah, I
10:43:35 agree with you.
10:43:35 Q. And when you use six in your material balance calculation, you
10:43:40 came up with a total cumulative flow of 3.4 million barrels?
10:43:44 A. That is correct.
10:43:44 Q. So that's a reasonable estimate?
10:43:46 A. It's one of the bounds of amount of oil spilled.
10:43:51 Q. That's a reasonable estimate?
10:43:54 A. I mean, I think -- I mean, I'm just calculating the uncertainty
10:43:58 on the amount of oil spilled, so I think that if you assume that
10:44:02 six microsips is the correct value, then you get 3.4 million
10:44:06 barrels of oil spilled.
10:44:06 Q. And you acknowledge that six microsips is a reasonable value to
10:44:10 input into a material balance calculation?

10:44:12 A. That's the three values which actually BP had indicated, so I
10:44:17 also considered those values to be within the bounds of, you know,
10:44:20 reality.
10:44:20 Q. Now, in your expert report where you indicate you're using 12
10:44:36 microsips, you cite a single document three different places in
10:44:44 your report as your support for choosing 12, don't you?
10:44:49 A. I do.
10:44:50 Q. And that's a presentation by Bob Merrill dated July 8th?
10:44:59 A. I don't remember the exact date, but I think there is a
10:45:01 presentation by Bob Merrill on reservoir depletion, yes.
10:45:05 Q. Let's -- just so it's clear, let's go ahead and look at one of
10:45:09 the footnotes from your expert report. Actually, we'll -- I think
10:45:13 we're on the same page, we'll look at presentation.
10:45:33 Let's take a look at TREX 10841N.3.1. We've called out
10:45:51 some of the parts of this, but you recognize this page of this
10:45:55 PowerPoint, don't you, sir?
10:45:56 A. Yes, I do.
10:45:57 Q. And this is what you're citing in your expert report as opposed
10:46:00 to using 12?
10:46:01 A. Yes.
10:46:02 Q. Now, when you decided to base your decision to use 12 microsips
10:46:11 for rock compressibility, based on looking at that document, did
10:46:14 you ask yourself why did the author put "most likely" around -- as
10:46:22 quotations marks? Why did he use quotation marks around the phrase
10:46:27 "most likely"?

10:46:28 A. What was your question?
10:46:32 Q. Sure. Didn't ask it very well. You see where it says, recommend new, "most likely," and then it has some numbers including 12 microsips?
10:46:43 A. Yes.
10:46:44 Q. Did you ask yourself when you decided to rely on that document to use 12 microsips as your base case, "I wonder what the author meant when he put 'most likely' in quotation marks?"
10:46:57 A. I mean, I assume that it is the most likely value. I am not sure actually.
10:47:05 Q. You're not sure if that meant that it was the most likely value?
10:47:08 A. But that's what it says. I mean, most likely value, so.
10:47:11 Q. You weren't sure when you looked at that PowerPoint and decided to use 12 microsips whether that was meant literally or whether "most likely" in quotation marks was meant to signify some qualification?
10:47:30 A. I just assumed that to be the most likely value.
10:47:32 Q. And you, to quote you from your deposition, you get the point that that might not, in fact, have been meant to convey that that was the most likely value?
10:47:40 A. I think what I was saying in my deposition is that -- I mean, I think you were asking me, if I remember correctly, and correct me if I'm wrong, but what you were asking me is that is it an average or is somewhere in the middle value. And I think you were asking

10:47:57 me related to that is it the most likely value or is it some
10:48:01 average, and I said, "Yeah, I get the point."
10:48:03 And I think the reason is because if you don't have a
10:48:06 whole lot of knowledge about the value being -- once you know the
10:48:11 minimum is 6 and maximum is 18, is the most likely value 12? Maybe
10:48:15 not. I mean, it could be 13, it could be 11. It's possible that
10:48:19 the distribution doesn't have to be uniform between those limits.
10:48:24 So if somebody would have said that the value is, most
10:48:27 likely value is not 12, it's 11 and that's what the report would
10:48:31 have said, I would have used 11 in my analysis.
10:48:34 Q. And what we're actually talking about when we met the last time
10:48:39 was that the data, the measurements on the Macondo rocks themselves
10:48:47 indicated a rock compressibility of 6, correct?
10:48:51 A. That is correct.
10:48:51 Q. And you, yourself, when you studied that same data and did your
10:48:56 report for the federal Flow Rate Technical Group, you looked at the
10:49:00 Weatherford rock mechanics laboratory measurements and you said
10:49:04 rock compressibility is 6?
10:49:06 A. That's correct.
10:49:06 Q. But at the time this presentation was made, the well was about
10:49:12 to be shut-in?
10:49:13 A. Right.
10:49:14 Q. And the context was that they were specifically evaluating the
10:49:20 risk to shut in, correct?
10:49:21 A. The well integrity was important, yes.

10:49:22 Q. The risk of shutting in the well, right?
10:49:26 A. Well integrity, I think -- I assume that's the same thing,
10:49:29 right?
10:49:30 Q. But the specific risks they were looking at was a risk from
10:49:34 buildup of pressure once the capping stack was shut?
10:49:37 A. Right.
10:49:38 Q. And the higher the compressibility number --
10:49:40 A. Yeah.
10:49:41 Q. -- the higher you would predict the resulting pressure?
10:49:45 A. Yeah, higher the compressibility the pressure will be higher,
10:49:51 yes, that is correct.
10:49:52 Q. What I was asking you about in the deposition was, do you know,
10:49:55 sir, whether when the person who wrote that put "most likely" in
10:50:01 quotation marks, he was referring to using a number in the middle
10:50:07 spot that would traditionally be used for the most likely value
10:50:10 when you have a low, middle, and high, and instead using the most
10:50:15 likely number as the low number and then using two alternative
10:50:18 higher cases to be sure they were capturing worst-case scenarios?
10:50:23 A. Well, I mean, if you're just saying that this particular
10:50:28 analysis only looked at the worst-case scenario, then they should
10:50:33 have just used 18 because 18 microsips would have given them the
10:50:37 worst possible increase in the pressure.
10:50:40 And I think when you read the document, what it says is
10:50:44 that they considered these possibilities. And I think what
10:50:48 Dr. Merrill did in his analysis is what any reservoir engineer

would do, is he looked at all of the possibilities and said, "Here are the possible ranges in the pressure values you would expect to see if the well was shut-in at that particular time. And here is the uncertainty with respect to aquifer. Here is the uncertainty with respect to compressibility."

So personally, what I see in the document is what I would expect to see in any reservoir simulation exercise.

Q. And what you would expect to see in a normal simulation exercise is you put your most likely number in the middle, and then you test a lower possibility at the uncertainty range and a higher one, right?

A. Yes. And he did that.

Q. And if you're, in fact, going to do something different for an audience that was used to seeing the most likely number with a lower number below and a higher number above, and you were putting instead a higher number, like 12, in the middle, you might describe it as "most likely" in quotation marks just to tip the audience off to that not to take it literally as being the most likely value, wouldn't you?

A. I am not sure what you're getting at really.

Q. Well, you read the deposition testimony of Bob Merrill?

A. I did.

Q. And he said that at the time he wrote this PowerPoint he did not regard 12 microsips as the most likely value, didn't he?

A. What he said in his testimony is that that value was in the

middle of 6 and 18, and I think you asked me that question in the deposition, and I said, "Okay, yeah. Okay, I agree." I think that -- there is a possibility that the distribution between 6 and 18 could be different than just simply a uniform distribution or some symmetric distribution. And 12 may not be the most likely value. I accept that. I mean, it's possible.

But I didn't have any other information except this document so -- and it said most likely value, so I used 12 microsips as the most likely value.

So could another rock mechanic come up with a different distribution, sure. I mean, I don't have an expertise in rock mechanics.

Q. Well, sir, when you say you didn't have any information besides this, you had the Weatherford measurements from the actual rocks, correct?

A. I did.

Q. And you've actually been involved in a study of rock compressibility in deep underwater reservoirs in the Gulf of Mexico, haven't you?

A. So I guess you're referring to my paper or you're talking about --

Q. Yes, I am referring to your published article published, I believe, it was in the *SPE Journal*. Let's take a look at --

A. One of the meetings, I think, yeah.

Q. Pardon me?

10:53:45 A. One of the SPE meetings I think.
10:53:48 Q. Let's a look at TREX 11560.1.1, and that's your name there as a
10:54:00 coauthor of this article?
10:54:02 A. Yes.
10:54:02 Q. And in this article you and your coauthors surveyed all of the
10:54:10 Gulf of Mexico deep water oil reservoirs that you could get data
10:54:15 from, and you looked at the distribution of different reservoir
10:54:21 properties for them, right?
10:54:22 A. Yes.
10:54:22 Q. So let's take a look at TREX 11560.4.1. So when you surveyed,
10:54:40 and we're looking at the callout here, the bottom line, it's not
10:54:44 highlighted, but it's in the lower left, "F12 rock compressibility
10:54:49 is measured in microsips," correct?
10:54:51 A. Uh-huh. Yes.
10:54:53 Q. And the caption to the table it says, "For each parameter high
10:54:58 and low extreme values and medium value are determined according to
10:55:03 the extensive study on lower tertiary reservoirs in the GoM." Did
10:55:09 I read that correctly?
10:55:11 A. You did read it correctly.
10:55:12 Q. And so the low value or the low extreme value would be one
10:55:15 microsips and the high extreme value for all of these reservoirs
10:55:19 you surveyed would be ten, correct?
10:55:22 A. Yes.
10:55:22 Q. And the medium value was three?
10:55:24 A. Yes.

10:55:24 Q. Now, you also, when you did your study of the Macondo reservoir
10:55:42 for the Flow Rate Technical Group, you, yourself, were asked to do
10:55:46 your modeling, not with an expected value and a low and a high, but
10:55:54 taking the most likely value as a base case and then using higher
10:55:58 numbers for worst-case scenarios, correct?
10:56:01 A. That is correct.
10:56:01 Q. Now, I want to look at some of these internal BP e-mails that
10:56:22 parts of which were not read to you or by you on your direct
10:56:26 examination. So let's start with 8771.1.1. So this is one of the
10:56:48 e-mails that you knew about, right, sir?
10:56:51 A. Yes, I did.
10:56:52 Q. And Kelly McAughan, you talked about her on direct examination,
10:56:57 is writing to Steve Willson. Do you know who he is?
10:57:00 A. Yes.
10:57:01 Q. Who is he within BP?
10:57:03 A. He is a rock mechanics expert.
10:57:04 Q. And she is saying, "We had a meeting with James Dupree today
10:57:10 regarding pressure depletion. The other REs were questioning our
10:57:15 PVC being 'low' at six microsips." You see low being in quotation
10:57:21 marks there?
10:57:22 A. Okay.
10:57:23 Q. Did you ask yourself when you saw that, I wonder what they mean
10:57:26 by that? If they mean that literally or if they mean that in the
10:57:30 context of the kind of study we're doing here?
10:57:33 A. I think that if you look at the e-mails, and honestly, I could

10:57:40 not go into their heads and try to figure these out. But if you
10:57:45 look at the subsequent discussion regarding the pore volume
10:57:49 compressibility, the discussion concentrates on sidewall core
10:57:54 versus whole core. And so if you look at all of the subsequent
10:57:59 discussion and the response from David Schott as well as Steve
10:58:04 Willson to this e-mail, it talks about the fact that, oh, I think
10:58:07 what you're referring to is really the sidewall core
10:58:11 compressibility being less than whole core compressibility.
10:58:15 So I simply refer to this e-mail as a starting point
10:58:19 that, indeed, other reservoir engineers were questioning that value
10:58:22 being low because there was some concern about the fact that
10:58:27 compressibility values were chosen based on the sidewall cores.
10:58:31 Q. Sir, when you say you can't get into their heads as to what
10:58:34 they meant by these e-mails, isn't that exactly what you're doing?
10:58:38 Basing your decision to use 12 microsips on some e-mails where you
10:58:43 haven't talked to the people and you don't know the context of
10:58:45 them?
10:58:46 A. No, I am not going into their heads. I think that -- the
10:58:49 reason I think you keep on saying that I only referred to one
10:58:53 reference in my report, but proof of the pudding is basically when
10:58:59 what you use in the simulation, because that simulation exercise is
10:59:02 the most important exercise you are doing to test the well
10:59:05 integrity. And all the e-mails actually reach the same conclusion,
10:59:10 that these range of possible values between 6 and 18 is the most
10:59:15 appropriate range we should use.

10:59:18 Q. Well, we'll see what those e-mails say. I am going to go back
10:59:21 over them a little more.
10:59:23 A. Okay.
10:59:23 Q. In terms of the proof of the pudding, as you say, in what they
10:59:26 actually used, you had -- at the time you decided to choose 12
10:59:33 microsips for rock compressibility, you hadn't seen the "proof of
10:59:38 the pudding" about what BP reservoir engineers, including some of
10:59:43 the same ones we've been looking at, like, Bob Merrill, the Senior
10:59:47 Reservoir Engineer, you hadn't seen the numbers for rock
10:59:49 compressibility that they went back to using after this safety
10:59:54 evaluation of the risk of shut-in, had you?
10:59:57 A. So are you referring to the certain documents you were showing
11:00:04 me at the time of deposition?
11:00:05 Q. Sure. Let's take a look at TREX 11551.1.1. And this is that
11:00:26 same Senior Reservoir Engineer whose name we saw in the e-mails you
11:00:29 talked about on direct examination, Bob Merrill, correct?
11:00:32 A. Uh-huh, yes.
11:00:33 Q. This is a couple of weeks later when the shut-in is done,
11:00:36 right?
11:00:36 A. Right.
11:00:37 Q. And now, he is writing a technical memorandum trying to predict
11:00:43 what pressures would be encountered when the relief well hit the
11:00:48 Macondo reservoir, right?
11:00:50 A. Yes, yes, I can see that.
11:00:54 Q. And he's using -- let's look at TREX 11551.3.1 -- 6 microsips

for rock compressibility. Right?
A. Yes.
Q. And if you based your decision to use 12 microsips on what you thought was a consensus at the time of shut-in, this would indicate a change of that consensus, wouldn't it, sir?
A. I don't know what this particular simulation was related to. I haven't looked at the results of this particular simulation. But as I said before, I mean, I think that there are those three possible values. I think if you use a compressibility of 6 -- I think Dr. Merrill also used an aquifer size, which is 3.8 times the size of oil reservoir in the same document, which you are showing me, and if you include the influence of aquifer and compressibility of 6, practically you'll get the same result as no aquifer with 12 microsips.

There are many combinations. There's a lot of uncertainty in these type of calculations, and you can reach the same conclusion as to amount of oil spilled based on different combinations of these results.

Q. When you mention aquifer, you have not included in your -- when you came up with your opinion on the cumulative flow of Macondo, you did not include the contribution of aquifer support to additional -- to what might have been additional flow, correct? You did not regard aquifer support as contributing a quantitative amount in your calculation of cumulative flow?
A. No, no, I did not, but I am just showing the same document. It

11:03:01 shows the influence of aquifer and that's my point.
11:03:04 Q. And in general, because the aquifer is out there in the distal
11:03:09 parts of the formation and has a different permeability and there
11:03:14 could be faults and so on, aquifer support normally would show up
11:03:18 later in a production, not on an 86-day timeframe, right?
11:03:22 A. Well, I think that if you look at Dr. Merrill's presentation,
11:03:28 it shows a significant difference in average pressure at the end of
11:03:32 the shut-in depending on the influence of aquifer. It's about --
11:03:36 between 800 psi minus to 200 psi plus. So it's quite significant.
11:03:42 MS. ENGEL: Your Honor, Mr. Boles is now asking
11:03:45 Dr. Kelkar to analyze aquifer support, which he was fighting pretty
11:03:50 hard on direct not to have him do.
11:03:52 MR. BOLES: Dr. Kelkar is bringing it into his
11:03:55 interpretation of why Dr. Merrill uses 6 microsips for drilling the
11:03:59 relief well.
11:04:00 THE COURT: Overrule the objection.
11:04:01 BY MR. BOLES:
11:04:07 Q. Let's go back and pick up the -- and get into these e-mails
11:04:13 that you based your guess on that you would use 12 microsips for
11:04:19 your base case.
11:04:22 Now, you mentioned Steve Willson was the expert
11:04:39 geomechanic of the group who we saw in those e-mail strings, right?
11:04:44 A. Yes.
11:04:44 Q. Let's see what he had to say, TREX 11557.2.1. When he was
11:04:57 first apprised of the idea of using some alternative higher numbers

for rock compressibility, he e-mailed to Bob Merrill and Kelly McAughan, "I don't think you can go much above 6 microsips and still honor the data," didn't he?

A. Yeah.

Q. And then later, TREX 11557.1.1, he comes -- he e-mails the same group and some others, "David, I have spoken with Bob Merrill and have more context now around the question being asked." Did I read that correctly?

A. You did.

Q. And in order to know what the significance is of any subsequent decisions about alternative numbers to use for rock compressibility, you would like to know, wouldn't you, Dr. Kelkar, what that context is that Steve Willson obtained by speaking with Dr. Merrill?

A. Not really, because if I read the entire e-mail it says that the initial response was more to do with what we measured on the Macondo, which, as you correctly point out, has some inherent biases. So I am just assuming that people are asking him questions about if there were any inherent biases in the measurements and how they could be corrected. And he is saying, then, I should have something later about this.

Q. So you never saw any study or any conclusion by BP that there was biased in the Macondo cores, did you?

A. I don't have to, this is what the e-mail says.

Q. So you're getting it from these e-mails?

11:06:47 A. These are BP experts who are writing these e-mails, so.
11:06:52 Q. When Mr. Willson talked about bias, do you know if he was
11:06:56 talking upward or downward bias or possibly both or either?
11:07:01 A. I think that he is talking about downward bias. And only
11:07:04 reason I am concluding is that -- I am not interpreting this
11:07:07 e-mail, but subsequent e-mails show that they had to correct for
11:07:13 the whole core compressibility by going upward compared to the
11:07:19 sidewall cores. I am just assuming that this is an upward bias.
11:07:23 Q. They did that on one analog well, correct?
11:07:28 A. I don't remember exactly, but I think there were two fields
11:07:31 they were referring to, but maybe it could be one. I don't
11:07:34 remember exactly.
11:07:35 Q. But it would be important to know in terms of knowing whether
11:07:41 or not they looked at another field and saw differences in
11:07:45 compressibility measurements between two wells, and said, "Maybe
11:07:48 there's a bias in rotary sidewall cores, so maybe we should
11:07:53 increase what we use for Macondo for the safety evaluation of risk
11:07:56 of shut-in and use some higher numbers as well as the measured
11:08:00 number." You don't know if that was the context in which all of
11:08:04 these e-mails were sent back and forth, do you?
11:08:07 A. I mean, I can only read what's in front of me. And the entire
11:08:13 e-mail flow never says that we should consider higher value because
11:08:18 we are considering well integrity. All the discussion centers
11:08:21 around the fact that there is a bias because of sidewall cores, and
11:08:25 I just have to believe that discussion.

11:08:27 Q. Sir, on your direct examination, you said that sidewall cores
11:08:30 are used all the time in this industry, didn't you?
11:08:34 A. They are cheaper.
11:08:35 Q. And in 30 years of reservoir engineering, you've never heard
11:08:40 anybody talk about a downward bias in rock compressibility
11:08:44 measurements on rotary sidewall cores, have you?
11:08:48 A. I think this is the first time I encountered really rock
11:08:54 compressibility to be so prominent, and part of the reason is
11:08:57 because the oil reservoir is above bubble point. Most of the times
11:09:02 once the reservoir pressure drops below bubble point, the impact of
11:09:06 compressibility becomes quite small because gas expansion becomes
11:09:09 so much more important.
11:09:10 But in this reservoir, it just turns out that rock
11:09:12 compressibility has assumed a prominent role.
11:09:15 Q. Well, rock compressibility assumed a prominent role in that
11:09:19 Society of Petroleum Engineers article that we just saw that you
11:09:22 published, didn't it?
11:09:25 A. It was one of the parameters. I don't think it was the most
11:09:28 important parameter, but it was one of the parameters because we
11:09:31 were looking at the water flooding response. But, yeah, I mean, we
11:09:35 considered the sensitivity with respect to formation
11:09:36 compressibility.
11:09:36 Q. It was an important parameter in that article, wasn't it?
11:09:39 A. I mean, we considered the sensitivity with respect to rock
11:09:46 compressibility. I don't know whether it was -- I don't remember,

but it could have been. I mean, I am not saying -- I don't want to say no.
Q. You didn't drop any footnotes in that article saying, "By the way, some of these measurements may be off because they're taken with rotary sidewall cores"?
A. To be honest, I don't remember when we got the rock compressibility data whether the data came from sidewall or the whole core. I just don't remember that.
Q. Let's go back to TREX 11557.1.1, where the rock compressibility expert Steve Willson is telling the reservoir engineers, "I now have context around the question being asked." And you don't know what that context is, do you, sir?
A. Well, the only thing I can infer from this e-mail is that -- which is the last line in that statement, that which you correctly point out they have some inherent biases. So I assume the context is related to the difference in the sidewall versus whole core. But I don't know. Like I said, I don't know.
Q. And you think it would be really important to understand the context of these e-mails that you used to make your decision to use 12 microsips?
A. All of the subsequent discussions -- and you're showing me one of those e-mails -- but all of the subsequent discussions basically point out to the biases in the sidewall versus the whole core. So I have to assume that that was the discussion which was taking place even outside the context of these e-mails.

Q. We will look at the subsequent discussions in a minute, but what I want to focus on, sir, is you think it's really important to understand the context of these documents; like, the context Steve Willson mentions when he says, after having written an e-mail saying, "We have to honor the data. We can't go above 6." And then he has a conversation with Bob Merrill about what's going on with the shut-in coming in. Now he says, "I have more context about the question being asked." And you think it's really important for you to have known that context?

A. Sure. I mean, more information you have, I think better are your results for sure.

Q. And you don't know what was discussed --

A. No, I don't know.

Q. -- between Dr. Merrill and Mr. Willson?

A. No, I don't know what was discussed, no.

Q. And you would agree, wouldn't you, sir, that the BP personnel involved in this modeling were concerned about creating the worst-case scenarios for purposes of ensuring safety during this process?

A. I think that the simulation exercise was extremely important from well integrity point of view, absolutely.

Q. Yes. But I'm actually being a little more specific, sir. I'm saying that you would agree that the people involved in this model were concerned about creating the worst-case scenarios for purposes of ensuring safety during the shut-in process?

11:13:11 A. I absolutely agree. I think they would like to look at the
11:13:20 worst-case scenario and ensure that, indeed, the results will cover
11:13:23 the broad range of possibilities, yes.
11:13:25 Q. Now, let's look at -- after Mr. Willson gets the context, let's
11:13:37 see an e-mail that I don't believe you spoke about in your direct
11:13:41 examination, 8772.1.1.
11:13:48 This is Kelly McAughan, Bob Merrill, "Steve Willson did a
11:13:53 check of the calculator for us, too. That is how we arose at 6
11:13:58 microsips. I even talked to him last Thursday about it as a check
11:14:01 and he said that it is still a good number especially with our
11:14:05 lower porosities." Do you see that, sir?
11:14:08 A. Yes.
11:14:08 Q. "But I will see if he can give us a maximum value as well." So
11:14:16 what -- do you, in your discerning of science from the BP e-mails
11:14:23 to come up with 12 microsips, what do you make of that, that the
11:14:27 geomechanic specialist, Steve Willson, still thinks 6 is a good
11:14:31 number, but he will see if he can give us a maximum?
11:14:33 A. Yes.
11:14:33 Q. Did that figure into your decision to use 12 microsips based on
11:14:38 these e-mails?
11:14:39 A. I think that what I am reading from this e-mail, and I think
11:14:43 this is quite consistent with all of the subsequent e-mails, is
11:14:47 that there is some inherent bias in the measurements and he wanted
11:14:53 to make sure all of the range of possibilities are considered. And
11:14:57 Steve is going to consider basically what is the maximum

11:15:00 possible value you can have with respect to rock compressibility,
11:15:05 and there is the decision that the value is between 6 and 18.
11:15:09 So, look, I am not arguing here that my value of 12 is
11:15:14 the correct one versus 6 or 18. I think if you look at the range
11:15:19 of possibilities, which is 6 to 18, I simply reproduce my results
11:15:25 between 6 and 12 in my material balance calculations because I am
11:15:29 assuming that the results which are presented in these e-mails are
11:15:32 reflective of what I have done in my calculations.
11:15:36 Q. Well, are you assuming that the results that we saw reflected
11:15:40 in Mr. Merrill's going back to using 6 microsips after the risk
11:15:46 evaluation of shut-in was done and he is modeling the relief well,
11:15:50 are you assuming that that reflects the right value for rock
11:15:53 compressibility?
11:15:54 A. It could be if you take aquifer into account. I mean, the
11:15:58 thing is, that's what I'm saying, that I didn't include aquifer,
11:16:02 Dr. Merrill included aquifer. And I think these are all of the
11:16:05 possibilities one has to look at when you are examining the
11:16:10 results.
11:16:14 Q. Let's look at TREX 9318.4.1. Here is a BP model done after the
11:16:30 shut-in risk evaluation using 6 microsips where there was an
11:16:34 assumption of no aquifer. Did you consider this in coming up with
11:16:39 your opinion that you would use 12 microsips based on what BP
11:16:43 scientists believed?
11:16:45 A. I think that I've looked at this document, but there is also
11:16:49 another model which also had 14 microsips.

11:16:51 Q. Let's take a look at that, TREX 9318.8.1. Part of the same
11:17:02 presentation. And sure enough, there it is, last line, rock
11:17:07 compressibility of 14 microsips, right, Dr. Kelkar?
11:17:10 A. Yes.
11:17:10 Q. And let's look what it says up above. "USGS parameters
11:17:16 increased $C_R$." That's rock compressibility, right?
11:17:20 A. Uh-huh.
11:17:21 Q. So he is modeling there using the alternative numbers that the
11:17:26 government is using at that time -- or do you know?
11:17:29 A. I assume USGS is U.S. Geological Survey, so.
11:17:36 Q. You mentioned analog well, sir. Let's take a look at TREX
11:17:41 9283.43. Have you ever seen this before?
11:17:53 A. I have.
11:17:53 Q. And this is the predrill prediction of rock compressibility at
11:17:58 Macondo done by that same rock mechanics expert, Steve Willson, who
11:18:05 acknowledged that there could be bias. Didn't say how much or
11:18:09 didn't say it was always one direction, but acknowledged there
11:18:13 could be bias in the rotary sidewall core, correct?
11:18:17 A. Yes.
11:18:17 Q. And you mentioned in your direct examination looking at analog
11:18:20 wells, correct?
11:18:21 A. Yes.
11:18:21 Q. When you did your own evaluation of the Macondo well, it was
11:18:25 your opinion that analog wells shouldn't be considered, right?
11:18:29 A. Are you talking of my --

11:18:34 Q. Before you were a litigation expert, when you were working for
11:18:36 the federal Flow Rate Technical Group earlier in the incident, you
11:18:41 said, "I am not going to consider analog wells. They're too far
11:18:45 away."?
11:18:45 A. I had data from one well, and the fluid properties from that
11:18:49 well were significantly different, and I was given only one week to
11:18:54 perform my analysis. So it was very difficult to use that data,
11:18:59 actually.
11:19:00 But anyway, yes, I did not use the one -- the data from
11:19:04 one oil well, yes, that's true.
11:19:06 Q. Well, let's talk about that, your having only one week to do
11:19:08 that analysis. As a result of having only one week, you were
11:19:14 careful to note to the federal Minerals Management Service, MMS,
11:19:22 that there were uncertainties in your analysis, correct?
11:19:25 A. Yes.
11:19:26 Q. And let's see -- let's take a look at TREX 9841 -- actually,
11:19:39 that's not what I want to look at. I want to look at the Kelkar
11:19:44 report. Just a minute, I'll get you the page. We're looking for
11:20:09 the page on 9859.19 -- before we go, don't change it yet, sorry.
11:20:22 This is your report commissioned by the federal Minerals Management
11:20:28 Service as part of the Flow Rate Technical Group on the Macondo
11:20:31 well, correct?
11:20:31 A. Yes.
11:20:32 Q. And, again, you wanted to note the uncertainties that were
11:20:36 inherent in your analysis, right?

11:20:38 A. Yes.
11:20:39 Q. So let's look at page 19, 9859.19. And let's highlight the
11:20:48 fourth paragraph, please. No. 4. So you said -- this is what you
11:20:52 reported, "Uncertainties in rock compressibility. We have used the
11:20:56 average rock compressibility 5.61 microsips" -- correct?
11:21:01 A. Yes.
11:21:01 Q. -- "from the database as a base case and maximum
11:21:06 compressibility of 8 microsips for the high case." Correct?
11:21:09 A. Yes.
11:21:09 Q. In terms of the bias of rotary sidewall cores, you understand
11:21:31 that to be caused by the fact that there can be horizontal
11:21:35 laminations on rock than cause its strength properties to be
11:21:39 different in the horizontal plane versus a vertical plane?
11:21:43 A. I think that's the inference I got from the e-mails which I
11:21:47 have read, yes.
11:21:48 Q. And your analysis of the Macondo rock is that there are no such
11:21:52 laminations that would cause that kind of bias, isn't it?
11:21:55 A. I didn't really do that type of analysis in Macondo myself.
11:22:03 Q. I don't know whether you did the analysis, but you said that
11:22:08 you don't see shale laminations in the Macondo sandstone?
11:22:12 A. That is true. I think what I said is that there are no
11:22:16 laminations in the -- let me see how I said it. I think that the
11:22:23 sand is clean, I think that's what I said, the gamma ray log shows
11:22:25 the blocky structure of the sand in the model, I think that's what
11:22:30 I said, which is true. I mean, the gamma rays actually do indicate

11:22:34 very clean sand.
11:22:37 Q. I think I am going to leave behind for a moment rock
11:22:40 compressibility and go to the next of the three variables in your
11:22:43 material balance equation, which I guess we're calling stock-tank
11:22:54 original oil in place; is that right?
11:22:55 A. Yes.
11:22:55 Q. In your direct examination, you talked a fair amount about
11:23:06 uncertainty in the material balance analysis that's caused by
11:23:14 uncertainty in the original oil in place; is that right?
11:23:16 A. I think one of the input parameters where there is an
11:23:21 uncertainty of the initial oil in place, yes.
11:23:24 Q. Now, you believe that the amount of oil that flowed from the
11:23:40 Macondo well can be accurately estimated using material balance,
11:23:45 the method you and Dr. Blunt have used, correct?
11:23:50 A. I mean, are you saying that -- am I implying that there is a
11:23:55 single value? Because I am not.
11:23:56 Q. Actually, sir, I am not saying anything. This is the very
11:23:59 first sentence from --
11:24:00 A. Yeah, I mean, I think that, yeah, within the realm of
11:24:03 uncertainty obviously material balance is a reasonably good method
11:24:06 to calculate the amount of oil spill, absolutely.
11:24:10 Q. That's not actually what you said in your report. What you
11:24:11 said in the very first sentence of your executive summary was, "The
11:24:14 amount of oil that's spilled from the Macondo well can be
11:24:17 accurately estimated using standard industry accepted petroleum

11:24:22 engineering techniques."
11:24:23 A. Okay.
11:24:24 Q. Isn't that right? I mean, do you agree with that or have you
11:24:28 changed your opinion?
11:24:29 A. I mean, I think what you read is correct. I think that what I
11:24:33 believe in, actually, that I think that -- but that does not mean
11:24:37 that there are no uncertainties in this analysis. Yes, but --
11:24:40 yeah, okay, I think I agree with what you just said.
11:24:45 Q. And in terms of uncertainties, it's your opinion that -- well,
11:24:56 under direct examination you talked about uncertainties as
11:24:58 indicated by the predrill analysis by BP of geology and geophysics,
11:25:05 right?
11:25:06 A. You're talking about the oil in place?
11:25:08 Q. Yes, oil in place.
11:25:10 A. Okay. Yes, so I think that there was a predrill report which
11:25:16 actually had the P10, P50 and P90 values as to how much oil there
11:25:22 was in place, yes.
11:25:23 Q. So P10 is what was predrill, that's given a 10 percent
11:25:29 probability of being found?
11:25:30 A. Right.
11:25:31 Q. And P90 a 90 percent probability?
11:25:34 A. Yes.
11:25:34 Q. And P50 being the middle?
11:25:36 A. Yes.
11:25:36 Q. And P50 is what you used?

11:25:39 A. I did. And I think what I was saying in my direct testimony is
11:25:44 that the reason I concentrated on P50 is because of subsequent
11:25:50 drilling of the well which provided the thickness of the reservoir
11:25:54 at that location, which was consistent with what was predicted in
11:25:57 the P50 estimate.
11:25:58 Q. And that's what I want to focus on, sir.
11:26:00 A. Okay.
11:26:01 Q. Because on your direct examination, you -- when you were asked
11:26:04 whether there was more uncertainty with material balance than other
11:26:06 methods, the thing you said is that, well, you have to rely on
11:26:10 geological data and geophysical data. And then you went on to talk
11:26:16 about the range of possible oil in place from BP's predrill
11:26:22 analysis of geological and geophysical data, right?
11:26:25 A. That's true.
11:26:26 Q. But it's your opinion, isn't it, sir, that that uncertainty was
11:26:29 greatly reduced by the fact that when BP drilled the well they hit
11:26:37 exactly the thickness that they had produced -- that they had
11:26:41 predicted predrill, right?
11:26:43 A. Yes.
11:26:44 Q. That narrowed the uncertainty in using the material balance
11:26:52 analysis with respect to the original oil in place variable?
11:26:56 A. It definitely would narrow the uncertainty because you actually
11:26:59 validated your P50 model to some extent by drilling the well.
11:27:03 Q. So you have a more precise and reliable estimate of that STOIIP
11:27:11 variable in the material balance equation than you do if you use

11:27:14 the predrill predictions that varied all over the place?
11:27:17 A. Post drill uncertainty is definitely less than predrill
11:27:20 uncertainty, absolutely.
11:27:21 Q. Well, in particular here, sir, where the predrill prediction is
11:27:25 based on interpretation of seismic data and geology, correct?
11:27:29 A. Yes.
11:27:29 Q. So they're trying to estimate, looking at different treatments
11:27:34 of seismic data, how wide the field may be, right?
11:27:38 A. Right.
11:27:38 Q. And how long?
11:27:39 A. Yes.
11:27:39 Q. And how thick?
11:27:41 A. Yes.
11:27:42 Q. So if you -- if the geophysicists and geologists make a
11:27:48 prediction based on that and then they drill exactly the thickness
11:27:52 that they predicted as the P50, then you have a far more certain
11:27:56 and more reliable estimate of the STOIIP variable in the material
11:28:02 balance equation?
11:28:03 A. The uncertainty will definitely be a lot smaller after the well
11:28:07 was drilled, yes, that is true.
11:28:09 Q. And you have said that you think that the STOIIP numbers that
11:28:20 are being used by you and Dr. Blunt have a remarkable consistency?
11:28:26 A. Not the STOIIP numbers. The hydrocarbon pore volume.
11:28:33 Q. So what you refer to as the initial volume of oil numbers being
11:28:38 used?

11:28:38 A. But that's at reservoir conditions rather than under standard
11:28:44 conditions, because he does use different value of the formation
11:28:47 volume factor. So his STOIIP is different, but his hydrocarbon in
11:28:52 place is similar, yes. That's what I said, yes.
11:28:55 Q. And there is one other thing that he does different from you in
11:28:58 terms of deriving the STOIIP number, isn't there, sir, pretty major
11:29:03 factor?
11:29:05 A. He does his own analysis of the pressure data, is that what
11:29:09 you're referring to?
11:29:10 Q. Yes. But using that pressure data -- by the way, in your last,
11:29:14 in the last summary slide I saw summarizing your criticism of
11:29:20 Dr. Blunt, I can only just take a note here, you were criticizing
11:29:24 his material balance analysis and you said he does not include
11:29:27 pressure data, right? If that was listed as one of your criticisms
11:29:36 of Dr. Blunt, that would be incorrect, wouldn't it?
11:29:39 A. It shouldn't have said that, yeah. I mean, I cannot imagine we
11:29:45 would have said that.
11:29:46 Q. He didn't use the PT-B pressure data from the time period of
11:29:51 the incident, right?
11:29:52 A. Yeah, I think dynamic information, he did not use the dynamic
11:29:59 pressure data, but that's true of any material balance method.
11:30:01 It's a limitation of material balance technique that you cannot
11:30:04 include the dynamic data in that analysis, yes.
11:30:07 Q. Well, he used the data from the pressure gauge put on the
11:30:13 capping stack and used to measure the pressure buildup after

11:30:17 shut-in, didn't he?
11:30:18 A. He did.
11:30:19 Q. And he used the pressure data that was measured before the
11:30:23 incident as well, correct?
11:30:29 A. Before the -- you're talking about flowing pressure or you're
11:30:33 talking about the shut-in pressure?
11:30:34 Q. The reservoir pressure.
11:30:35 A. He had the initial pressure data.
11:30:40 Q. Right.
11:30:41 A. And then he used the buildup after the well was shut-in and
11:30:45 matched that buildup pressure with his model. So he used the
11:30:49 pressure data after the well was shut in, yes.
11:30:52 Q. Another criticism you had of Dr. Blunt, while we're on this
11:30:57 subject, is that he -- and I am just going to read from your
11:31:02 report, that "Dr. Blunt has completely ignored the rate variation
11:31:07 that occurred just prior to shut-in as the choke valve closed."
11:31:11 Did you write that in your report, sir?
11:31:13 A. If you quote it, then I assume I wrote it. Yes.
11:31:18 Q. Let's take a look. It's TREX 11550R.7.1. There we go. Is
11:31:36 that an accurate excerpt from your expert report?
11:31:39 A. It is.
11:31:39 Q. And you now know that's not correct, right?
11:31:42 A. I think that there was one case he did consider the fact that
11:31:46 that were -- from Ratzel report, he did consider the rate
11:31:50 variation.

11:31:50 Q. Right. In other words, he has a whole appendix devoted to
11:31:54 that, doesn't he?
11:31:55 A. You're talking about the rate variation prior to --
11:31:59 Q. Yes, his appendix is completely devoted to looking at how might
11:32:05 rate changes affect the validity of my analysis?
11:32:08 A. Well, I think this particular statement which I was making was
11:32:11 related to just prior to shutting the well in. If you look at his
11:32:15 different rate profiles which he has in that appendix, they don't
11:32:18 really include this particular effect, so I am not referring in
11:32:22 general to a specific rate variation just prior to shut in.
11:32:26 I think that my point was, and I think there is a
11:32:32 significant discussion in my rebuttal report, and I think
11:32:35 Dr. Gringarten uses the rate variation prior to shut-in, I have
11:32:39 used the rate variation prior to shut-in. And what I show is that
11:32:45 the relative behavior of the pressure is quite different if you
11:32:48 account for the rate variation prior to shut-in.
11:32:51 So I am not saying he completely ignores all of the rate,
11:32:55 I am just saying just prior to shut-in.
11:32:56 Q. Actually, you were saying he completely ignores it, but you're
11:32:59 saying now you don't mean that?
11:33:01 A. No, that statement just says just prior to shut-in. I mean, it
11:33:05 very specifically says that.
11:33:06 Q. Well, in fact, he looked at rate data just prior to shut-in,
11:33:11 right?
11:33:11 A. And he does, he does consider one case, so you're right.

11:33:15 Q. Now, Dr. Blunt also analyzes whether the entirety of the
11:34:04 oilfield sandstone would be connected to the Macondo well, doesn't
11:34:13 he?
11:34:13 A. He does.
11:34:15 Q. That's a connectivity analysis?
11:34:17 A. Yes.
11:34:18 Q. Now, you haven't done your own expert analysis of the geology
11:34:23 of Macondo reservoir, have you?
11:34:24 A. I did not.
11:34:27 Q. Just to go over a little background, the geology is that this
11:34:31 sandstone reservoir consists not of a uniformly thick and
11:34:38 extensively continuous slab, but it's actually made up of a
11:34:42 number -- an unknown number of individual sinuous channels of sand
11:34:49 that were deposited on the bottom of the ocean?
11:34:51 A. Yes.
11:34:51 Q. And it's important to know -- since it's not just a continuous
11:34:59 slab of sand, it's important to know how much of that colored blob
11:35:03 that we see down there in the seismic is actually channels that are
11:35:07 connected to the well and how many of them are not, right?
11:35:09 A. Yes.
11:35:09 Q. In fact, that's one of the primary jobs of a reservoir engineer
11:35:13 is assessing connectivity, isn't it?
11:35:16 A. If you want to predict something, yes.
11:35:18 Q. And you haven't done any independent analysis of whether there
11:35:31 are possible compartments or baffles or barriers to flow for fluids

traveling from other channels that might not have been directly connected to the well?

A. So let me explain it this way. I think that when BP predicted P10, P50 and P90, and typically when you use the geophysical data to evaluate that information, they will use certain seismic threshold, cutoff to determine what volume is connected.

So BP had already included certain cutoffs to determine how much oil volume is connected under P10, P50 and P90 case. The fact that they drilled the well turned out that the thickness was consistent with what was observed clearly indicated that BP had done a good analysis of the geological and geophysical data. And I didn't see any reason that I should second-guess what BP had done.

Q. Now, what they analyze -- I didn't mean to cut you off. Sorry.

A. Just one more thing. And then subsequent to shutting the well, there was a pressure buildup where the pressure measurements were collected. And those pressure measurement indicated a very strong connectivity in the channel sand. So I think both of those pieces of information tells you that the well is well connected to the reservoir and it's a channel sand, and the linear flow behavior is quite indicative in the pressure data.

Q. So I guess we agree that it's appropriate and standard use to use the pressure data to assess the degree of connectivity, correct?

A. Absolutely.

Q. Dr. Blunt did such an analysis, didn't he?

11:37:21 A. He did use it.
11:37:22 Q. And you did not?
11:37:23 A. I mean, I showed that basically in my analysis that the
11:37:28 pressure data indicates a strong continuity, but the reason I did
11:37:34 not use the type of analysis Dr. Blunt did is because of the fact
11:37:38 that there is so much uncertainty in the rate prior to shutting of
11:37:43 the well, and I state that in my rebuttal report as well as my
11:37:49 original report.
11:37:50 It's not like that the well test analysis is impossible
11:37:54 to do. I think there are a lot of softwares which are available
11:37:57 which you can analyze the well test data. The problem is that when
11:38:01 there is a lot of great uncertainty, it is very difficult to do
11:38:04 that type of evaluation.
11:38:05 Q. I thought I just heard you say in answer to my prior question,
11:38:09 sir, that you did look at somebody's pressure analysis and assure
11:38:12 yourself that there was complete connectivity of this reservoir.
11:38:16 A. No, it's my own pressure data. I mean, I think I showed that
11:38:19 in my direct -- I mean in the original report, the half slope on
11:38:25 the pressure data and show that basically, showed a very strong
11:38:30 connectivity in the reservoir.
11:38:30 Q. So your pressure analysis is reliable in terms of connectivity,
11:38:34 but Dr. Blunt 's isn't in terms of being able to use pressure from
11:38:39 the Macondo buildup to assess connectivity?
11:38:42 A. No. I think that he also shows the similar type of strong
11:38:47 connectivity in the data -- I don't have any objections to that. I

11:38:52 1 think that what I object to is the fact that he ignores certain
11:38:57 2 pressure data after shut-in, and what I mentioned in my direct
11:39:03 3 examination is that one of the main purposes of the buildup data is
11:39:08 4 to estimate the reservoir parameter, such as skin factor and
11:39:13 5 permeability, and the early pressure data can be quite useful in
11:39:18 6 that analysis.
11:39:19 7 Dr. Blunt does ignore some of the pressure data, and then
11:39:22 8 when he calculates the permeability, he decides to discard it and
11:39:27 9 instead chooses to use a permeability value which is given by
11:39:33 10 Dr. Gringarten.
11:39:33 11 Q. He uses a higher permeability value, isn't that right, than the
11:39:37 12 one that he deduced?
11:39:40 13 A. He uses 329 millidarcies than 300. But my point is he discards
11:39:46 14 his own estimate. He calculates the permeability and he discards
11:39:51 15 it because he says it's not reliable, so I am going to go back to
11:39:56 16 Dr. Gringarten's value. And so --
11:39:58 17 Q. Dr. Kelkar -- I'm sorry, I didn't mean to cut you off.
11:40:00 18 A. Go ahead.
11:40:01 19 Q. Dr. Kelkar, you really think that if Judge Barbier goes and
11:40:03 20 looks at Dr. Blunt's report he is going to see a sentence in there
11:40:07 21 saying, "my determination of permeability is not reliable"?
11:40:10 22 A. Okay. I don't know the exact statement, but I think he says
11:40:13 23 that Dr. Gringarten's value is more reliable, so I am going to use
11:40:17 24 that. Something to that effect.
11:40:18 25 Q. And there's a good reason for that, right, sir? Dr. Gringarten

11:40:22 is the world's leading expert on well test analysis, as you told me
11:40:27 in your deposition?
11:40:27 A. That's not the reason Dr. Blunt actually uses Dr. Gringarten's
11:40:31 value. I think his reason is interesting, and it's quite
11:40:34 appropriate, is that because in the MDT testing, which is what
11:40:40 Dr. Gringarten analyzes, he has rate information; whereas, when
11:40:44 Dr. Blunt uses his data, he realizes there is no rate information
11:40:49 available.
11:40:49 Q. And that's because in assessing permeability in standard
11:40:57 petroleum engineering, you want to know the pressure and the rate
11:41:01 history?
11:41:01 A. Absolutely.
11:41:02 Q. And there's only one time that that's available here in a
11:41:10 measured way outside of the blowout, outside of the incident, and
11:41:14 that was before the incident on April 12th when that wireline tool
11:41:19 was put down the well that you're referring to as the MDT, correct?
11:41:23 A. Yes.
11:41:23 Q. And then when that -- when that tool was sucking sample fluids
11:41:30 out of the reservoir, it was measuring flow rate and pressure
11:41:34 response, and those are the two things you need to get
11:41:37 permeability, correct?
11:41:38 A. Yes.
11:41:38 Q. And that's what Dr. Gringarten used to derive his permeability
11:41:42 number?
11:41:43 A. That is correct.

11:41:44 Q. And he is the only one in this case who has derived a
11:41:46 permeability number with that MDT tool where you know the flow rate
11:41:50 and you know the pressure history, and it's not affected by all of
11:41:53 these uncertainties of the incident we've talked about?
11:41:55 A. Dr. Larsen also did that, but Dr. Gringarten did that, yes.
11:42:00 Q. You had a criticism of Dr. Gringarten's use of the MDT to
11:42:06 assess or measure or estimate permeability in your rebuttal report,
11:42:10 didn't you, sir?
11:42:11 A. What I say in my report is not necessarily the criticism of his
11:42:18 analysis. I am not an expert in MDT. What I say is that the scale
11:42:23 of issues in the permeability measurement can be quite important.
11:42:28 And when I refer to that is that when you are making measurements
11:42:31 of permeability based on core data versus MDT data versus well
11:42:34 tests, you are going to see some variation, and that's because of
11:42:37 the differences in the scale.
11:42:39 So what I was talking about is that appropriateness of
11:42:41 the scale. I don't think I was criticizing, per se, his analysis.
11:42:45 Q. And by "scale," you mean how far out into the reservoir is that
11:42:52 MDT taking the temperature of the permeability, if you will, or
11:42:55 measuring the permeability?
11:42:57 A. Yes, I think that's --
11:42:58 Q. Sometimes known as a radius of investigation?
11:43:00 A. That's correct.
11:43:01 Q. And I believe you told me in deposition that you would be
11:43:03 reassured of the reliability of an MDT tool estimate of

permeability as long as the radius of investigation was several hundred feet out?
A. That's what I said.
Q. And you don't know as you sit here, sir, whether, in fact, the MDT tool's radius of investigation for measuring permeability out into the reservoir is, say, on the order of 600 feet?
A. I don't know.
Q. I want to go back again to connectivity. You have not done your own expert analysis of the geology of Macondo, correct?
A. No, and I explained the reasons.
Q. And you have not analyzed how much of the total volume of oil that was down in the Macondo reservoir was connected to the well?
A. What I mentioned -- again, let me just repeat that. I did not do that analysis. But when BP predicted P10, P50 and P90, essentially they used certain cutoffs of connectivity to determine the connected volumes. I didn't see any reason that I should do that analysis myself again.
Q. Sir, in that -- you're referring to the BP predrill geology and geophysical report that was shown on direct examination, correct?
A. Yes.
Q. And there's -- that report doesn't say anything about a connectivity analysis, does it?
A. It doesn't.
Q. And you don't believe that there are Gulf of Mexico reservoirs of the geological type of Macondo that have a hundred percent

11:44:46 connectivity, do you?
11:44:47 A. Huh-uh, that's true. But I think that the cutoffs do actually
11:44:54 capture that type of connectivity is my point. But, yes, I mean,
11:44:57 there are no reservoirs with hundred percent connectivity.
11:44:59 Q. But you don't know -- you don't know all of the factors that
11:45:03 went into deciding the BP's predrill P10, P50, P90 cutoffs?
11:45:08 A. No.
11:45:09 Q. And you don't know whether that included connectivity?
11:45:12 A. No. They will include connectivity, that's why you get the
11:45:16 pessimistic, the optimistic and the P50 cases. I don't know the
11:45:20 specific values. I think that's what you're asking me.
11:45:23 Q. Well, there are a lot of reasons you can have a P10, P50, P90
11:45:28 variation, aren't there, sir?
11:45:29 A. Yeah. It is possible that there could be a difference of
11:45:33 physical interpretation of the data, and that might have resulted
11:45:36 in different values. But in general, when you look at the
11:45:39 geophysical analysis, the most common method of defining different
11:45:45 volumes is using different cutoffs, certain seismic attribute
11:45:49 cutoff, which is used to determine how much volume is there.
11:45:52 Q. But that BP predrill report doesn't say anything about
11:45:58 connectivity, does it?
11:45:59 A. No.
11:45:59 Q. So whether or not those numbers factor in a connectivity
11:46:04 prediction predrill, you don't know for sure?
11:46:08 A. It's not mentioned.

11:46:10 Q. And in any event, the best way to know that, as I think you
11:46:14 were saying earlier, is to do a post drill evaluation from how the
11:46:19 pressure wave moves out and where it hits boundaries and whether
11:46:23 it's hitting boundary short of the full extent of the oilfield
11:46:28 reservoir, correct?
11:46:29 A. That's one way. But it's not that easy.
11:46:36 Q. And you think it's absolutely possible that some of the
11:46:38 channels in the Macondo reservoir are not or were not connected to
11:46:44 the well?
11:46:44 A. I have no way of knowing that, yes.
11:46:53 Q. Now, I want to take a brief break from walking through the
11:46:59 material balance variables of compressibility and original oil in
11:47:06 place and talk to you a little bit more about this parameter of
11:47:09 permeability.
11:47:25 Now, let's see -- let's look at Demonstrative D-21003.1.
11:47:39 This was used by United States during their opening statement as
11:47:44 sort of a range of permeability estimates. On the left-hand side
11:47:48 you see the column that says "Predrill Estimates"?
11:47:52 A. Yes.
11:47:53 Q. Dr. Kelkar, as a petroleum engineer, you wouldn't put reliance
11:47:58 on a predrill estimate once you have post drill data, would you?
11:48:03 MS. ENGEL: Your Honor, Dr. Kelkar doesn't offer an
11:48:05 opinion on permeability in his report, so I'm not sure where we're
11:48:08 going with this.
11:48:08 MR. BOLES: Actually, he does, your Honor. On direct

11:48:09 examination he talked about productivity index as being an
11:48:12 important part of validating his cumulative flow number and he used
11:48:17 a number for permeability in there of 300 millidarcies, and I can
11:48:21 give you the cite.
11:48:22 MS. ENGEL: If he wants to ask him about his productivity
11:48:26 index calculation, he can ask that, but I don't understand where
11:48:29 we're going with the permeability specific question.
11:48:33 MR. BOLES: Where we're going is the reasonableness of
11:48:34 permeability numbers that he's used and other experts have used,
11:48:37 just as you've asked him about reasonableness of what other experts
11:48:40 have done.
11:48:41 THE COURT: Okay. Go ahead. I'll overrule the
11:48:43 objection.
11:48:46 BY MR. BOLES:
11:48:47 Q. Dr. Kelkar, I want to refer you to the second column there, the
11:48:51 second kind of fuzzy green column that says "Post Drilling
11:48:55 Technical Memorandum." Do you see that?
11:48:59 A. Okay.
11:49:00 Q. And it kind of shows permeability as sort of a fading-out
11:49:07 bottom and top, or the top around 500 millidarcies, do you see
11:49:12 that?
11:49:12 A. Okay.
11:49:13 Q. Now, you got -- let's take a look at the chart of
11:49:19 permeabilities from that document. Let's look at TREX 9767.19.
11:49:36 You've seen that before, right, sir?

11:49:37 A. Yes.
11:49:38 Q. And you used that in coming up with your permeability of 300
11:49:43 millidarcies?
11:49:44 A. I used the core average to calculate the productivity index.
11:49:52 Q. When you looked at the core data you calculated a permeability
11:49:55 of 300 millidarcies, correct?
11:49:57 A. Yes.
11:49:57 Q. But you also say in your report that BP's post drill summary
11:50:03 report indicates a permeability of 300 millidarcies?
11:50:07 A. Right, right. I think this is that report.
11:50:10 Q. Not 500 millidarcies?
11:50:13 A. Yeah, I used the average from here, yes.
11:50:15 Q. Now, I want to look at what you did when you looked at the --
11:50:23 when you talk about the core data, we're talking about measurements
11:50:26 on rock samples by Weatherford Laboratories?
11:50:29 A. Yes. And I think -- I believe they were corrected for air to
11:50:36 liquids, I think.
11:50:37 Q. In other words, those air permeabilities on the two right-hand
11:50:44 columns, arithmetic air permeability, that's arithmetic average air
11:50:50 permeability, correct?
11:50:50 A. Yes, from that particular zone.
11:50:52 Q. From each of those different horizons?
11:50:55 A. Yes.
11:50:56 Q. The numbers on the far right column, that stands for geometric
11:51:00 average air permeability, right?

11:51:02 A. Yes.
11:51:02 Q. And so those numbers were corrected or scaled by BP engineers
11:51:09 for what it would -- what their equivalent would be in permeability
11:51:14 to oil, right?
11:51:14 A. Yes.
11:51:15 Q. And you did the same thing when you looked at this data, didn't
11:51:22 you?
11:51:22 A. For which case? I mean, I just used one value in my report,
11:51:29 which is 300 millidarcies.
11:51:31 Q. After looking at this data?
11:51:33 A. Yes, yes.
11:51:34 Q. From the BP post drill technical evaluation?
11:51:37 A. Yes.
11:51:38 Q. Now, let's go back again to your report to the federal
11:51:45 government before you were a litigation expert, TREX 9859, and
11:51:57 let's look at page 17, so that's 9859.17. So here you took a
11:52:06 couple of columns from the Weatherford measurements, I'm referring
11:52:11 to the two right-hand columns, permeability for two different
11:52:20 petroleum-based fluids, decalene and xylene?
11:52:25 A. Yes.
11:52:25 Q. Based on your analysis you concluded that the permeability of
11:52:29 the Macondo reservoir was about 70 millidarcies, didn't you?
11:52:32 A. Yes.
11:52:34 Q. And we talked earlier about since you were rushed and only had
11:52:37 a week to do this, you thought it was important to tell the Mineral

11:52:42 Management Service a range of uncertainty in your parameters,
11:52:45 right?
11:52:45 A. Yes. And I think I used 50 percent more than this value. But
11:52:50 I think these values are wrong. I mean, clearly I think I
11:52:53 discussed that in my deposition that these are way too low. And I
11:52:59 think the cores were not clean and I think I just thought that
11:53:02 liquid permeability would be more representative in my calculation,
11:53:05 but it turns out to be the fact that I was wrong in using these
11:53:09 values.
11:53:09 Q. Let's take a look at 9859.19 and look at paragraph three now.
11:53:24 So when you advised the federal Mineral Management Service about
11:53:27 uncertainty and permeability, you said, "This is one of the most
11:53:32 important parameters for uncertainty due to its impact on wells
11:53:36 productivity." Right?
11:53:37 A. Yes.
11:53:37 Q. That's because under Darcy's Law flow rate is directly
11:53:42 proportional to permeability, right?
11:53:44 A. Yes.
11:53:44 Q. Double the permeability, you double the flow rate?
11:53:47 A. For the given pressure drop, yes.
11:53:48 Q. Sure. So if you take your 300 millidarcies permeability in
11:53:53 your expert report and double it to over 500 millidarcies like some
11:53:57 of the other United States experts have done, you would get a
11:54:00 doubled flow rate, wouldn't you? All other things being equal?
11:54:04 A. That's an interesting question. It's not that straightforward,

11:54:11 and the reason is because when you couple the wellbore to the
11:54:14 reservoir, the wellbore constraints can also make a difference in
11:54:18 the way you predict the rate.
11:54:20 So I don't think the rate will necessarily double,
11:54:23 because as you increase the rate the pressure drop in the tubing
11:54:26 also increases and it adds more resistance to the flow. So the
11:54:32 bottom hole pressure will go up as a result of that and eventually
11:54:35 the rate will equilibrate to something less than double the rate.
11:54:40 But if you're asking me a question, would the rate
11:54:42 increase, the answer is yes.
11:54:42 Q. Well, but under Darcy's Law, which is one of the two
11:54:45 fundamental equations of reservoir engineering, isn't it, sir?
11:54:49 A. That is true, but the bottom hole pressure is not constant when
11:54:54 you couple the wellbore to the reservoir. I mean, you are only
11:54:58 pressure which is constant in Macondo is the bottom of the ocean.
11:55:02 That pressure is given. But the pressure in the tubing can change
11:55:07 as the rate increases, and when that pressure drop increases the
11:55:10 bottom hole pressure will increase to reflect higher rate.
11:55:13 So you're not going to see a doubling of the rate by
11:55:16 doubling of the permeability. But I don't know what that value
11:55:20 will be, but if you're asking me a question would the rate be
11:55:23 higher, the answer is yes.
11:55:24 Q. Actually what I was asking is, under Darcy's Law, isn't flow
11:55:28 rate directly proportional to the number for permeability?
11:55:31 A. For a given pressure drop. And that's important.

11:55:33 Q. Fair enough. Fair enough. So you told the federal Mineral
11:55:40 Management Service that you've assumed that permeability values can
11:55:47 be 50 percent higher than that of the base case values obtained
11:55:50 from core measurements, correct?
11:55:52 A. Yes.
11:55:53 Q. So that would be about 120 millidarcies?
11:55:56 A. Yes.
11:55:57 Q. So let's take a look at D-24402. I just want to kind of wrap
11:56:11 up our permeability discussion by just kind of seeing the big
11:56:15 picture here. So in the bottom row in pink, you've read the expert
11:56:19 reports of Dr. Larsen, Dr. Huffman, Dr. Pooladi-Darvish, Dr. Hsieh,
11:56:25 haven't you, sir?
11:56:26 A. I have -- yes. I have not -- yes, I have read the reports,
11:56:36 yes.
11:56:36 Q. Did you remember that they used permeability numbers between
11:56:39 400 and 850 millidarcies?
11:56:42 A. Yes.
11:56:42 Q. And you used in that calculation that you talked about on
11:56:47 direct examination as validating your cumulative flow number, the
11:56:54 productivity index, you used a permeability number of 300
11:56:56 millidarcies, correct?
11:56:58 A. I did use 300 value, millidarcy value, yes.
11:57:02 Q. By the way, in that productivity index that you calculated
11:57:06 ended up being 25 percent off of what is in your report?
11:57:09 A. Yes. Yes, I don't remember exactly, but I think I told you

11:57:14 what the correct value was in the deposition.
11:57:17 Q. Yes, you did. I appreciated that.
11:57:19 Let's now talk about porosity. Let's look at just real
11:57:25 quickly D-24403, it's turned out from --
11:57:31 THE COURT: Mr. Boles, let me just ask you, can you give
11:57:33 me an estimate of how much time you have left?
11:57:35 MR. BOLES: Yes, I think in about 10 or 15 minutes.
11:57:38 THE COURT: All right. Well, let's just go ahead.
11:57:42 BY MR. BOLES:
11:57:42 Q. It's turned out in the rebuttal report of Dr. Huffman he makes
11:57:46 some, bases some discussion about rock compressibility on the
11:57:51 number for porosity in the Macondo well reservoir, and that's the
11:57:56 percentage of the rock that's taken up by air space, right,
11:58:00 Dr. Kelkar?
11:58:01 A. Yes.
11:58:01 Q. But you used a porosity of 21.7 percent, correct?
11:58:08 A. Yes.
11:58:08 Q. Looks to be -- as far as you're aware all of the other experts
11:58:13 use that number in this case, on both sides, use that number as
11:58:15 well, don't they?
11:58:17 A. Yes.
11:58:17 Q. And you got that number by calculating the thickness weighted
11:58:23 porosity from measurements on the Macondo rock?
11:58:29 A. That is true.
11:58:30 Q. Last material balance variable, the pressure change. The one

11:58:36 1 big -- one of the big differences between what you did and what
11:58:40 2 Dr. Blunt did has to do with translating the pressure measurements
11:58:47 3 from where they were taken at the capping stack, at the seafloor,
11:58:50 4 down to what you're trying to analyze as a reservoir engineer,
11:58:54 5 which is --
11:58:56 6 A. Bottom hole.
11:58:57 7 Q. -- bottom hole, thank you. And you do that translation by
11:59:01 8 trying to estimate the weight of the oil in the wellbore, correct?
11:59:04 9 A. Yes.
11:59:04 10 Q. That's sometimes called the hydrostatic head?
11:59:07 11 A. Yes.
11:59:08 12 Q. And of course when these measurements start at the capping
11:59:15 13 stack, it's right when the well's been shut-in, correct?
11:59:19 14 A. Yes.
11:59:19 15 Q. So the well's been flowing up, up until the point?
11:59:24 16 A. Yes.
11:59:24 17 Q. And the wellbore fluids that are coming up are hot?
11:59:27 18 A. Yes.
11:59:27 19 Q. Over 200 degrees temperature, right?
11:59:31 20 A. Yes, 240, yes.
11:59:33 21 Q. And then once the capping stack is shut they're not flowing
11:59:37 22 anymore, are they?
11:59:39 23 A. There is some influx of the fluid at the bottom hole even after
11:59:42 24 the well is shut-in; but there is no flow to the surface, that's
11:59:46 25 true.

11:59:46 Q. So there's no more hot oil coming into keep hot that entire
11:59:54 thousands of feet of oil trapped in the wellbore?
11:59:59 A. For few hours there will be some influx of oil. Because the
12:00:05 bottom hole does not know the well has been shut-in at the top, so
12:00:10 there is some time difference between when the well is shut-in at
12:00:14 the surface versus what's happening at the bottom hole. But, yes,
12:00:18 I mean, I think the flow rate is substantially reduced when you
12:00:21 shut the well.
12:00:21 Q. And I am not referring just to a few hours, I am referring to
12:00:24 the several weeks of shut-in pressure data from the capping stack
12:00:28 to August 3rd.
12:00:29 A. Okay.
12:00:30 Q. During that time the wellbore will have cooled, correct?
12:00:33 A. Yes.
12:00:33 Q. And when it cools it gets more dense?
12:00:35 A. Yes.
12:00:36 Q. And more dense oil weighs more, right?
12:00:39 A. True.
12:00:39 Q. So the translation from the capping stack to the reservoir is
12:00:43 going to be affected by that?
12:00:44 A. Yes.
12:00:44 Q. In other words, that conversion factor if known for certain
12:00:51 would be different over time as the wellbore cooled?
12:00:54 A. That is true.
12:00:54 Q. And you did not take into account wellbore cooling in your, in

12:00:59 calculating your hydrostatic head to convert from capping stack
12:01:04 pressure to reservoir pressure?
12:01:05 A. I did not.
12:01:06 Q. By the way, on direct examination the number for cumulative
12:01:18 flow that was put up there for you was 4.5 to 5.5 million, but I
12:01:27 believe you said in your deposition that your best estimate is 5
12:01:29 million barrels?
12:01:30 A. I just took an average of the two numbers, yes.
12:01:35 Q. And in your material balance analysis, you used -- I think you
12:01:42 already talked about that on direct, so I'll skip that in the
12:01:44 interest of getting us all to lunch here.
12:01:47 Sir, you're aware that at the end, toward the end of this
12:01:55 incident some oil was collected by vessels and didn't go into the
12:02:01 ocean, correct?
12:02:02 A. Yes.
12:02:02 Q. And there was some measurements of collection rates?
12:02:06 A. Yes.
12:02:07 Q. You don't think that your material balance analysis is
12:02:14 unreliable because you haven't explicitly and specifically analyzed
12:02:20 those collection rates, do you?
12:02:22 A. No. I think what I said is that more data you have in your
12:02:26 model, better the model becomes. And I think material balance has
12:02:31 that inherent limitation that it cannot incorporate the dynamic
12:02:36 data in the analysis.
12:02:36 Q. Right. But the material balance analysis done by you and

12:02:40 Dr. Blunt is not unreliable merely because you haven't taken into
12:02:46 account the collection rates?
12:02:47 A. No, it doesn't have the ability to incorporate that
12:02:50 information. Period.
12:02:51 Q. And it's not unreliable because of that?
12:02:53 A. No. I mean, it's -- the assumptions are what the assumptions
12:02:57 are in material balance.
12:02:58 Q. This is my last question for you, sir. In the United States'
12:03:16 pretrial brief, ten-page brief summarizing their case, they mention
12:03:20 that trying to distinguish between you and Dr. Blunt by saying that
12:03:25 you "ground truth your material balance by calculating a capping
12:03:32 stack flow rate," and I heard you testify on direct about your
12:03:36 calculation of a capping stack flow rate. You wouldn't refer to
12:03:39 what that does for your material balance analysis as being ground
12:03:43 truthing it, would you, sir?
12:03:45 A. I think what I was referring to, and I said the same thing in
12:03:48 deposition, that if I would have calculated the rate of 1,000
12:03:51 barrels and if I had calculated four and a half million barrels of
12:03:55 oil spilled or five and a half million barrels, then I would have
12:03:58 questioned myself that the results are not consistent. The fact
12:04:01 that I calculated the rate to be 54,000 barrels was much more
12:04:05 reasonable in light of what I had calculated to be the total oil
12:04:10 spill.
12:04:10 So that's what I meant by consistency. Not that I had
12:04:14 quantified exactly the numbers of the oil produced versus the rates

12:04:18 at which the well was flowing over 86 days.
12:04:21 Q. You were using it to see if you were in the ball park?
12:04:23 A. That is correct.
12:04:24 Q. Because your calculation of capping stack flow rate didn't come
12:04:28 into play in your material balance analysis, did it?
12:04:30 A. It did not.
12:04:32 MR. BOLES: Thanks, Dr. Kelkar.
12:04:35 THE WITNESS: Thank you.
12:04:35 THE COURT: Any redirect, Ms. Engel?
12:04:37 MS. ENGEL: Your Honor, I do have some if you want to
12:04:39 take a lunch break.
12:04:40 THE COURT: No, let's go ahead and finish with this
12:04:43 witness so he doesn't have to come back. He may have better things
12:04:47 to do this afternoon.
12:05:22 Just remember I heard everything he said on direct so you
12:05:25 don't have to have him repeat it all, okay?
12:05:28 MS. ENGEL: Yes, sir.
12:05:29 REDIRECT EXAMINATION
12:05:29 BY MS. ENGEL:
12:05:29 Q. Dr. Kelkar, I just want to ask you a few questions to follow-up
12:05:33 on what Mr. Boles asked you.
12:05:35 First, he asked you if it was reasonable to use 6
12:05:41 microsips for compressibility in your material balance analysis and
12:05:46 I think your answer was yes. Is it just as reasonable to use 18
12:05:49 microsips in that analysis?

12:05:50 A. Yes.
12:05:51 Q. You were also asked about this SPE paper that you coauthored.
12:05:58 What role did you have in that work?
12:06:00 A. It was the work done by one of my students actually. He did
12:06:05 the work and he collected the data in that analysis, I was just
12:06:12 advising in terms of what type of analysis should be done with
12:06:15 respect to that data.
12:06:15 Q. So would you consider yourself a principle author of that work?
12:06:19 A. I am not the principle author of that work.
12:06:23 Q. Now, you were asked also about the compressibility value that
12:06:28 you used in your FRTG, you Flow Rate Technical Group work, and we
12:06:35 looked at your report a little bit. And at that time, you
12:06:38 testified on direct that at that time you only had the Weatherford
12:06:42 Lab data available to you, correct?
12:06:44 A. Yes.
12:06:44 Q. And you didn't have all of these other documents that you've
12:06:48 since looked at to adjust your evaluation of formation
12:06:55 compressibility, right?
12:06:56 A. That is correct.
12:06:57 Q. So had you had that additional information available to you at
12:07:02 the time you did your Flow Rate Technical Group work, would you
12:07:06 have considered this additional information?
12:07:08 A. Absolutely. Any more information you have available makes your
12:07:11 results better.
12:07:11 Q. And might that have altered the formation compressibility value

12:07:15 that you used in your FRTG paper?
12:07:17 A. Yes.
12:07:18 Q. I just want to clarify one thing with respect to I think
12:07:35 Mr. Boles asked you if you said or if there was a slide that said
12:07:40 Dr. Blunt didn't use any pressure data. And I think let's put up
12:07:44 D-21671. And I think that this might have been the slide that
12:07:52 Dr. Boles -- or sorry, Mr. Boles, upgrade you -- Mr. Boles was
12:07:56 referring to. And here you're discussing the limitations of the
12:08:02 material balance methodology, right?
12:08:04 A. Yes.
12:08:04 Q. And it's one of those limitations of the method that you used,
12:08:08 the fact that you can't use certain types of a additional pressure
12:08:12 data like you can use in other analyses like reservoir simulation?
12:08:16 A. That is correct.
12:08:17 Q. You were also asked about the predrill report, which I believe
12:08:27 is TREX 5246, BP's Predrill Technical Assurance Memorandum, and
12:08:35 asked quite a few questions about whether they were quantifying
12:08:39 connected volume in that report. Do you recall that?
12:08:42 A. Yes.
12:08:42 Q. Is there any reason for BP to be quantifying unconnected volume
12:08:47 in their Predrill Technical Assurance Memorandum?
12:08:49 A. Well, what I mentioned again in my response is that BP will use
12:08:56 certain geophysical attribute threshold to determine the connected
12:09:02 volume, because ultimately the oil in place can only be calculated
12:09:05 by looking at where the oil is located and how oil is connected.

12:09:10 So I think the fact that you have P10, P50, P90 implies that they
12:09:15 have also considered the connected volume in their analysis.
12:09:22 Q. And just a couple of last questions. Did you try in your
12:09:27 expert work here to estimate permeability to a high degree of
12:09:32 certainty?
12:09:32 A. I did not. I just used a single value in my -- just to check,
12:09:38 really, as a productivity index.
12:09:40 Q. And did you try to estimate porosity to a high degree of
12:09:44 certainty for purposes of your expert report?
12:09:47 A. I just used the core data and calculated the average, weighted
12:09:50 average.
12:09:50 Q. And you were asked right at the very end of your
12:09:57 cross-examination about wellbore cooling and whether you analyzed
12:10:02 wellbore cooling, and I believe your answer was no. But does
12:10:08 wellbore cooling make a difference to your material balance
12:10:12 analysis?
12:10:13 A. It doesn't. And because Dr. Gringarten has used the wellbore
12:10:17 cooling because he directly took Dr. Blunt's data in his analysis
12:10:22 and his average pressure values are consistent with what I
12:10:26 calculated. So it wouldn't make any difference in the material
12:10:29 balance calculations as far as the amount of oil spilled is
12:10:32 concerned.
12:10:33 MS. ENGEL: Thank you, Dr. Kelkar, I have nothing
12:10:35 further.
12:10:36 THE COURT: All right. Thank you. Thank you, Doctor,

12:10:38 you're done. We will recess for lunch, it's about 12:10. I
12:10:46 believe the government has one remaining expert?
12:10:51 MS. HIMMELHOCH: That's correct, your Honor.
12:10:52 MR. O'ROURKE: We're going to play one 15-minute video
12:10:54 after lunch and then the final expert.
12:10:56 THE COURT: Dr. Pooladi-Darvish, okay. Thank you. Okay.
12:11:02 We will be back at -- well, I didn't give a time. Let's say, let's
12:11:07 make it 1:25, that's an hour and 15 minutes.
12:11:11 MR. BROCK: I was going to mention to you, Dr. Blunt is
12:11:14 here and ready to go first thing in the morning at 8 o'clock. I
12:11:17 think we will take most of the afternoon with the tape and the
12:11:20 witness and we will be ready to go first thing in the morning.
12:11:22 THE COURT: That's fine.
12:11:25 THE DEPUTY CLERK: All rise.
12:11:27 (WHEREUPON, A LUNCH RECESS WAS TAKEN.)

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REPORTER'S CERTIFICATE

I, Karen A. Ibos, CCR, Official Court Reporter, United States District Court, Eastern District of Louisiana, do hereby certify that the foregoing is a true and correct transcript, to the best of my ability and understanding, from the record of the proceedings in the above-entitled and numbered matter.

Karen A. Ibos, CCR, RPR, CRR, RMR
Official Court Reporter

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