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UNITED STATES DISTRICT COURT  
EASTERN DISTRICT OF LOUISIANA

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IN RE: OIL SPILL BY THE Docket No. MDL-2179  
OIL RIG DEEPWATER HORIZON Section "J"  
IN THE GULF OF MEXICO ON New Orleans, LA  
APRIL 20, 2010 Thursday, October 10, 2013  
CIVIL

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

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UNITED STATES OF AMERICA Docket No. 10-CV-4536  
V. Section "J"

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BP EXPLORATION & PRODUCTION,  
INC., ET AL

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DAY 8, 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

WITNESSES FOR BP/ANADARKO:

PAGE/LINE:

MARTIN J. BLUNT

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Direct Examination by Mr. Brock	2092/7
Cross-Examination by Mr. Cernich	2184/9

P R O C E E D I N G S

(THURSDAY, OCTOBER 10, 2013)

(MORNING, AFTERNOON SESSION)

(OPEN COURT.)

08:05:27 6 THE COURT: Good morning, everyone. Just give me one  
08:05:30 7 second. Give you guys a heads-up on the time, but I forgot mine  
08:05:43 8 back on my desk, so I am going to ask Ben to tell everybody what  
08:05:47 9 the clock time is.

08:05:50 10 THE LAW CLERK: For the United States, you have used  
08:05:52 11 11 hours and 6 minutes, you have 33 hours and 54 minutes remaining;  
08:05:56 12 BP has used 10 hours, 39 minutes. You have 34 hours and 21 minutes  
08:06:00 13 remaining.

08:06:01 14 THE COURT: All right. Okay. Preliminary matters?

08:06:06 15 MR. REGAN: Yes, your Honor, Matt Regan on behalf of BP.  
08:06:09 16 I have a series of exhibits to offer, and I will do them one at a  
08:06:13 17 time just for clarity on the record. First, BP offers the exhibits  
08:06:16 18 used with Dr. Pooladi-Darvish.

08:06:19 19 THE COURT: All right. Any objection? Hearing none,  
08:06:22 20 those are admitted.

08:06:23 21 MR. REGAN: BP offers the exhibits used with Dr. Kelkar.

08:06:27 22 THE COURT: Any objection? No objection, those are  
08:06:29 23 admitted.

08:06:30 24 MR. REGAN: BP would now offer the exhibits it used with  
08:06:34 25 Dr. Zick.

08:06:35 1 THE COURT: No objection, those are admitted.

08:06:37 2 MR. REGAN: BP offers the exhibits it used with  
08:06:40 3 Dr. Griffiths.

08:06:40 4 THE COURT: No objection, those are admitted.

08:06:42 5 MR. REGAN: And BP --

08:06:43 6 THE COURT: You're on a roll here, Mr. Regan.

08:06:47 7 MR. REGAN: BP offers the exhibits it used with  
08:06:50 8 Dr. Dykhuizen.

08:06:50 9 THE COURT: Any objection? All right, those are  
08:06:52 10 admitted.

08:06:53 11 MR. REGAN: Thank you, your Honor.

08:06:56 12 MR. LANGAN: Your Honor, Andy Langan for BP. Last night  
08:06:59 13 we sent a letter about the deposition designations for  
08:07:02 14 Dr. Bushnell. The DOJ has responded. I think we're essentially in  
08:07:07 15 agreement. So I wanted to tell you --

08:07:10 16 THE COURT: Ben told me this morning, and I have not had  
08:07:13 17 a chance to look at it.

08:07:14 18 MR. LANGAN: Perhaps, I don't know, but perhaps we can  
08:07:16 19 cut through this and save everybody some time and trouble.

08:07:19 20 THE COURT: Okay.

08:07:20 21 MR. LANGAN: So I believe, and counsel can correct me,  
08:07:23 22 that we've agreed that there is not going to be any submission of a  
08:07:25 23 Bushnell deposition bundle. We may disagree as to why that is, but  
08:07:29 24 the bottom line is there is not going to be a submission of a  
08:07:33 25 Bushnell deposition bundle.



08:07:35 1           Second thing is I think the DOJ said the other day,  
08:07:38 2           yesterday or the day before, and I have confirmed, that there is  
08:07:40 3           not going to be a Bushnell report proffered or admitted in any way.

08:07:45 4           THE COURT:   Correct, too?

08:07:46 5           MS. HIMMELHOCH:   Yes, your Honor.

08:07:48 6           MR. LANGAN:   And, finally, our position is Magistrate  
08:07:50 7           Judge Shushan's September 12th order still stands. I don't know if  
08:07:54 8           the DOJ agrees or not, but -- I am not sure how important that is,  
08:07:58 9           but our position is it still stands. And that's essentially where  
08:08:02 10          we are.

08:08:02 11          THE COURT:   I've made occasional exceptions to the order,  
08:08:06 12          put it that way.

08:08:08 13          MR. LANGAN:   Understood. Thank you, your Honor.

08:08:13 14          MS. PENCAK:   Good morning, your Honor, Erica Pencak for  
08:08:16 15          the United States. With respect to the exhibits that were used by  
08:08:19 16          the United States with Dr. Dykhuizen on Monday, there is still one  
08:08:23 17          objection from BP to those. Would you like to speak to that?

08:08:30 18          MR. REGAN:   Sure. Your Honor, Matt Regan on behalf of  
08:08:34 19          BP. The exhibit is TREX 11191, which I believe is a Post-it note  
08:08:39 20          that was used with Dr. Dykhuizen. Dr. Dykhuizen did not have  
08:08:44 21          foundation for the document, and what he cited was a deposition of  
08:08:47 22          Trevor Hill, who also said he didn't know who wrote the document.

08:08:50 23                 The government contends that it was written by a  
08:08:53 24          Dr. Saidi, but they didn't ask Dr. Saidi about the document. So we  
08:08:58 25          don't think the document has foundation, and we object to its

08:09:02 1 admission through an expert who is relying on Trevor Hill, because  
08:09:05 2 we don't think that establishes foundation either.

08:09:08 3 MS. PENCAK: Thank you. Yesterday the deposition clip of  
08:09:12 4 Trevor Hill was played discussing this TREX, which is 11191, and he  
08:09:18 5 said that based on context, more likely than not, it was Ms.  
08:09:23 6 Saidi's handwriting. Also Monday in court, your Honor did allow  
08:09:27 7 the witness to testify about the exhibit.

08:09:29 8 THE COURT: I did. I didn't recall what he said. I'll  
08:09:32 9 look -- you all submitted -- we have the deposition transcript of  
08:09:35 10 Mr. Hill, Ben? We'll look at that and make a ruling on that.

08:09:40 11 MS. PENCAK: Thank you, your Honor. One other matter. I  
08:09:42 12 have the list of the exhibit callouts and demonstratives used by  
08:09:45 13 the United States with Dr. Zick. There have been no objections to  
08:09:49 14 that list.

08:09:49 15 THE COURT: All right. Without objection, those are  
08:09:52 16 admitted.

08:09:53 17 MS. PENCAK: Thank you, your Honor.

08:09:54 18 THE COURT: Sure. Anything else? All right. BP can  
08:09:58 19 call its first witness.

08:09:59 20 MR. BROCK: Your Honor, BP calls Dr. Martin Blunt.

08:10:05 21 THE COURT: Okay. I have not seen any sort of *Daubert*  
08:10:11 22 motion or any other motion in limine regarding Dr. Blunt; is that  
08:10:15 23 correct?

08:10:17 24 MR. CERNICH: That's correct, your Honor.

08:10:22 25 THE DEPUTY CLERK: If you'll raise your right hand.

08:10:23 1 (WHEREUPON, MARTIN J. BLUNT, WAS SWORN IN AND TESTIFIED AS  
08:10:28 2 FOLLOWS:)

08:10:28 3 THE DEPUTY CLERK: If you'll take a seat. If you'll  
08:10:30 4 state and spell your name for the record.

08:10:33 5 THE WITNESS: My name is Martin Julian Blunt, last name  
08:10:37 6 spelled B-L-U-N-T.

08:10:40 7 MR. BROCK: Your Honor, may I approach just to put a  
08:10:42 8 bottle of water on the stand?

08:10:44 9 THE COURT: Sure.

08:10:44 10 MR. BROCK: May I proceed?

08:10:53 11 THE COURT: Yes.

08:10:53 12 VOIR DIRE EXAMINATION

08:10:54 13 BY MR. BROCK:

08:11:02 14 Q. Would you please state your full name and current employment  
08:11:05 15 for the Court.

08:11:06 16 A. Yes, my name is Martin Julian Blunt. I am a professor of  
08:11:10 17 petroleum engineering at Imperial College London.

08:11:13 18 Q. Dr. Blunt, could you pull that microphone up just a little  
08:11:17 19 closer to where you are.

08:11:20 20 A. Does that work?

08:11:22 21 Q. That's better, thank you. Dr. Blunt, what were you asked to do  
08:11:25 22 for BP in this case?

08:11:27 23 A. I was asked to perform an analysis of Macondo reservoir, and  
08:11:33 24 from that analysis to determine the volume of oil that was  
08:11:35 25 released.

08:11:36 1 Q. I want to talk first a little bit about your educational  
08:11:40 2 background, and I have pulled up D-23501, and actually we're going  
08:11:46 3 to address here your educational background and some of your early  
08:11:50 4 industry experience. So if you would share with Judge Barbier a  
08:11:58 5 general summary about your educational background and then what you  
08:12:02 6 did in your first few years of employment in the area of reservoir  
08:12:06 7 engineering.

08:12:07 8 A. Yes. My first degrees and Ph.D. from the University of  
08:12:14 9 Cambridge. My Ph.D. was in physics. When I graduated in 1988, I  
08:12:20 10 worked for BP, their offices in Sunbury, which is near London. I  
08:12:27 11 was working as a reservoir engineer. My work there was principally  
08:12:31 12 on determining better methods for reservoir simulation, better  
08:12:35 13 numerical methods. And those methods were then implemented into a  
08:12:40 14 commercial simulator that BP was using.

08:12:42 15 Q. When you say you were working on reservoir simulation, what do  
08:12:46 16 you mean by that?

08:12:46 17 A. Reservoir simulation is where you model on a computer how fluid  
08:12:54 18 flows underground. As an example, for instance,  
08:12:58 19 Dr. Pooladi-Darvish yesterday presented a reservoir simulation  
08:13:00 20 model. So I was trying to improve the accuracy of models such as  
08:13:07 21 those that have already been presented in this case.

08:13:09 22 Q. What was the result of your work at BP in terms of reservoir  
08:13:14 23 modeling and the other work that you did?

08:13:16 24 A. Well, the main result of my work was an improved numerical  
08:13:24 25 scheme, an improved way of modeling this, that was then implemented

08:13:28 1 into the simulator.

08:13:31 2 I also began what has been a career-long theme of my  
08:13:36 3 work, which is to understand core data and then make predictions of  
08:13:41 4 flow properties.

08:13:43 5 Q. When you say that you have an interest in core data, what do  
08:13:47 6 you mean by that?

08:13:49 7 A. Measurements that are made on core samples, by which I mean  
08:13:52 8 samples of rock that are taken from the reservoir.

08:13:54 9 Q. And why is it important for a reservoir engineer to analyze  
08:13:58 10 core data and understand the meaning of the core data?

08:14:02 11 A. Because those are measurements that are made on the samples of  
08:14:06 12 rock that come from the reservoir, those measurements determine  
08:14:09 13 properties such as permeability that are very important in flow  
08:14:13 14 models that are used to predict oil production and used to design  
08:14:17 15 how you're going to optimize oil production in field.

08:14:20 16 Q. Will you be using those principles as we get into your opinions  
08:14:23 17 in this case?

08:14:23 18 A. Yes, I will.

08:14:24 19 Q. Let me direct your attention now to D-23502, and let's talk a  
08:14:31 20 little bit about what you did after you left BP. And if you would  
08:14:36 21 just remind the Court, how long were you at BP and then in what  
08:14:40 22 year did you make a change of employment?

08:14:42 23 A. So I worked for BP for four years, and in 1992 I was offered a  
08:14:48 24 job working on the faculty of petroleum engineering at Stanford  
08:14:53 25 University. And I was at Stanford for seven years.

08:14:55 1 Q. Why was Stanford University a place that you were interested in  
08:15:02 2 participating -- let me reask that.

08:15:07 3 Why was Stanford University attractive to you?

08:15:09 4 A. I suppose the major reason was I would consider the time. It  
08:15:14 5 was the best petroleum engineering department in the world, and  
08:15:18 6 it's still certainly one of the best. And obviously Stanford is in  
08:15:22 7 a very attractive location and generally fantastic university, and  
08:15:26 8 greatly enjoyed my time there.

08:15:28 9 Q. And what was your area of interest in terms of research and  
08:15:32 10 teaching while you were at Stanford?

08:15:33 11 A. So while I was at Stanford I taught a number of classes, but  
08:15:40 12 the ones most relevant to this case are on reservoir engineering,  
08:15:44 13 which one of the basic concepts that I taught was material balance  
08:15:46 14 which I am going to apply here.

08:15:48 15 In terms of research, there were two strands to my  
08:15:52 16 research, one was continuing the development of better numerical  
08:15:55 17 methods for reservoir simulation, and the other was, again,  
08:15:59 18 understanding fluid flow, the small scale or the scale of little  
08:16:03 19 pieces of rock, particularly the analysis of the flow of oil, water  
08:16:08 20 and gas.

08:16:09 21 Q. Could you focus, Dr. Blunt, on this bullet point here, "Founder  
08:16:13 22 of Streamsim Technologies and winner of the SPE Uren award,  
08:16:19 23 U-R-E-N. And then also research that you did that was sponsored by  
08:16:25 24 the United States government and major oil companies during your  
08:16:28 25 years at Stanford.

08:16:31 1 A. Yes. So as I said, we developed new methods for looking at or  
08:16:35 2 simulating numerical methods, computer methods for looking at flow  
08:16:39 3 in reservoirs, and one of those is based on a technique which is  
08:16:43 4 known as streamlines.

08:16:45 5 So myself and two of my former Ph.D. students in 1996  
08:16:48 6 formed a start-up company that's called Streamsim Technologies,  
08:16:53 7 still operating, based in California.

08:16:55 8 It's not quite correct -- I have been awarded the SPE  
08:16:58 9 Uren award, but, in fact, specifically based on that research, we  
08:17:02 10 were awarded the Ferguson medal from the Society of Petroleum  
08:17:06 11 Engineers, which is for the best paper written by an author under  
08:17:09 12 the age of 33. So we were recognized for the Society of Petroleum  
08:17:13 13 Engineers for that work at the time that I was at Stanford.

08:17:16 14 Q. You've also mentioned here that you have done research for the  
08:17:20 15 United States government and major oil companies. What was that  
08:17:26 16 research and what department of government sponsored your research?

08:17:29 17 A. So the U.S. government sponsorship was from the U.S. Department  
08:17:36 18 of Energy. I received substantial funding from them to look at  
08:17:39 19 what's technically called three-phase flow, that's the flow of oil,  
08:17:44 20 water and gas, and also had sponsorship from a consortium of major  
08:17:49 21 oil companies.

08:17:49 22 Q. Dr. Blunt, after you left Stanford, where did you go?

08:17:54 23 A. I became a professor of petroleum engineering at Imperial  
08:17:59 24 College London, that's my present position.

08:18:00 25 Q. I have up now D-23503, and could you just use this slide to

08:18:06 1 describe for Dr. Barbier a little bit about the history of Imperial  
08:18:11 2 College in the area of petroleum engineering, and then talk about  
08:18:13 3 what you've done there that is pertinent to the opinions that you  
08:18:18 4 bring to the Court today.

08:18:19 5 A. Yes. Imperial College is a technical university in that it  
08:18:25 6 does science, engineering and medicine. And it's always had very  
08:18:30 7 much a sort of practical aspect, so it was very -- it's highly  
08:18:33 8 ranked academically. But we do try and do things that are relevant  
08:18:38 9 to industries in our founding charter.

08:18:43 10 Just a couple of weeks ago, we celebrated our centennial  
08:18:48 11 of petroleum teaching research, I gave a presentation of a  
08:18:49 12 centennial celebration. So we've been working on this for 100  
08:18:51 13 years, 1913 we started.

08:18:54 14 And I've -- as well as being a professor, I've headed up  
08:18:58 15 a research group in this area, petroleum engineering and rock  
08:19:01 16 mechanics research group. And until two years ago, I served as the  
08:19:06 17 head of the department or department chair in the Department of  
08:19:09 18 Earth Science and Engineering. That brings together both  
08:19:11 19 engineers, but also geologists and geophysicists in one department  
08:19:16 20 working together.

08:19:17 21 Q. Did you continue to write and teach subjects about subjects  
08:19:23 22 that are relevant to your opinions in this case?

08:19:26 23 A. Yes. I teach all our master students. These are master  
08:19:30 24 students in petroleum engineering, petroleum geoscience, petroleum  
08:19:36 25 geophysics; so it's over 100 students a year, and I teach material



08:19:40 1 balance. I've thought thousands of students material balance, and  
08:19:43 2 that's essentially the basis of what I am going to present my  
08:19:46 3 calculations today.

08:19:46 4 Q. I want to talk a little bit about industry applications of your  
08:19:51 5 research and some of the work that you've done. I think we've  
08:19:56 6 talked about the streamline -- Streamsim issue, but can I ask you,  
08:20:03 7 have you provided reservoir simulation services for major oil  
08:20:05 8 companies?

08:20:06 9 A. Yes, or at least through Streamsim, it provides essentially  
08:20:12 10 reservoir simulators, so the numerical, the computer tools that all  
08:20:16 11 companies use. And those tools are used by a number of major oil  
08:20:20 12 companies all around the world.

08:20:21 13 Q. And then speak to the issue a little more about iRock  
08:20:26 14 Technologies and what your role is with iRock.

08:20:28 15 A. So this has been a continuing interest of mine ever since when  
08:20:33 16 I was at BP. What it is, is taking samples of rock, small samples  
08:20:38 17 of rock, indeed sometimes very small samples of rock from the  
08:20:42 18 reservoir, imaging, that is looking at what these samples look  
08:20:46 19 like, and from that making predictions, making predictions in  
08:20:50 20 properties such as, for instance, permeability or elastic  
08:20:52 21 properties from which you can get compressibility.

08:20:57 22 This has sort of burst into the commercial domain in the  
08:20:59 23 last few years. In 2010, a company iRock Technologies was founded  
08:21:04 24 by one of my former Ph.D. students. I am the chief technology  
08:21:10 25 officer of that company.

08:21:10 1 BY MR. BROCK:

08:21:13 2 Q. This bullet right here where you talk about providing  
08:21:15 3 predictions of rock properties for major oil companies, can you  
08:21:19 4 describe that work, Dr. Blunt?

08:21:22 5 A. Yes, as I think I said, companies will give us small samples of  
08:21:27 6 rock, and it can be a whole core, they can be a rotary sidewall  
08:21:35 7 core, they can be actually just a chip of rock. We image the rock  
08:21:40 8 so we can look and sort of zoom in and look at what's called the  
08:21:43 9 pore space using an X-ray microscope, and from that we then make  
08:21:47 10 predictions. So we have numerical models, computer models that  
08:21:51 11 make predictions of fluid properties or flow properties.

08:21:54 12 Q. I want to talk about just a couple of other things in terms of  
08:21:59 13 industry background. I've called up now D-23505, and I'll ask you  
08:22:09 14 first, do you have experience consulting with major oil companies  
08:22:14 15 with regard to Gulf of Mexico deepwater reservoirs?

08:22:18 16 A. Yes, indeed I do. I think the main thing here to point out is  
08:22:24 17 Statoil, which is a Norwegian oil company, has a series of  
08:22:27 18 workshops, and I was invited to a workshop a couple of years ago to  
08:22:32 19 discuss reservoir engineering issues associated with deep  
08:22:37 20 reservoirs in the Gulf of Mexico. It's a workshop for a week,  
08:22:42 21 there are only about a dozen people who are invited there. I was  
08:22:46 22 one, I think, of two academics and the rest were leading reservoir  
08:22:51 23 engineers from major oil companies, and we discussed essentially,  
08:22:54 24 brainstormed issues associated with recovery from those reservoirs.

08:22:59 25 Q. We have a second bullet point here, "World's largest sandstone

08:23:05 1 reservoir Kuwait Oil Company hired Dr. Blunt to analyze  
08:23:10 2 measurements from cores."

08:23:11 3 Can you describe your engagement for the Kuwait Oil  
08:23:14 4 Company and how it's relevant to your opinions in this case?

08:23:17 5 A. Yes. And I've worked on this for a few years now. So the  
08:23:24 6 Kuwait Oil Company has the world's largest sandstone reservoir. In  
08:23:29 7 fact, it's the second largest oil reservoir in the world. They  
08:23:32 8 have over 1,000 wells. They've taken measurements from thousands  
08:23:35 9 of cores, and they want to make sense of those measurements. They  
08:23:39 10 say, how can we use these measurements wisely in our reservoir  
08:23:43 11 simulations to predict and manage oil recovery.

08:23:46 12 So I've been given access to all of that data and I've  
08:23:52 13 reviewed all of that data, and including there is measurements of  
08:23:57 14 rock mechanics measurements including pore volume compressibility.

08:24:01 15 Q. Like what you will be discussing today?

08:24:04 16 A. Indeed. That's relevant to the discussion of that today.

08:24:07 17 Q. Last slide on general background. D-23506. I am going to have  
08:24:18 18 to ask you to just brag on yourself just a little bit here,  
08:24:22 19 Dr. Blunt. If you could just describe for the Court the awards  
08:24:25 20 that you have received that recognize the work that you've done in  
08:24:33 21 the area of reservoir engineering.

08:24:35 22 A. Yes. The two major ones that I note, the second and third  
08:24:41 23 there, so two years ago I received an award from the Society of  
08:24:48 24 Petroleum Engineers, and that was the Uren award that you mentioned  
08:24:52 25 previously, and that's for outstanding contributions to petroleum

08:24:55 1 engineering technology made before the age of 45.

08:24:58 2           And then last year I was honored by the Society of Core  
08:25:02 3 Analysts, that's the society that looks at core samples, develop  
08:25:05 4 measurement techniques and how to predict what's going on, so I was  
08:25:09 5 given their Darcy Award. That's for lifetime achievement.

08:25:12 6 Q. In the year that you were awarded the Society of Petroleum  
08:25:18 7 Engineers award for outstanding contributions to the field before  
08:25:21 8 age 45, how many recipients of that award were there that year?

08:25:27 9 A. It was just one, me. There's one award a year.

08:25:29 10 Q. We've talked about Darcy's equation some in this case. The  
08:25:34 11 year that you were given this award for lifetime achievement, how  
08:25:38 12 many recipients were there that year?

08:25:39 13 A. Again, there's one each year.

08:25:42 14 Q. Now, just very quickly in the area of publishing. You say here  
08:25:47 15 200 scientific papers and over 8,000 citations. What's the  
08:25:52 16 reference here to 8,000 citations?

08:25:55 17 A. Okay. Citation means that another engineer or scientist has  
08:26:03 18 referred to my work in one of his or her publications. So that's  
08:26:07 19 happened more than 8,000 times.

08:26:09 20 Q. In the field of petroleum engineering, do you know of any  
08:26:17 21 author who has had their work cited more than 8,000 times?

08:26:21 22 A. Well, it's not something I've really checked in detail, but I  
08:26:25 23 am not aware of anyone else. In fact, the only person I do know  
08:26:29 24 who's got a similar number of citations at least is Professor  
08:26:32 25 Robert Zimmerman, one of my colleagues at Imperial, and he is one

08:26:36 1 of the BP-retained experts in this case.

08:26:40 2 MR. BROCK: Your Honor, at this point, we would tender  
08:26:42 3 Dr. Blunt as an expert in reservoir and petroleum engineering.

08:26:47 4 THE COURT: Any objection? Without objection, he is  
08:26:50 5 admitted -- accepted, I mean.

08:26:54 6 DIRECT EXAMINATION

08:26:55 7 BY MR. BROCK:

08:26:56 8 Q. Dr. Blunt, let me turn now to your approach to the case. What  
08:27:00 9 method did you use to determine the cumulative flow of oil from the  
08:27:06 10 Macondo reservoir?

08:27:06 11 A. I used the material balance method.

08:27:08 12 Q. And how did you decide what method to use?

08:27:13 13 A. It was based on my review of the data, the information that we  
08:27:25 14 had pertaining to Macondo, obviously in the light of my expertise.

08:27:31 15 Q. Did you consider methodologies other than material balance?

08:27:35 16 A. Yes, I did.

08:27:36 17 Q. Can you describe for the Court other methodologies where you  
08:27:41 18 have expertise that you've considered and the reasons that you did  
08:27:46 19 not use those methodologies and instead chose material balance?

08:27:50 20 A. Yes. In fact, when I was first retained on this case, which  
08:27:54 21 was about two years ago, initially I considered using the reservoir  
08:27:58 22 simulation method, so conceptually similar to the approach that  
08:28:03 23 Dr. Pooladi-Darvish has used. But I decided actually quite quickly  
08:28:08 24 to abandon that approach.

08:28:11 25 Q. Why is that?

08:28:11 1 A. Well, it's not actually the reservoir simulation itself that I  
08:28:17 2 considered the issue here. It's that you couple a model of the  
08:28:21 3 reservoir underground with the well, so you have to simulate the  
08:28:26 4 fluid flow not just through the reservoir, but the potentially  
08:28:30 5 restricted flow into the well, the flow up through the well, and  
08:28:33 6 the flow through the surface equipment. So you have to have a  
08:28:36 7 couple model. That's completely standard in reservoir engineering.  
08:28:40 8 There's nothing unusual necessarily about it, but --

08:28:44 9 Q. Go ahead.

08:28:45 10 A. But the difficulty in this case is it's a complex calculation  
08:28:50 11 even if, for instance, we're looking at the final day. At that  
08:28:57 12 time, there aren't many impediments to flow downhole. There was at  
08:29:01 13 least some understanding of the surface equipment, so you can do a  
08:29:04 14 calculation. And calculations have been presented already.

08:29:07 15           The problem is that the restrictions downhole have  
08:29:12 16 changed over time. We know that there were restrictions at the  
08:29:17 17 beginning of the accident that weren't there at the end. We know  
08:29:21 18 there have been lots of changes to the configuration of the surface  
08:29:24 19 equipment.

08:29:25 20           And then there's the problem of erosion. Now, I am not  
08:29:27 21 an expert in this area and not pretending that I would know, so  
08:29:30 22 when I was looking at this problem, I said, well, that quotes  
08:29:35 23 outflow performance, the flow into the well up through the well and  
08:29:38 24 the surface equipment.

08:29:39 25 Q. In the context of modeling when you use the term "outflow

08:29:42 1 performance," what is that; and if that's a challenge here, why is  
08:29:46 2 that?

08:29:47 3 A. It's a challenge because it's difficult to calculate at any one  
08:29:51 4 time and it's very difficult to know how it varied over time. So  
08:29:57 5 my view there was I couldn't have a good quantitative description  
08:30:05 6 of the outflow performance as a function of time.

08:30:08 7 Q. How did the experts that engaged in modeling in this case deal  
08:30:14 8 with that issue, just generally?

08:30:16 9 A. In general what appears to have happened is made a calculation  
08:30:21 10 of outflow performance normally near the end of the spill and then  
08:30:25 11 simply asserted that that's remained constant throughout the spill  
08:30:29 12 period or possibly allowed a short period at the beginning of the  
08:30:35 13 accident where that changed.

08:30:37 14 And the problem I have is having reviewed all of the  
08:30:43 15 expert reports in this case, I haven't seen what I've described as  
08:30:48 16 a precise, accurate quantification of how the outflow performance  
08:30:54 17 varied over time.

08:30:55 18 Q. Dr. Blunt, did you prepare a report in support of the material  
08:31:01 19 balance methodology that you elected to use in this case?

08:31:06 20 A. Yes, I did.

08:31:07 21 Q. I am going to put up D-23507. And is this the cover page to  
08:31:16 22 your report?

08:31:16 23 A. Yes, it is.

08:31:19 24 MR. BROCK: Your Honor, at this point, we would offer  
08:31:21 25 Dr. Blunt's report, which is TREX 011553R, into evidence.

08:31:31 1 THE COURT: All right. Any objection? Without  
08:31:34 2 objection, it's admitted. Is there only a single report?

08:31:39 3 MR. BROCK: It's just a single report, yes.

08:31:40 4 THE COURT: Okay.

08:31:41 5 BY MR. BROCK:

08:31:42 6 Q. Dr. Blunt, at a high level, what did you do to prepare this  
08:31:45 7 report?

08:31:47 8 A. What I did was I reviewed all of the data pertinent to the  
08:31:55 9 Macondo reservoir, and then I used that data in the light of my  
08:31:59 10 knowledge and experience and review of the scientific literature to  
08:32:03 11 perform a calculation of how much oil was released.

08:32:05 12 Q. Now, I want to pull up D-23508, and I'd like for you to state,  
08:32:17 13 Dr. Blunt, your view as to the cumulative oil released, and then  
08:32:22 14 I'll ask you some questions about these other bullet points here.

08:32:26 15 A. My best estimate of the cumulative oil released is 3.26 million  
08:32:33 16 stock-tank barrels. I have considered a range based on the range  
08:32:39 17 of measured data, and that range is between 2.9 and 3.7 million  
08:32:47 18 stock-tank barrels.

08:32:49 19 Q. When you say here, or we say here in this next bullet point  
08:32:52 20 that you helped us put together, "U.S. estimates higher than  
08:32:57 21 3.7 million stock-tank barrels dishonor measured data and ignore  
08:33:02 22 scientific facts and engineering methods." Can you give the Court  
08:33:07 23 just a quick overview of what you mean by that? We're going to get  
08:33:11 24 into some of the detail as we go through, but just at a high level  
08:33:14 25 what do you refer to there?



08:33:16 1 A. Because all of the details are in my report. But what I am  
08:33:19 2 mentioning here is we do have data that enables me to do my  
08:33:22 3 calculation, actually good quality data. If you come up with an  
08:33:28 4 estimate that's more than 3.7 million stock-tank barrels, you've  
08:33:31 5 had to dishonor that data, you've had to disregard some of the  
08:33:34 6 measured data pertinent to this case, and/or you've had to  
08:33:40 7 disregard fundamental physical phenomena.

08:33:47 8 Q. We'll talk about that a little bit as we go. One issue on  
08:33:50 9 methodology here I would like to ask you about. Several of the  
08:33:53 10 experts for the United States have talked about uncertainty ranges.  
08:33:59 11 We've heard about 10 percent, 12 percent, 20 percent, 30 percent,  
08:34:05 12 30 percent plus. Is your range here, this 2.9 to 3.7, is that an  
08:34:14 13 uncertainty range?

08:34:17 14 A. No, I wouldn't describe it in that way. Let me do describe  
08:34:24 15 what I've done. That is the range that honors the data, so from  
08:34:29 16 the data I was given, those are the range of values consistent with  
08:34:35 17 that. But, in doing my calculations there have been a number of  
08:34:41 18 times where a certain degree of judgment could be used. And where  
08:34:45 19 that has happened I've made the judgment, a reasonable judgment,  
08:34:51 20 that would lead to the highest amount of oil released.

08:34:55 21 So this isn't really an uncertainty range. I am not  
08:34:58 22 saying, for instance, it's not possible that the oil release could  
08:35:01 23 be less than 2.9 million. It's more of a range that's consistent  
08:35:04 24 with the data and a reasonable upper bound on that.

08:35:07 25 So I am pretty sure, as I sit here, that the data does

08:35:13 1 not support a number that's higher than 3.7, and my best estimate  
08:35:16 2 under those conservative assumptions is around 3.26.

08:35:20 3 Q. Just for purposes of giving an example, what's an example of an  
08:35:26 4 area in which you have elected to use a conservative number if  
08:35:33 5 there's a question about a data point?

08:35:37 6 A. Okay. I'll give you two examples because I think they're the  
08:35:40 7 two most significant here.

08:35:42 8           The first is we're going to talk about the connected oil  
08:35:48 9 volume, and to determine that I need a determination of  
08:35:51 10 permeability. And I discuss in my report a number of different  
08:35:55 11 determinations of permeability, but in the end, I used the highest  
08:35:59 12 possible value, which is what's called the P10, the highest  
08:36:02 13 plausible value that's been determined by Professor Gringarten.  
08:36:06 14 There are other determinations that are slightly lower, it's  
08:36:09 15 certainly higher than his mid range or best case. I've taken the  
08:36:13 16 upper bound.

08:36:14 17           The other one is -- are we going to talk about this  
08:36:18 18 because it affects one of the key inputs into my calculations, is  
08:36:21 19 this issue of cooling. And we're going to talk about wellbore  
08:36:24 20 cooling, or at least I discuss it in my report. I completely  
08:36:28 21 ignore the fact that the cold ocean will cool the oil. Clearly, if  
08:36:34 22 you include that, you get more cooling. So again, very much erring  
08:36:39 23 on the side of allowing more oil to be released. I don't think  
08:36:43 24 they're unreasonable assumptions, but they're certainly assumptions  
08:36:47 25 that are on the generous side.

08:36:48 1 Q. And again, generally, we'll look at this in a little more  
08:36:53 2 detail as we go. But can you summarize the difference between your  
08:36:56 3 approach to measured data and judgment calls and decisions that  
08:37:02 4 witnesses for the United States have made about those same types of  
08:37:06 5 issues?

08:37:08 6 A. Yes. As I said, I've followed best scientific practice. I've  
08:37:15 7 primarily based my calculations on the prime resource material;  
08:37:20 8 which is, what were the measurements? What were the measurements  
08:37:23 9 on Macondo? On the field as a whole? On the samples that were  
08:37:28 10 taken from the field? On both the fluid and the rock samples? And  
08:37:32 11 I've also considered, you know, the fundamental physics, hot  
08:37:37 12 things, cool down. I've looked at the geology.

08:37:40 13 In contrast, again as discussed in my report in detail,  
08:37:44 14 in many significant respects, the U.S. government experts have  
08:37:48 15 disregarded experimental data without scientific foundation, or --  
08:37:54 16 and/or they have ignored -- they haven't looked at the geology.  
08:37:58 17 And they've said that hot things don't cool down for some reason.

08:38:02 18 So there are a number of different cases where they've  
08:38:07 19 simply not followed best practice, ignored fundamental scientific  
08:38:11 20 phenomena, and disregarded the data.

08:38:13 21 Q. Thank you, Dr. Blunt. Let's turn, now, to a discussion of what  
08:38:20 22 you did in this case, and I guess we'll just ask this for the  
08:38:24 23 record. In terms of the study that you undertook to arrive at your  
08:38:30 24 conclusion on cumulative flow, did you study the Macondo reservoir?

08:38:34 25 A. I studied the Macondo reservoir, yes. I am a reservoir

08:38:39 1 engineer.

08:38:39 2 Q. So just with that as a set up, we have a demonstrative up now.  
08:38:43 3 It's D-23509. That is basically just a teaching model, but can you  
08:38:50 4 just walk Judge Barbier through how this model reflects how a well  
08:39:00 5 flows through a reservoir, and some of the information that you can  
08:39:05 6 derive predrill about the reservoir as well as information you can  
08:39:11 7 derive after the well is drilled.

08:39:13 8 A. Well, let's -- the focus of my work and, in fact, everything I  
08:39:21 9 do, is deep underground. It's often quite difficult to sort of get  
08:39:25 10 that focus. So actually, what I proposed here is just some simple,  
08:39:29 11 essentially, teaching tools, if you don't mind, your Honor.

08:39:33 12           So here I've just got some sand. There's nothing special  
08:39:36 13 about this sand. It's just ordinary beach sand. And you can see  
08:39:40 14 the little grains of sand. Why am I talking about this? If we  
08:39:44 15 were to look out to the Mississippi, we see that the Mississippi is  
08:39:47 16 flowing and it's ladened with tons and tons and tons of this sand.  
08:39:52 17 Where does this sand come from? It comes from eroding the meltings  
08:39:57 18 of the continental U.S. grain by grain. And the Mississippi and  
08:40:03 19 its antecedents have been doing this for at least the last 50  
08:40:08 20 million years --

08:40:09 21 Q. Fifty?

08:40:10 22 A. Fifty. So for millions of years thousands and thousands and  
08:40:15 23 thousands of tons of sand have been eroded away, brought down  
08:40:20 24 through the Mississippi, and then dumped into the Gulf of Mexico.

08:40:26 25           As well as that, of course there's mud. That's why when

08:40:29 1 you look at the Mississippi it looks cloudy, so there's a mixture  
08:40:32 2 of sand and mud.

08:40:34 3           So what happens? As you deposit all of this sand at the  
08:40:41 4 seabed, but we're depositing more and more sand. So if I sort of  
08:40:46 5 indicate here, this is the seabed. We have lots and lots of sand,  
08:40:51 6 even today, being deposited in the Gulf of Mexico. Well, of  
08:40:55 7 course, if you're doing this over millions of years, you're going  
08:40:58 8 to get a huge column of sand. And, in fact, when we were looking  
08:41:03 9 at Macondo it was deposited probably about 13 million years ago and  
08:41:08 10 it's about 13,000 feet below the seabed.

08:41:13 11           So if you think about it, well, is it still sand? As you  
08:41:18 12 can imagine with 13,000 feet of sediment weighing down on it, these  
08:41:26 13 grains of sand are crushed. It's hot, it's boiling hot that deep.  
08:41:33 14 What happens is the sands get crushed and fused together and you  
08:41:36 15 form something like this. A solid piece of rock.

08:41:40 16           Now, I'll say straight away, this isn't a piece of  
08:41:43 17 Macondo rock. It's, in fact, a Bentheimer sandstone from a quarry  
08:41:49 18 in Germany. But the reason why I am showing it is this is more or  
08:41:54 19 less a pure quartz sand, basically sand crushed together. That's  
08:41:59 20 more or less the mineralogy of Macondo.

08:42:03 21           The porosity, which is how much is solid and how much is  
08:42:06 22 still there in these microscopic gaps between the sand grains, is  
08:42:11 23 about the same as Macondo. It's about the same as was measured on  
08:42:14 24 Macondo. So we have, when we're looking at Macondo as a reservoir,  
08:42:19 25 what we're thinking about here is rock like this. The oil is

08:42:24 1 contained in microscopic pores between the sand grain. You can't  
08:42:31 2 see them with the naked eye. You would need a microscope to see  
08:42:35 3 those. And the oil flows through that, and of course, as you can  
08:42:39 4 imagine, the rock is under very high pressure as, indeed, are the  
08:42:42 5 fluid.

08:42:43 6 Q. Is reservoir engineering the study of how this oil that we've  
08:42:48 7 depicted here, and I will let you describe this for the Court  
08:42:50 8 instead of me doing it, but how oil will flow through this  
08:42:55 9 sandstone and be produced from a well? Is that what reservoir  
08:43:01 10 engineering does?

08:43:02 11 A. Yes.

08:43:02 12 Q. So just if we use this as just a teaching tool, Dr. Blunt, can  
08:43:09 13 you just describe for the Court what we've depicted here and what  
08:43:11 14 the effect is of drilling a well into a sandstone reservoir, like  
08:43:20 15 the demonstrative that you have shown to the Court today?

08:43:23 16 A. Yeah. I have to say, one of the sort of I want to say  
08:43:26 17 conceptual challenges of reservoir engineering are the leaps and  
08:43:30 18 scale. In this picture, that's 13,000 feet, so it's several miles.  
08:43:35 19 What we're showing here in black are bits of sandstone, and the  
08:43:40 20 black is to indicate that it contains oil.

08:43:43 21 The green, you might say, "Well, what's this sort of the  
08:43:47 22 greeny color?" I mentioned the mud in the Mississippi. What  
08:43:50 23 happens to the mud? Well, that also gets deposited, that also gets  
08:43:54 24 crushed down at high temperatures and pressure. That forms shale.  
08:43:57 25 So in Macondo surrounding the sandstone is shale. The shale

08:44:02 1 doesn't allow flow.

08:44:03 2           So you have these channels of sand containing oil. These  
08:44:07 3 channels may be up to a mile or so wide. They're going to extend  
08:44:12 4 out of the plane of the picture and meander several miles. Macondo  
08:44:16 5 is about five miles long. It's a reservoir.

08:44:19 6 Q. So when you drill a well -- just zooming in a little bit now --  
08:44:25 7 if you drill a well into a reservoir, what effect is that going to  
08:44:32 8 have on the sandstone reservoir and how -- what are the things that  
08:44:36 9 derive production of the oil through that sandstone to the well?

08:44:42 10 A. So, your Honor, in normal oilfield operations and also in  
08:44:49 11 Macondo, of course, you drill a well deep underground; and in  
08:44:53 12 Macondo, it contacted some oil bearing sandstone. The oil is at  
08:45:01 13 very, very high pressures. It's about 800 -- in Macondo, about 800  
08:45:06 14 times normal atmospheric pressure. Of course, the well, that's a  
08:45:09 15 conduit to the surface at lower pressure, flow goes from high to  
08:45:13 16 low pressure.

08:45:14 17           So what happens is you drill the well. When oil flows,  
08:45:19 18 what happens is you go from high pressure to low pressure.

08:45:23 19 Q. I have the pressure gauge moving now.

08:45:25 20 A. The pressure decreases, the oil is expanding and moving out  
08:45:30 21 into the well, and that's your oil production. And what we've  
08:45:33 22 shown here is the sort of light gray is supposed to indicate the  
08:45:38 23 oil at lower pressure. That's oil that's flowed to the well. You  
08:45:41 24 don't necessarily -- you don't drill one well that connects the  
08:45:44 25 entire field, so you can have some regions of sandstone there that

08:45:48 1 weren't connected to the well, so they stay unaffected.

08:45:51 2 Q. Now, in terms of how you apply your discipline to this process,  
08:45:59 3 what do you do, Dr. Blunt to try to understand the ability of the  
08:46:05 4 well to flow -- of the reservoir to flow to the well?

08:46:09 5 A. Well, you need to understand the properties of the fluid and  
08:46:15 6 rock, and you need to use measurements of pressure. So  
08:46:18 7 essentially, the data you need is, well, what's the extent of the  
08:46:23 8 whole field? How much of that field is connected to the well?  
08:46:26 9 What are the properties of the rock that you measure from taking  
08:46:30 10 out rock samples? What are the properties of the fluid and what's  
08:46:34 11 the change in pressure?

08:46:35 12 Q. And is that information that is available to you for this case  
08:46:40 13 in order to utilize the material balance equation?

08:46:43 14 A. Yes, it is, your Honor. And in my opinion, actually, quite  
08:46:46 15 good quality data as well.

08:46:48 16 Q. I want to talk about that just for a second. This is a  
08:46:51 17 demonstrative that we used in opening statement, but you can see  
08:46:56 18 that we've depicted April 12th MDT pressure and fluid samples, and  
08:47:03 19 April 14th core samples. I don't want to get into too much detail  
08:47:08 20 here on these, but how is this information helpful to you,  
08:47:12 21 Dr. Blunt, in formulating your opinion that the material balance  
08:47:19 22 equation is an appropriate and good tool to answer this question?

08:47:23 23 A. Well, your Honor, material balance is simply conservation of  
08:47:27 24 mass. So what you do is you work out how much oil was connected to  
08:47:32 25 the well to begin with, and then in the end when the flow stops,



08:47:36 1 how much oil was left. The difference is how much oil was  
08:47:40 2 produced. So to do that -- and this is what's pointed out, I  
08:47:45 3 think, with the data is -- you need to know how much oil was there  
08:47:47 4 to begin with. You have a seismic survey that looked at the extent  
08:47:51 5 of the field that was done before drilling --

08:47:53 6 Q. The seismic survey is not depicted here, but that occurred at  
08:47:56 7 an earlier point in time.

08:47:57 8 A. That was even earlier, right.

08:47:59 9 Q. And it was a predrill data point for you to utilize in thinking  
08:48:03 10 about the size of the reservoir?

08:48:05 11 A. Yeah.

08:48:06 12 Q. And we'll talk about that.

08:48:08 13 A. And then before the accident, there was what's called an MDT  
08:48:12 14 tool that measured the initial pressure, so I know where we start.  
08:48:16 15 Fluid samples were taken from the reservoir, so we know about the  
08:48:18 16 properties of the fluids. A couple of days later core samples were  
08:48:23 17 drilled out of the reservoir, and so we got some idea of the rock  
08:48:26 18 properties.

08:48:26 19 Then we need to know -- so that's enough for us to know  
08:48:30 20 what happened, you know, how much oil was there to begin with. We  
08:48:33 21 need to know the final state of the reservoir, and for that,  
08:48:37 22 principally, we need to know the final pressure.

08:48:39 23 Q. And is that information also available to you through the final  
08:48:43 24 measured pressure over here that we've depicted as the August 3rd  
08:48:48 25 entry?

08:48:48 1 A. Indeed. So there were pressure measurements made on the  
08:48:52 2 capping stack just before the well was closed and for 19 days  
08:48:56 3 afterwards. And again, it's described in my expert report. This  
08:49:00 4 19 days of pressure measurements are extremely valuable for  
08:49:04 5 determining a number of important things, of which the most  
08:49:08 6 important one was what the final pressure was.

08:49:10 7 Q. Now, in the middle here we've depicted 86 days of flow and some  
08:49:14 8 of events that could be seen and things that were known during the  
08:49:20 9 life of the well. Are these items that we have depicted here some  
08:49:25 10 of the challenging -- challenges to using a hydraulics model to  
08:49:31 11 solve this question?

08:49:33 12 A. Indeed. That's the beauty of the material balance analysis, it  
08:49:38 13 doesn't matter what happened in between. As long as you know where  
08:49:41 14 you started and where you ended up, you know the cumulative. If  
08:49:45 15 you have a hydraulics approach, you need to know every detail and  
08:49:49 16 nuance of what was happening for 86 days.

08:49:52 17 Now, if you did know that, it's not that the material  
08:49:56 18 balance approach is invalid, you would come up with a calculation  
08:50:00 19 that has to be consistent with material balance, but it might help  
08:50:04 20 refine the uncertainty, reduce your uncertainty.

08:50:07 21 But in my opinion, as I said, I haven't seen anyone who  
08:50:11 22 has really quantified how this varied over time.

08:50:14 23 Q. Dr. Blunt, you were here yesterday when Dr. Kelkar testified  
08:50:20 24 that the amount of oil that spilled from the Macondo well can be  
08:50:24 25 accurately estimated using the material balance. Did you hear

08:50:27 1 that?

08:50:28 2 A. Yes.

08:50:28 3 Q. And do you agree with that?

08:50:30 4 A. Yes, I do.

08:50:31 5 Q. Now, I want to turn our attention to D-23511A. And just in  
08:50:43 6 terms of the Court's understanding of material balance and how it  
08:50:49 7 works in simple terms, have you helped us develop an analogy using  
08:50:55 8 a truck that can be used to explain what we're doing with material  
08:51:01 9 balance to solve for the problem of quantity of oil?

08:51:04 10 A. Yes. This is an analogy, your Honor, to maybe try and  
08:51:10 11 understand what material balance is and to help motivate the three  
08:51:14 12 key inputs that we are going to have into the equation.

08:51:17 13 So we've illustrated here a truck. What the key thing  
08:51:20 14 here is, imagine you have a truck and you've got a leaking tire so  
08:51:26 15 you're going to get a flat tire. And the calculation we're going  
08:51:30 16 to do in this analogy is how much air has come out of the tire.

08:51:35 17 Q. I am going to flatten the tire.

08:51:37 18 A. We have the little video. So what we want to know is how much  
08:51:43 19 air came out of the tire. Well, when you first pumped up the tire  
08:51:49 20 you inflate the tire, you have a pressure gauge, so you measure  
08:51:52 21 what the pressure is, you know what the pressure was to begin with.

08:51:54 22 Now the tire is deflated. You can also measure the  
08:51:59 23 pressure. It's going to be a lower pressure, of course, and the  
08:52:01 24 amount of air that's come out of the tire is going to be  
08:52:04 25 proportional to that pressure drop, that change in pressure.

08:52:09 1 Exactly analogous to Macondo, the initial pressure was measured,  
08:52:13 2 capping stack pressures were measured, and again, as detailed in my  
08:52:16 3 expert report, you can, then, work out with reasonable accuracy  
08:52:19 4 what the final pressure was, so what the pressure drop was.

08:52:22 5 But that's not everything. It's not just pressure. The  
08:52:26 6 next thing that, again, hopefully is reasonably obvious, is if you  
08:52:30 7 have a big truck tire, you're going to release more air than if you  
08:52:34 8 had a small bicycle tire. So the amount of air that's released is  
08:52:38 9 proportional to how much air you had in the tire to begin with.  
08:52:42 10 Exactly the same as in Macondo. One of the key inputs is how much  
08:52:46 11 oil was there originally that could flow to the well. That's the  
08:52:51 12 second input.

08:52:52 13 Then there's a third input. And the Court has already  
08:52:58 14 heard quite a lot of discussion about this third input, so it is  
08:53:02 15 important, and it's technically called the compressibility. Let me  
08:53:07 16 explain it with air. If you're pumping up a bicycle tire and you  
08:53:13 17 press on the air, it compresses. If you release the pressure, it  
08:53:19 18 expands. Now, when you're talking about air in this tire, the air  
08:53:23 19 is expanding because it starts off at high pressure and then goes  
08:53:27 20 to low pressure and it expands. But we use the word  
08:53:30 21 compressibility anyway. We're really talking about expandability,  
08:53:33 22 but it's compressibility.

08:53:37 23 Q. This is another one of the petroleum engineering backwards  
08:53:40 24 terms that we are struggling with?

08:53:42 25 A. Yes, it's a backwards term. And you can't blame petroleum

08:53:45 1 engineers, it's universal in science.

08:53:49 2           So in Macondo, it's exactly the same. You've got the oil  
08:53:52 3 at very high pressures. As the pressure drops that oil expands and  
08:53:58 4 we need to know the compressibility of the oil. That was measured  
08:54:01 5 experimentally at three independent service labs, and actually,  
08:54:04 6 among all of the various experts, there's no particular  
08:54:07 7 disagreement over that number.

08:54:08 8           But there's a second feature. We look at this. What  
08:54:13 9 forces the air out of the tire? It's not just the air expanding.  
08:54:18 10 What's the purpose of a tire? The tire is pumped up to high  
08:54:20 11 pressure to keep up the truck, to keep the truck off the road.  
08:54:26 12 When you allow a leak, you've got this heavy truck that's pressing  
08:54:31 13 down on the tire. You've got this elastic tire that's very taut,  
08:54:35 14 and it squeezes and it's pushing out more air.

08:54:40 15           That's exactly what happens in Macondo. We're talking  
08:54:44 16 about this 13,000 feet of sand and rock above the reservoir. You  
08:54:50 17 got the oil at very high pressure. The oil comes out. The oil is  
08:54:55 18 now at lower pressure, and like squeezing a sponge, the huge weight  
08:54:59 19 of rock presses down and it compresses the rock. And that's an  
08:55:05 20 additional contribution. And so there's what I've described here  
08:55:10 21 is the elasticity of the tire. The analogy in Macondo is the rock  
08:55:15 22 compressibility, and that's one key point of disagreement among the  
08:55:18 23 experts in this case.

08:55:19 24 Q. If you used the material balance analogy like we have here and  
08:55:25 25 you have data and information that allows you to understand the

08:55:32 1 amount or volume of oil, the change in pressure, and the elasticity  
08:55:37 2 or the compressibility, can you reliably calculate the amount of  
08:55:43 3 oil that flowed from the well if -- or the amount of air that came  
08:55:49 4 out of the tire if you were solving for that?

08:55:51 5 A. Yes. I mean, this is -- if you imagine this analogy. If you  
08:55:57 6 wanted to know how much air came out of the tire, you multiply  
08:56:00 7 those three numbers together, fundamentally, and that's what we're  
08:56:05 8 doing for the material balance calculation in Macondo.

08:56:07 9 Q. Now, if you were using a hydraulics methodology to try to  
08:56:12 10 understand how much air came out of the tire, and let's say,  
08:56:18 11 hypothetically, that we're looking at a tire that had a puncture on  
08:56:22 12 Day 1 and you're trying to solve for the problem at Day 86, what  
08:56:27 13 would you have to know if you're doing hydraulics modeling to solve  
08:56:31 14 that problem?

08:56:31 15 A. Well, the analogy here, your Honor, would be, yes, imagine you  
08:56:36 16 realized that you had run over a piece of glass about three months  
08:56:39 17 ago and now you have this flat tire. I am going to examine the  
08:56:44 18 tire and look at the hole that I've got at the tire right at the  
08:56:48 19 end. It's not unreasonable to say, if you got a good analysis of  
08:56:52 20 exactly what the hole was like and you know all of the flow  
08:56:54 21 properties and you run the most sophisticated fluid dynamics or air  
08:57:00 22 dynamics codes, you could probably get an estimate of how fast the  
08:57:05 23 air was coming out of the tire on the last day.

08:57:09 24 But you need to know how the air was coming out of the  
08:57:12 25 tire for the last three months. Well, how did that hole evolve

08:57:15 1 over time? How does it depend on, you know, what was in the truck  
08:57:19 2 or how you were driving it? It's a highly uncertain calculation.  
08:57:23 3 In fact, frankly, I don't think anyone would approach the  
08:57:27 4 calculation that way because you would say, but you know the  
08:57:29 5 pressure in the tires to begin with, you knew the pressure at the  
08:57:32 6 end, you would use that information surely.

08:57:34 7           And that's the analogy with Macondo. You know what was  
08:57:37 8 in Macondo to begin with, you calculate what was there at the end,  
08:57:42 9 that's the difference. And you don't need to essentially speculate  
08:57:46 10 about what happened in between.

08:57:49 11 Q. Let's turn to the material balance equation quickly, D-23513,  
08:57:55 12 as on the screen now. Judge Barbier has heard about the formula, I  
08:58:01 13 think you've discussed the components of the formula. I just want  
08:58:04 14 to ask you one question about this before we move forward.

08:58:09 15           We heard yesterday that the use of the material balance  
08:58:14 16 is more uncertain here than the way that it's historically been  
08:58:20 17 used. And I'll just ask you, sir, do you agree with that and then  
08:58:26 18 your response.

08:58:28 19 A. Okay. Let's put it this way, this is exactly the same equation  
08:58:33 20 that was employed by Dr. Kelkar and I don't have any problem with  
08:58:37 21 the equation. And Dr. Kelkar was also quite right to say that  
08:58:41 22 traditionally the equation is used in slightly different way, and  
08:58:44 23 that is, you measure the oil released and use it to find that end  
08:58:49 24 variable how much oil you have underground.

08:58:52 25           So in principle, we're using the slightly different way

08:58:59 1 and the uncertainty, and there is uncertainty, is related to how  
08:59:01 2 uncertain the variables are here. But material balance has been  
08:59:05 3 around for 60 years, and it's quite an old method and it's  
08:59:09 4 traditionally used for oilfields where there isn't actually very  
08:59:14 5 good quality data. In particular, there isn't seismic data. The  
08:59:17 6 sort of good quality seismic data that we're looking at for Macondo  
08:59:20 7 has only been around for a few years. It's much more recent.

08:59:23 8           So while there's still uncertainty in this calculation,  
08:59:27 9 specifically, what Dr. Kelkar mentioned was the uncertainty in N;  
08:59:33 10 but as described in my report, we have good quality seismic data  
08:59:39 11 and that combined with an analysis of the geology and the pressure  
08:59:42 12 enables me to put a robust upper bound on it. Let's not exaggerate  
08:59:48 13 the uncertainties. They do exist, but they don't want to, say,  
08:59:52 14 invalidate this calculation at all.

08:59:54 15 Q. And are there checks on consistency that you can utilize within  
09:00:01 16 your discipline on the issue of the oil volume connected to the  
09:00:05 17 well? I don't want to get into the details of that yet, but are  
09:00:08 18 there consistency checks that can be utilized to verify the  
09:00:13 19 calculations that are made?

09:00:14 20 A. Yes. The other thing, again, that is stressed in Section 5 of  
09:00:20 21 my expert report is, the way it's presented here, it looks like  
09:00:22 22 it's a bit of -- I hate to say this, sort of pick and choose. You  
09:00:27 23 just determine N in isolation, then C, then delta P. But it's not  
09:00:31 24 like that, your Honor. Those three numbers have to fit in a single  
09:00:37 25 coherent picture of the reservoir. The essence of reservoir



09:00:40 1 engineering is does the totality of the data make sense? So I  
09:00:45 2 can't pick any old numbers here. I am certainly going to be  
09:00:47 3 constrained by the data, but even then I have to make sure that  
09:00:51 4 they're all mutually consistent. And that's a final consistency  
09:00:56 5 check that gives confidence that what you're doing is reasonable  
09:00:58 6 and it helps narrow the uncertainty.

09:01:01 7 Q. I want to turn now, just briefly, in order to frame the issues  
09:01:06 8 to areas where there are agreement -- where there is agreement  
09:01:10 9 between you and experts for the United States and where there is  
09:01:14 10 disagreement. And I think I would ask you right now just to focus  
09:01:18 11 on where you and Dr. Kelkar agree and where you disagree in terms  
09:01:25 12 of the components utilized for the material balance equation, and  
09:01:29 13 then we'll get to the details of it.

09:01:31 14 A. Yes. So the green indicates that --

09:01:36 15 Q. I'm sorry. Let me, for the record, say I have up now D-23514.

09:01:43 16 A. It's actually a reproduction of one of the tables in my expert  
09:01:48 17 report.

09:01:48 18 The green basically means in the end, even if we get  
09:01:51 19 there in different ways, there's not a big difference in the  
09:01:54 20 number. And the red is there is a big difference, makes a big  
09:01:57 21 impact on the oil released.

09:01:58 22 So if we look at Dr. Kelkar with his oil volume as he  
09:02:01 23 presented yesterday, he does have a lower bound, or what he  
09:02:05 24 describes as a lower bound of 110 million stock-tank barrels, very  
09:02:09 25 similar to what I have. So that's why there's a bit of green in

09:02:12 1 that box. But he also considers oil volumes that I can show, I can  
09:02:16 2 demonstrate are implausible.

09:02:21 3 For compressibility, and, I think, this is the most  
09:02:24 4 significant point of disagreement between us, he doubles the  
09:02:29 5 measured value without scientific foundation, so that's a big point  
09:02:33 6 of disagreement.

09:02:33 7 The pressure drop -- and again, there's a lot of  
09:02:37 8 discussion about details, and we approach this problem in a very  
09:02:40 9 different way. But in the end, although he noted yesterday that  
09:02:44 10 there was a difference in our pressure drops, and I agree with him  
09:02:47 11 there, it's not that significant. It's not the reason why we have  
09:02:52 12 such different numbers for oil released.

09:02:54 13 Q. Now, let me ask you to focus just for a minute on  
09:02:58 14 Dr. Pooladi-Darvish. Are the inputs that you utilized, that is,  
09:03:04 15 oil connected to well, compressibility, and pressure drop, are they  
09:03:08 16 components of his analysis?

09:03:11 17 A. Yes. There is a point here. Dr. Pooladi-Darvish doesn't  
09:03:17 18 employ material balance, however, material balance is just  
09:03:20 19 conservation of mass. So in his simulation model, you can say, on  
09:03:24 20 how much oil did he have in his model to begin with? How much was  
09:03:27 21 there at the end? And the difference is what was released. And he  
09:03:33 22 has values of oil in place, compressibility, and pressure drop.  
09:03:37 23 And I've checked, and of course, you know, he is using perfectly  
09:03:41 24 reasonable software. You could use a material balance approach to  
09:03:46 25 analyze what's happened.

09:03:47 1           So in the case of Dr. Pooladi-Darvish, his oil volume  
09:03:54 2 certainly for his base case, but for virtually all of his cases, he  
09:03:58 3 is much larger than I consider to be credible.

09:04:03 4           For compressibility, however, he does use the measured  
09:04:07 5 data. So we agree on compressibility. He has a base case of 6  
09:04:10 6 microsips, no problem there.

09:04:11 7           And on pressure drop there is a big disagreement. He  
09:04:15 8 basically has essentially an implausible hot oil in his well.

09:04:19 9 Q. Thank you. And then for Dr. Hsieh, did your review of the  
09:04:24 10 records indicate that he has agreement with you on oil volume?

09:04:27 11 A. Yes.

09:04:32 12           MR. CERNICH: Your Honor, I am going to object to the  
09:04:34 13 discussion of Dr. Hsieh. His expert testimony was excluded here in  
09:04:39 14 the court, and as Dr. Hsieh testified, he received these inputs  
09:04:43 15 from BP.

09:04:46 16           MR. BROCK: This is a chart from his report, your Honor.

09:04:50 17           THE COURT: He didn't have -- Dr. Hsieh testified as a  
09:04:53 18 fact witness.

09:04:54 19           MR. BROCK: This is a demonstrative from Dr. Blunt's  
09:04:59 20 report that has not been objected to. We've given them this  
09:05:03 21 exhibit, it has not been objected to.

09:05:07 22           MR. CERNICH: We're objecting to the testimony, your  
09:05:10 23 Honor. Dr. Hsieh had to be removed from being an expert due to the  
09:05:13 24 Court's limit on experts, and now Professor Blunt is rebutting an  
09:05:18 25 expert who wasn't here, who also testified that these inputs were

09:05:23 1 provided by BP.

09:05:26 2 THE COURT: He testified only as a fact witness, as I  
09:05:29 3 recall, and not as an expert. So to the extent --

09:05:33 4 MR. BROCK: I can move on.

09:05:34 5 THE COURT: Let's do that, it would be easier.

09:05:37 6 BY MR. BROCK:

09:05:39 7 Q. Dr. Blunt, let's now turn to the first variable of the material  
09:05:43 8 balance equation, and that is the connected oil volume. And I'll  
09:05:52 9 just ask you if we look at D-24605, this is just the material  
09:06:03 10 balance equation, and now we're going to discuss oil volume. Do  
09:06:07 11 you see that?

09:06:08 12 A. Yes.

09:06:08 13 Q. And, Dr. Blunt, what is your evaluation of the connected oil  
09:06:17 14 volume at the Macondo reservoir?

09:06:20 15 A. My best determination is that it's 112 million stock-tank  
09:06:28 16 barrels. I do present in my report a range of numbers, and I  
09:06:33 17 considered these to be a robust upper bound on what the connected  
09:06:38 18 oil volume could be.

09:06:39 19 Q. And that's D-24605, Dr. Blunt's connected oil volume of 112  
09:06:49 20 million stock-tank barrels.

09:06:52 21 Dr. Blunt, I am now going to pull up D-24465 and ask you  
09:06:58 22 if you can use this demonstrative to explain to the Court one of  
09:07:02 23 the data points that you utilized for calculating connected oil  
09:07:09 24 volume.

09:07:10 25 A. Okay. So what you see on the left there, your Honor, is a

09:07:16 1 seismic image of the Macondo reservoir. What happens there, this  
09:07:22 2 is before drilling, you send sound waves down through the rock.  
09:07:26 3 The sound waves reflect back up where there are changes in his rock  
09:07:30 4 properties or indeed when there's changes because the fluid has  
09:07:33 5 changed, so you go from water in the pore space to hydrocarbons.

09:07:37 6 What is actually shown here is an interpretation of that  
09:07:40 7 survey performed by BP geophysicists. And the bright colors --  
09:07:47 8 Q. Dr. Blunt, you're doing fine. I was just going to ask you,  
09:07:50 9 just so that Judge Barbier is oriented to this picture, show him  
09:07:58 10 where the Macondo well was actually drilled, and then I think  
09:08:02 11 you're going to get to talking about the reservoir.

09:08:04 12 A. So there's the Macondo well, although this image was done  
09:08:08 13 before drilling. And this is BP's license block, so this is the  
09:08:13 14 scale that's three miles.

09:08:14 15 Q. What are the other two red dots above the Macondo well?

09:08:19 16 A. Those I am having difficulty seeing them. Yes, I can see them  
09:08:22 17 on my screen. Those were other wells that BP planned to drill and  
09:08:26 18 actually did not.

09:08:27 19 Q. I'm sorry I interrupted you, but go ahead.

09:08:30 20 A. So what are the colors indicating? The colors are indicating  
09:08:35 21 how much or what thickness of hydrocarbon-bearing sandstone are you  
09:08:39 22 likely to encounter. So the pale colors, sort of green and yellow  
09:08:45 23 here, means a lot of oil. If you go to the blue, it's less thick.  
09:08:50 24 The purple is even less thick, and the black basically there isn't  
09:08:54 25 any oil.

09:08:55 1           So if you're a geophysicist, you look at this picture and  
09:09:00 2 you need to decide where to drill the well, and it comes as no  
09:09:05 3 surprise that BP targeted their well right in the center of the  
09:09:08 4 thickest portion of sandstone, and that's more or less what they  
09:09:11 5 encountered.

09:09:12 6 Q.   When was this data collected that's reflected in this seismic  
09:09:17 7 image?

09:09:17 8 A.   This was predrill, this is before the accident.

09:09:21 9 Q.   And what did you do with this seismic analysis?

09:09:29 10 A.   So the seismic tells you the total rock volume that holds oil.  
09:09:37 11 And it's -- again, this in itself is not controversial; it's been  
09:09:45 12 adopted by Dr. Kelkar and was the foundation of his calculations.

09:09:48 13 Q.   Why do you get a different number than Dr. Kelkar?

09:09:51 14 A.   The reason is that Dr. Kelkar assumes that all of this volume  
09:09:59 15 is connected to the well. And from his testimony yesterday, it  
09:10:07 16 could be misinterpreted. The seismic survey here is simply looking  
09:10:12 17 at the total volume of hydrocarbon-bearing sandstone, it is not  
09:10:17 18 making a comment on connectivity.

09:10:20 19           That requires additional information, and the additional  
09:10:23 20 information you need to do is you need to study the likely geology  
09:10:27 21 of the field and you need to perform a pressure analysis to  
09:10:31 22 quantify.

09:10:31 23 Q.   Is it a standard reservoir engineering technique or practice to  
09:10:38 24 consider the geology of the reservoir after you have this  
09:10:43 25 information?

09:10:44 1 A. Of course, it's absolutely standard. You create a geological  
09:10:48 2 model, you have a model that's consistent with the pressure because  
09:10:52 3 if we're looking here, you've drilled one well. Do you need to  
09:10:56 4 drill more wells? How much of the oil are you going to produce?  
09:11:00 5 It's absolutely fundamental to understand the connectivity of the  
09:11:03 6 reservoir.

09:11:03 7 Q. I am going to put up now, Dr. Blunt, D-23518. And if you could  
09:11:12 8 just describe for the Court, briefly -- this is actually the cover  
09:11:16 9 page to your report -- what this depicts and how it's relevant to  
09:11:23 10 your evaluation of considering the geology -- let me just ask you  
09:11:30 11 to do that first.

09:11:32 12 A. Okay. So what's shown in the background is sort of a blow-up  
09:11:37 13 of some of the seismic survey. The problem with the seismic survey  
09:11:41 14 is it's an average. You don't know for certain where exactly that  
09:11:48 15 sandstone is located.

09:11:50 16 So this is a picture that was prepared by a BP geologist,  
09:11:56 17 and what he's done is he's placed over that map where it is  
09:12:00 18 possible that there could be channels of sandstone running across  
09:12:05 19 the reservoir.

09:12:07 20 Now, I've performed my own analysis of this as well.

09:12:11 21 Q. Is this part of what you do as a reservoir engineer?

09:12:14 22 A. Yes. You take your geological and geophysical information and  
09:12:19 23 construct a geological model and use it for reservoir engineering  
09:12:22 24 calculations.

09:12:22 25 Q. Have you brought with you today a teaching tool that you might

09:12:28 1 could use to show Judge Barbier how these channels are created and  
09:12:33 2 then how you can sort of see them in three dimensions in terms of  
09:12:37 3 what happens in the reservoir?

09:12:39 4 A. Yes. Certainly. Your Honor, I know it seems a bit strange,  
09:12:45 5 but this hopefully helps you visualize it. What I have got here is  
09:12:49 6 colored modeling clay, as you can see. What this represents is a  
09:12:52 7 sandstone channel. So I said, well, the sand flows out into the  
09:12:57 8 Gulf of Mexico and is dumped on the seabed. How is it, what's the  
09:13:01 9 shape? So, in fact, what we see here is that the sand tends to be  
09:13:05 10 dumped in a sort of meandering channel. And what this strand of  
09:13:08 11 clay is supposed to represent is this is about 100 feet wide, this  
09:13:14 12 meandering channel is several miles long. So that gives you an  
09:13:20 13 idea of the scale.

09:13:21 14 So a whole load of sediment is dumped in this sort of  
09:13:25 15 configuration. Then later you may have another channel that's  
09:13:30 16 deposited in those channels sort of intertwined.

09:13:34 17 Q. This is the process you described earlier that's occurring over  
09:13:37 18 millions of years?

09:13:38 19 A. Yes. And technically, as we see in this picture first, one of  
09:13:42 20 those strands of clay that's a channel, a collection of these  
09:13:46 21 strands of channel is called what's known as a channel complex, and  
09:13:50 22 you then may, over geological time, have a sequence of channel  
09:13:55 23 complexes.

09:13:56 24 So if you'll allow me, your Honor --

09:14:03 25 MR. BROCK: Is it okay if he stands up, Judge, just to



09:14:05 1 show you his model?

09:14:07 2 THE WITNESS: So what I am showing here, your Honor, is  
09:14:09 3 exactly the real clay model, and I've got a picture of this in my  
09:14:13 4 expert report, so I just took a picture of this model. So let me  
09:14:17 5 explain what I am showing you here.

09:14:20 6 These are the so-called channel complexes, the individual  
09:14:24 7 channels. I've overlaid it on the seismic map. So this is the  
09:14:28 8 extent of Macondo, this is about five miles.

09:14:30 9 The channels tend to run in this northwest-southeasterly  
09:14:36 10 direction, meandering through the field, sort of the dome-shaped  
09:14:40 11 structure, so the oil is trapped into this dome. The brown here  
09:14:45 12 represents the shale, the shale below and above and between these  
09:14:51 13 sand channels.

09:14:51 14 And then I said, well, we drill the Macondo well -- just  
09:14:55 15 for simplicity, I have a straw here, that's where the Macondo well  
09:15:01 16 was drilled. It went through three of these channels. The straw  
09:15:04 17 looks a bit crude, but it's actually more or less to scale, this  
09:15:09 18 length of the straw is about 13,000 feet, so it's roughly to scale,  
09:15:11 19 this gives you sort of depth here.

09:15:14 20 Now, what you can see immediately is the well will  
09:15:18 21 connect these sandstone channels, but not necessarily all of them.  
09:15:21 22 What I've simply for illustrative purposes in a different color,  
09:15:25 23 this sort lilac, this sort of purply-gray color, these are channels  
09:15:29 24 that contain oil but are not necessarily connected to the well.

09:15:33 25 Now, this is a geological model. I think it's a

09:15:37 1 perfectly reasonable and plausible model of how the sandstone might  
09:15:41 2 be arranged in Macondo. But I don't know the locations of each  
09:15:45 3 individual channel for sure; I need additional information to  
09:15:48 4 quantify connectivity.

09:15:49 5           So what I'm saying is, this oil is likely to be  
09:15:53 6 connected, this oil is likely not to be (INDICATING).

09:15:57 7 Q. And is one of the principles in standard reservoir engineering  
09:16:02 8 to utilize available data to evaluate how much of the reservoir is  
09:16:09 9 connected to a well site?

09:16:12 10 A. Well, of course, it's absolutely key because if you've got poor  
09:16:17 11 connectivity, you're not going to produce much from your well and  
09:16:19 12 you need to drill more wells. If you have good connectivity,  
09:16:23 13 that's obviously good in normal oilfield operations.

09:16:27 14 Q. Let's look at D-24362, and can you describe for Judge Barbier,  
09:16:34 15 does this show the drilling of a well through three reservoirs sort  
09:16:39 16 of like you demonstrated on -- with your straw?

09:16:42 17 A. So this was a three-dimensional model. What we're doing here  
09:16:46 18 is we're taking a vertical slice through the reservoir where the  
09:16:49 19 well was drilled.

09:16:50 20           Now, this is the one thing we do know, because we drilled  
09:16:53 21 the well, we can take measurements. So we know that the well went  
09:16:57 22 through three of these so-called channel complexes. This is a BP  
09:17:03 23 diagram, but consistent with my understanding of the geology,  
09:17:07 24 there's another package of sandstone, right, there's another  
09:17:14 25 sandstone channel. Remember it comes out of the plane of the

09:17:16 1 board, but that's not connected to the well, so that wouldn't  
09:17:19 2 produce oil.

09:17:20 3 Q. What is your conclusion from your review of the information and  
09:17:26 4 data as to whether or not the reservoir was fully connected?

09:17:34 5 A. At this stage we haven't quite got enough information to put a  
09:17:42 6 number on it, but what seems likely is that the well has  
09:17:46 7 encountered three of these channels, that there's pretty good  
09:17:51 8 connectivity along those channels. That makes sense. It's sort of  
09:17:55 9 a ripple of sandstone running across the reservoir. But there's  
09:17:58 10 going to be little or no flow between the channels because there's  
09:18:02 11 shale between them, and so there may be some channels that are not  
09:18:05 12 connected to the well.

09:18:08 13 Q. Did you review anything from the predrill analysis from BP that  
09:18:13 14 supported your view as to the likely geology of this reservoir?

09:18:17 15 A. Yes. So predrill obviously this was a concern that BP had,  
09:18:22 16 it's a general concern of these channel deepwater turbidite that  
09:18:27 17 there may be limited connectivity.

09:18:29 18 Q. Let me pull up Demonstrative 23520. And is this making the  
09:18:39 19 point that you just shared with the Court?

09:18:41 20 A. Yes. I mean, BP planned to drill three wells in the field.  
09:18:45 21 Why would they do that if one well connects everything? Well, you  
09:18:49 22 drill three wells for two reasons: One, of course, is with three  
09:18:52 23 wells you can produce the oil faster. But there is another reason,  
09:18:56 24 which is you hope with three wells you're going to hit all of the  
09:18:59 25 channels.

09:19:00 1           So, you know, even with a single well, they were  
09:19:05 2 suggesting that you'd only really confirm that you've accessed  
09:19:08 3 about 60 percent, and they were suggesting that if  
09:19:13 4 compartmentalization exists, and that they determined in production  
09:19:17 5 from pressure data, they may need to drill more wells.

09:19:21 6 Q. Let me ask you about your conclusions from the geological  
09:19:27 7 analysis, and I have here an excerpt from your report D-23521.  
09:19:35 8 And, Dr. Blunt, can you just look there at the highlighted portions  
09:19:40 9 of this demonstrative exhibit there in paragraph three and  
09:19:44 10 paragraph four and summarize quickly for Judge Barbier your  
09:19:49 11 conclusions with regard to limited connectivity?

09:19:52 12 A. Yeah. I mean, I think at this stage you're going to say it's  
09:19:56 13 really something we need to consider. Because you can have flow  
09:20:00 14 along the sandstone channels, but these channels don't necessarily  
09:20:04 15 all interconnect, there isn't necessarily flow between them. And  
09:20:08 16 that in Macondo, you know, clearly it didn't contact all, it  
09:20:13 17 contacted three of the complexes in the I want to say thickest part  
09:20:18 18 of the field, and those are the three layers for which we really  
09:20:21 19 have data because they were encountered when drilling the well.

09:20:24 20 Q. I want to now turn your attention to pressure analysis and  
09:20:29 21 whether or not that can be utilized to understand connectivity of  
09:20:34 22 the well. Did you quantify the impact of limited connectivity  
09:20:43 23 using information other than the seismic data?

09:20:47 24 A. Yes.

09:20:49 25 Q. Let me turn your attention to Demonstrative 23522, and ask you

09:21:01 1 to explain to the Court how you were able to quantify the impact of  
09:21:05 2 limited connectivity.

09:21:07 3 A. Limited connectivity is potentially an issue in these sorts of  
09:21:11 4 deepwater turbidites. Well, how do you know? You actually don't  
09:21:16 5 know until you start producing oil from the field. You can't just  
09:21:18 6 look at the seismic and hypothesize about the geology and come up  
09:21:22 7 with a connectivity number. What you need to do is you need to  
09:21:26 8 have additional data, you need to have data about how does the oil  
09:21:30 9 flow in this reservoir. And that data comes from, in this  
09:21:35 10 particular case, from the capping stack pressure analysis.

09:21:37 11 Q. And have you analyzed the capping stack pressure?

09:21:40 12 A. Yes.

09:21:41 13 Q. Let me just turn now to the next demonstrative, and if you will  
09:21:49 14 describe for the Court, please, how pressure can be used to define  
09:21:57 15 the contours of the reservoir and help you understand the issue of  
09:22:05 16 connectivity.

09:22:05 17 A. Okay. So as I think I've already mentioned, your Honor, for --  
09:22:11 18 the capping stack was measuring for pressure after the well was  
09:22:16 19 closed in, and the pressure was increasing over time for 19 days.

09:22:20 20 Now, that's a diagnostic test in standard reservoir  
09:22:25 21 engineering. We look at how the pressure builds up when you stop  
09:22:29 22 flow in a well. You normally actually only do it for one day, so  
09:22:31 23 the fact that we got 19 days has given us a lot of valuable  
09:22:36 24 information. And a bit like a physician looking at a chest X-ray  
09:22:39 25 that can diagnose what's wrong with a patient, the shape of this

09:22:43 1 buildup has characteristics which enable you to say things about  
09:22:47 2 the reservoir. And that's essentially what I've done.

09:22:50 3 Q. Let me just go to the next slide here, and you can see how this  
09:22:57 4 pressure signal is developing. Can you describe for Judge Barbier  
09:23:01 5 how this pressure allows you to understand the boundaries of the  
09:23:08 6 reservoir?

09:23:09 7 A. Yes. So what that was representing was how the influence of  
09:23:14 8 pressure moves out through the reservoir. And as you saw, to begin  
09:23:18 9 with, it went out in circles like ripples in a pond, that's known  
09:23:22 10 technically as the radial flow regime. Then it encounters barriers  
09:23:29 11 to flow on the channel side, so it's hit the end of the channels,  
09:23:35 12 it's hit shale and then you --

09:23:36 13 Q. How do you know from looking at the data that the pressure has  
09:23:39 14 hit the boundary?

09:23:40 15 A. From the diagnostic signature of the pressure. The data -- the  
09:23:43 16 details are in Appendix 4.3 of my report. But actually there's  
09:23:48 17 no -- again, among the experts, there's no disagreement about this.  
09:23:52 18 We all know that there's radial flow to begin with, that we then  
09:23:56 19 have flow confined in a channel. It's just the use of that data to  
09:23:59 20 quantify how much oil is connected that is my analysis.

09:24:05 21 So you see this going out like ripples in a pond. It  
09:24:09 22 hits no-flow barriers, barriers to flow. But it takes time for the  
09:24:15 23 pressure to move all the way out to the ends of the field. That's  
09:24:20 24 why having 19 days of pressure data was so valuable, because  
09:24:24 25 there's sufficient time to see the pressure, the impact of the

09:24:28 1 pressure at the well from barriers to flow like the south and the  
09:24:33 2 north end.

09:24:35 3           So what I can say here is in the pressure analysis, I  
09:24:43 4 know the size of this connected box. I know that it's a box and I  
09:24:48 5 don't, for instance, assume that there is no aquifer. I determined  
09:24:52 6 that there is no aquifer. The shape, the diagnostic shape of the  
09:24:59 7 pressure response says very clearly that there are no-flow  
09:25:03 8 boundaries here at the edges of the channel and there are no  
09:25:05 9 barriers to flow at these two ends (INDICATING).

09:25:08 10           So we know that we're producing oil from a contained box  
09:25:13 11 when we're trying to calculate how much oil was released and we  
09:25:17 12 know the shape of the box and we know the size of the box.

09:25:20 13           And again, all of the experts who have looked at this  
09:25:27 14 agree that mathematically, on average, we're looking at flow that  
09:25:31 15 looks like from a rectangular-shaped reservoir. What I am doing is  
09:25:35 16 now putting it in the context of additional data, the seismic and  
09:25:38 17 the geology.

09:25:39 18 Q. Now, using this pressure analysis and being able to define the  
09:25:45 19 rectangle -- and we've seen this from other witnesses -- what  
09:25:52 20 reservoir volume do you opine was connected to the well and how  
09:26:01 21 much was not?

09:26:02 22 A. Okay. So I've got a box here that gives me a connected area.  
09:26:09 23 As an aside, the size of the box is also related to the number that  
09:26:12 24 I used for permeability, and as I think I discussed at the outset,  
09:26:17 25 I used the highest plausible value of permeability from a robust

09:26:23 1 flow-based determination, and that's Professor Gringarten's P10  
09:26:27 2 value, the 329 millidarcies. It's higher than his best case. It's  
09:26:31 3 higher than I am going to show that I think the capping stack data  
09:26:35 4 gives you, but that's to give you the most generous assessment of  
09:26:39 5 connectivity, but it's not unreasonable because it's saying  
09:26:42 6 essentially the field is across all the way across. So I don't  
09:26:45 7 necessarily have a problem with it. So that's just an area.

09:26:47 8           What's the volume? What I've done is we know the total  
09:26:51 9 volume of oil, right, we know the total volume of oil. That comes  
09:26:55 10 from the seismic. Again, no disagreement about that. How much of  
09:26:58 11 that volume do I put in the red box and how much do I leave out?

09:27:01 12 Q. How did you approach that issue?

09:27:03 13 A. Again, using a conservative assumption to put as much oil in  
09:27:07 14 the box as possible. What I did was I said, look, this box  
09:27:10 15 overlays most of the thicker channels, doesn't it. So the most  
09:27:13 16 generous assumption was to say everything outside here is just  
09:27:16 17 purple, it's the smallest thickness it could be. And then I put  
09:27:20 18 all of the rest of the oil giving the maximum possible plausible  
09:27:25 19 thickness in here.

09:27:28 20 Q. And when you do that, thinking about it from a reservoir  
09:27:32 21 engineering perspective, what percentage of the total oil do you  
09:27:37 22 assign as connected oil to the Macondo reservoir?

09:27:42 23 A. That comes up --

09:27:43 24 Q. For the Macondo well, I mean. Sorry.

09:27:45 25 A. That comes up with a connectivity that I think is between 87



09:27:48 1 and 90 percent. That actually would be considered very good  
09:27:51 2 connectivity.

09:27:53 3 Q. And do you believe that that is a conservative input?

09:27:57 4 A. Yes, I think it's implausible to suggest that the connectivity  
09:28:01 5 is any higher. It may indeed be lower. But I don't think this is  
09:28:05 6 an unreasonable calculation.

09:28:06 7 Q. Now, a couple of questions about the pressure data that you  
09:28:12 8 analyzed. We heard from Dr. Kelkar yesterday that you didn't  
09:28:17 9 utilize the first 10,000 seconds of pressure data from the capping  
09:28:23 10 stack. First of all, for the record, how long is 10,000 seconds?

09:28:26 11 A. It's about three hours.

09:28:28 12 Q. And can you explain to the Court what the issues were, from  
09:28:34 13 your perspective, in terms of the question you were trying to  
09:28:38 14 answer about the first three hours of pressure data that was  
09:28:43 15 available?

09:28:44 16 A. So I talked about pressure being a sort of diagnostic. But  
09:28:50 17 there are different diagnostics and different reservoir properties  
09:28:53 18 that you get from different time periods. So I in my quantitative  
09:28:58 19 analysis didn't actually consider the first hour. So the first  
09:29:02 20 hour out of 19 days, I didn't consider.

09:29:06 21 What do you get after the first hour? You get properties  
09:29:08 22 such as wellbore storage and skin, very valuable pieces of  
09:29:12 23 information often, but those numbers don't affect my analysis. I  
09:29:16 24 don't need them for my analysis. So not considering that data was  
09:29:19 25 not a problem.

09:29:20 1           The reason why I didn't consider it is in that early time  
09:29:26 2 period, there's quite a lot of noise in the data, it's difficult to  
09:29:30 3 interpret and it is indeed very sensitive to exactly what the flow  
09:29:34 4 rate changes were choke closure.

09:29:36 5           But after about three hours -- and I've demonstrated this  
09:29:40 6 in Appendix E of my report. After about three hours, the  
09:29:44 7 diagnostic settles down. More or less regardless of what you're  
09:29:49 8 assuming about flow rate history, you still see the same diagnostic  
09:29:53 9 signature. And the diagnostic signature is this radial flow, the  
09:29:56 10 ripples in the pond. When you hit the sides of your channels and  
09:30:01 11 when you hit the ends. And it is well known in pressure transient  
09:30:06 12 analysis that looking at the boundaries of the reservoir, what I'm  
09:30:08 13 really interested is how big is that box. Looking at the  
09:30:13 14 boundaries is when the pressure gets to the boundaries. That's a  
09:30:16 15 late time response. That's something that you see after days.  
09:30:19 16 It's not a problem if you don't analyze the first few hours.

09:30:24 17 Q. Now, let me ask you just to look very quickly at D-24606, which  
09:30:31 18 we've styled "Dr. Blunt's Pressure Analysis." Is this a chart or  
09:30:37 19 an analysis from your report?

09:30:39 20 A. Yes. This is -- your Honor, this is one of the figures from  
09:30:45 21 Section 4.3 of my report. It does contain a lot of information and  
09:30:50 22 it is somewhat detailed. And I'll try not to bore you too much  
09:30:56 23 with details.

09:30:58 24 Q. If you would just address the issue of whether or not this  
09:31:00 25 helps you understand the reservoir size.

09:31:05 1 A. Yes. So what we have on the X axis here is time, but it's  
09:31:11 2 logarithmic time, and this is traditionally how it's done. So  
09:31:15 3 that's three hours, that's about 30 hours, that's about 300 hours.  
09:31:19 4 So that's looking at a couple of weeks, okay.

09:31:22 5 So the late times are already compressed up and the early  
09:31:28 6 times are expanded. So what you see here if you're an expert is  
09:31:32 7 you look at the slope, so this is the pressure going up. And what  
09:31:36 8 you do is you look at the slope. When you look at the slope, you  
09:31:39 9 get lots of valuable information. You get a sort of a constant  
09:31:43 10 slope, that's your radial flow, and then you see that the slope  
09:31:45 11 starts increasing, and that's a diagnostic of hitting boundaries,  
09:31:49 12 and that's channel flow. You see that after about 60,000 seconds,  
09:31:53 13 about 19 hours. So it's well beyond where I need to consider  
09:31:56 14 things.

09:31:57 15 And then you get this channel flowing. But that doesn't  
09:32:01 16 last forever, it begins to sort of flatten out there. One of the  
09:32:04 17 reasons for that is you're seeing the other barriers to flow at the  
09:32:08 18 ends.

09:32:08 19 So the thing that's really important to me is what's  
09:32:10 20 happening at about 19 hours, but it's channel flow, no ambiguity  
09:32:14 21 there from any of the experts, we all know it's channel flow. And  
09:32:17 22 then what's really happening there after 19 days to see the no-flow  
09:32:21 23 boundaries at the end. That's the sort of, one would say, X-ray  
09:32:23 24 diagnostic that an expert in this area can more or less read off  
09:32:32 25 the graph.

09:32:32 1 Q. Now, once you make a determination about the size of the  
09:32:36 2 reservoir and how much would be connected to the Macondo well or  
09:32:42 3 the location of the Macondo well, do you next need to look at  
09:32:47 4 converting reservoir barrels to stock-tank barrels?

09:32:53 5 A. Yes.

09:32:54 6 Q. And can you describe for Judge Barbier what your approach to  
09:32:59 7 that issue is or was. And I am going to put up for you D-23529,  
09:33:09 8 and I guess I'll just ask you first to briefly explain what you did  
09:33:13 9 to convert the connected reservoir volume.

09:33:16 10 A. Yes. So our focus so far has been on the reservoir. So we're  
09:33:21 11 deep underground and we're calculating volume, volumes in the  
09:33:24 12 reservoir or volumes of oil released fundamentally at reservoir  
09:33:28 13 conditions. But I am quoting numbers, as indeed is standard in the  
09:33:34 14 industry, in stock-tank barrels.

09:33:37 15 So what I have to do is I have to take this oil that's  
09:33:39 16 deep underground, bring it up to the surface. As it goes up to the  
09:33:44 17 surface, the pressure drops and bubbles of gas exsolves from the  
09:33:51 18 oil, like opening a can of soda, so the bubbles get to come up.  
09:33:55 19 And then when I reach the surface, I separate it out into oil, the  
09:33:58 20 liquid and the gas.

09:34:00 21 Q. And as part of that process, what method did you use to  
09:34:06 22 determine the value for the oil formation volume factor?

09:34:11 23 A. So the correction that you use, the oil actually shrinks  
09:34:16 24 because lots of gas has come out of the solution through the oil  
09:34:19 25 formation volume factor. Using the approach in my report, I used

09:34:23 1 the measured data, I used three sets of measured data from the  
09:34:26 2 three independent services that did the measurements, and the  
09:34:30 3 measurements were using the single-stage separation.

09:34:32 4 Q. Now, when you say that you used the measured values and there  
09:34:37 5 were three laboratories, what are you referring to there?

09:34:39 6 A. So fluid samples were taken from the well before the accident  
09:34:45 7 and there were measurements performed on them at Schlumberger, at  
09:34:50 8 Intertek and Core Labs, so three labs looked at them. I've taken  
09:34:54 9 those measured values and I've used all three in my calculations.

09:34:57 10 Q. And why did you choose to use the single-stage flash  
09:35:03 11 methodology, Dr. Blunt?

09:35:05 12 A. Okay. There are a number of reasons. The original reason is,  
09:35:10 13 well, I've got the directly measured data, it's unambiguous what it  
09:35:17 14 means, it simply means that the oil and gas remain in contact and  
09:35:20 15 then you separate them. And it's the industry standard, you  
09:35:26 16 commonly do encounter it in oilfield operations, but more to the  
09:35:30 17 point, it's the default option when you don't know for sure what  
09:35:34 18 the real separation process was.

09:35:36 19 Q. There's been discussion about a four-stage separation. Why did  
09:35:42 20 you not use that methodology?

09:35:44 21 A. So there is experimental data for a four-stage separation  
09:35:51 22 process, and that's also been discussed by Dr. Zick and it's what  
09:35:54 23 he recommended in his expert report. I have not done that, and let  
09:36:01 24 me explain why, is a multistage separation is what you may  
09:36:09 25 routinely do in normal oilfield operations to maximize the amount

09:36:14 1 of oil that's produced. But the problem here is there are infinite  
09:36:20 2 number of possible multistage separations.

09:36:22 3 I know there was one particular case looked at  
09:36:24 4 experimentally, but there's no evidence to suggest that that is  
09:36:28 5 exactly what BP would have done. They might have used fewer  
09:36:31 6 separators. They might have conceivably used more. They might  
09:36:35 7 have mixed oil from Macondo with oil from other fields. We simply  
09:36:39 8 don't know.

09:36:40 9 So even if you say that's the appropriate methodology,  
09:36:43 10 you don't know the number to use.

09:36:45 11 Q. And in using the four-stage separator methodology, is that  
09:36:52 12 something in practice that is conducted with a hundred percent  
09:36:57 13 efficiency?

09:36:58 14 A. No. And actually --

09:37:02 15 THE COURT: Dr. Blunt, I think when demonstrating  
09:37:05 16 something, you moved the microphone away from you. Pull it back up  
09:37:05 17 to you a little bit.

09:37:08 18 THE WITNESS: Maybe I should move forward.

09:37:10 19 THE COURT: Either way.

09:37:11 20 MR. BROCK: Pull it over even closer to you.

09:37:13 21 THE WITNESS: Is that okay?

09:37:14 22 MR. BROCK: That's much better.

09:37:16 23 THE WITNESS: So, yes, in these thermodynamic  
09:37:19 24 calculations and indeed in the experiments, they're very careful.  
09:37:22 25 And what they do is they have a hundred percent efficiency, so they

09:37:27 1 say the oil and the gas separate perfectly.

09:37:31 2 But in real oilfield operations, it's not like that.  
09:37:34 3 What a separator is, your Honor, I mean, crudely speaking, imagine  
09:37:39 4 a giant tank, and oil comes gushing into this tank and you have to  
09:37:43 5 separate the oil and gas. Well, the oil settles at the bottom and  
09:37:47 6 you have a pipe with the oil coming out, and the gas is at the top  
09:37:50 7 and you have a pipe coming out there.

09:37:51 8 Now, if you wait for days or weeks nice and carefully,  
09:37:54 9 you get this perfect separation, but you can't because you're  
09:37:59 10 producing oil really rapidly. So what happens is the gas comes  
09:38:02 11 rushing out of the top, but entrained in that are droplets of oil.  
09:38:06 12 You've lost that oil. So you never operate these separators at a  
09:38:10 13 hundred percent efficiency. So --

09:38:15 14 MR. CERNICH: Your Honor, I am going to object.  
09:38:17 15 Professor Blunt has no discussion in his report whatsoever about  
09:38:20 16 how separators are operated. He does -- I will admit that he does  
09:38:25 17 discuss the process of multi-stage separation and single-stage  
09:38:29 18 separation or he mentions those, but there is absolutely no  
09:38:32 19 discussion in his report about how these separators are operated.  
09:38:35 20 And he's demonstrated no expertise in this either in his CV, in his  
09:38:40 21 report, or -- anywhere in his report.

09:38:42 22 THE COURT: Okay. Are you going any farther with that?

09:38:45 23 MR. BROCK: That's basically it.

09:38:46 24 THE COURT: Okay. All right. I'll overrule the  
09:38:48 25 objection, but let's just move on.

09:38:50 1 MR. BROCK: All right. We will move on.

09:38:52 2 BY MR. BROCK:

09:38:53 3 Q. Dr. Blunt, you're also aware that Dr. Whitson developed an  
09:39:01 4 oceanic separation model, correct?

09:39:05 5 A. Yes.

09:39:05 6 Q. And did you review his report?

09:39:09 7 A. Yes.

09:39:10 8 Q. And does his oceanic separation model output a number that in  
09:39:21 9 terms of the formation volume factor that is similar to yours?

09:39:26 10 A. Yes. Dr. Whitson, I would consider him is widely regarded as  
09:39:34 11 the foremost expert in hydrocarbon phase behavior in the world. He  
09:39:39 12 has provided in his expert report a detailed analysis of what he  
09:39:45 13 thinks plausibly happened as the oil was released into the ocean  
09:39:50 14 and moved to the surface.

09:39:51 15 Q. In terms of the formation volume factor that is utilized by  
09:39:56 16 you, can you describe to Judge Barbier what that is in terms of the  
09:40:02 17 number?

09:40:03 18 A. Yeah. The number for the single-stage flash and the number for  
09:40:11 19 Dr. Whitson's oceanic process are essentially the same. And on  
09:40:16 20 good physical grounds this does not surprise me at all.

09:40:20 21 Q. Do you recall your number? That is, what is your formation  
09:40:26 22 volume factor number?

09:40:27 23 A. Well, I use a range of values based on the measurements, but  
09:40:32 24 the range is, off the top of my head under initial conditions, I  
09:40:33 25 think between 2.3 and 2.4.



09:40:43 1 Q. I am going to put up D-23532, just in the interest of time so  
09:40:54 2 we can keep moving. I would like for you to summarize, now, for  
09:40:59 3 Judge Barbier your opinion regarding oil volume; and then if you  
09:41:06 4 could also, as you do this, speak to how your analysis is different  
09:41:10 5 from the approach of the experts from the United States.

09:41:14 6 A. Yeah. So just to repeat, my best estimate of the connected oil  
09:41:18 7 volume is 112 million stock-tank barrels. I do consider a range of  
09:41:23 8 values, but as we discussed before, that isn't necessarily an  
09:41:26 9 uncertainty range. It's more providing an upper bound. I don't  
09:41:31 10 think it's plausible to suggest that it's significantly larger than  
09:41:35 11 that.

09:41:35 12 And the reason why the U.S. experts can present different  
09:41:38 13 numbers is they haven't considered the geology of the Macondo  
09:41:42 14 field; and they don't use the pressure analysis, even though there  
09:41:47 15 was pressure data available, to assess connectivity which is a  
09:41:50 16 standard best practice in reservoir engineering; and in my opinion,  
09:41:55 17 the conversion to stock-tank barrels that is used is ambiguous.  
09:42:02 18 There are an infinite number of possible conversions and it's based  
09:42:06 19 on something that is hypothetical or physically rather implausible.

09:42:10 20 Q. What is the impact, Dr. Blunt, of the assumptions made by the  
09:42:18 21 United States that are different from yours? And I'll just put up  
09:42:22 22 D-23533 as demonstrative that you can use to discuss this.

09:42:29 23 A. So what does it mean in terms of oil released? So I've got  
09:42:39 24 112. What does Pooladi-Darvish use, Dr. Pooladi-Darvish? He has a  
09:42:43 25 range of values, so what I've used is his base case. And I think

09:42:47 1 it's already been discussed already in court. The difference here  
09:42:51 2 is principally a different conversion process and ignoring  
09:42:56 3 connectivity, and they both have about the same contribution. So  
09:42:59 4 if you add those two together, it's a difference of about 930,000  
09:43:04 5 stock-tank barrels.

09:43:05 6 Dr. Kelkar, as I've said, has a lower bound that's more  
09:43:10 7 or less the same as mine, and an upper bound that he's higher,  
09:43:15 8 actually, more like Dr. Pooladi-Darvish's. I've taken the mid  
09:43:20 9 range, the number that gives you 5 million barrels essentially. So  
09:43:24 10 again, I consider that too large, and I don't use their conversion  
09:43:29 11 process. And that has an impact of about 480,000 stock-tank  
09:43:33 12 barrels on the calculation.

09:43:35 13 Q. Now, Dr. Blunt, let's turn to the second variable with regard  
09:43:39 14 to the material balance equation, and that is the issue of  
09:43:44 15 compressibility. And I'll just put the form D-23535. We're now  
09:43:53 16 talking about the second variable in the equation, correct?

09:43:55 17 A. Yes.

09:43:55 18 Q. And Dr. Blunt, if you'll look at D-24607, and just state for  
09:44:04 19 the record what you determined to be the value for rock  
09:44:11 20 compressibility?

09:44:11 21 A. Yes, the best determination of rock compressibility I consider  
09:44:15 22 to be 6.35 microsips; although, again, I do consider a range of  
09:44:19 23 values in my calculations consistent with the measurements.

09:44:22 24 Q. Let's look, now, at D-23536A, and I'll just ask you if you  
09:44:31 25 would, please, to now use these photographs to describe what is

09:44:39 1 compressibility; that is, what are we looking at and how does the  
09:44:45 2 reservoir rock compress?

09:44:46 3 A. So the emphasis on this discussion is going to be on rock  
09:44:50 4 compressibility because that's where there is the point of  
09:44:54 5 disagreement. What you see on the left is a photograph of one of  
09:44:58 6 the Macondo cores. It's about an inch across here. What I've  
09:45:05 7 shown here is actually from my report is an X-ray image actually of  
09:45:10 8 this Bentheimer sandstone. And the reason for showing that is you  
09:45:14 9 can, then, really see what we're talking about here.

09:45:16 10           What you've got is you've got grains of sand, quartz  
09:45:21 11 grains that are fused together so they're crunched together. So  
09:45:24 12 what we're looking at when we look at compressibility is how  
09:45:26 13 compressible is that rock. Now, if we think about compressibility,  
09:45:34 14 it's very easy to consider what you think about compressibility if  
09:45:37 15 you're looking at the sand. So, your Honor, if we go back to the  
09:45:40 16 sand and you imagine you're walking on the beach and you put your  
09:45:43 17 foot down, obviously, you can see that it's compressible, you can  
09:45:46 18 tap it down.

09:45:47 19           And how does that lead to more oil release? It's a bit  
09:45:50 20 like when you're on the beach, your footprint gets filled with  
09:45:55 21 water, you've actually squeezed water out of the sand. And that's  
09:45:59 22 essentially what we're looking at with core volume compressibility.

09:46:01 23           But, of course, we are not dealing with the sand in  
09:46:03 24 Macondo. We're dealing, as you can see, a core sample of sand,  
09:46:06 25 stone. It does have a compressibility under the huge pressures

09:46:08 1 that we're dealing with, and there will be a change in volume. And  
09:46:13 2 this rock will crush down, but not, obviously, by a huge amount,  
09:46:16 3 but it is a significant component to the calculations.

09:46:18 4 Q. And that compression affects how much oil will flow to the  
09:46:28 5 well?

09:46:28 6 A. Yes, the more it compresses --

09:46:31 7 Q. Let's use this diagram to look at that just a second, D-23537.

09:46:39 8 Dr. Blunt, can you use this diagram to sort of explain to Judge  
09:46:46 9 Barbier how is it that this compressibility of rock issue is so  
09:46:51 10 important?

09:46:52 11 A. So a cartoon to try and describe it because it's not the  
09:46:57 12 easiest concept to understand. So we sort of got a blow-up of the  
09:47:04 13 grains here. As I said, imagine the Macondo rock, and it's got  
09:47:09 14 13,000 feet of rock above it, so it's a bit, like, sort of Atlas  
09:47:13 15 with the weight of the world on his shoulders. But the oil is also  
09:47:16 16 at very high pressures, and the oil, if you imagine, is sort of  
09:47:20 17 trying to force the grains apart. The oil is sort of pushing back  
09:47:24 18 and that's sort of holding everything up.

09:47:27 19 Then when you drill a well --

09:47:28 20 Q. Let me go to the next demonstrative and see if this is helpful,  
09:47:33 21 D-23538. We've now got a well that's drilled into the reservoir.

09:47:38 22 A. So we drill a well. The oil flows from high pressure to low  
09:47:42 23 pressure into the well, so the oil pressure drops so the sort of  
09:47:46 24 helping, pushing back on the rock decreases, the weight crushes  
09:47:50 25 down on you and the rock begins to compress.

09:47:53 1           And of course, as it compresses, like squeezing a sponge,  
09:47:57 2           there's less room for the oil to be, there's less pore space, and  
09:48:01 3           that squeezes out an additional amount of oil.

09:48:04 4           So when we're looking at oil production from Macondo,  
09:48:07 5           there's essentially two components: There's the expansion of the  
09:48:10 6           oil itself, simply because the pressure drops and the oil expands;  
09:48:14 7           but there's also this extra contribution from the compression of  
09:48:17 8           the rock.

09:48:17 9           Q. So compressibility drives flow because compressed oil expands,  
09:48:25 10           driving out more oil, and the reduced oil pressure allows the  
09:48:30 11           overlying rock, in this case 13,000 feet of rock, to compress and  
09:48:39 12           that also squeezes out more oil?

09:48:41 13           A. Exactly.

09:48:42 14           Q. So that's the concept that we're looking at here.

09:48:58 15           Now, you've testified earlier today that Dr. Kelkar and  
09:49:01 16           Dr. Pooladi-Darvish use a value of 12 microsips. And I've got up  
09:49:08 17           D-23540. In their analysis -- excuse me. Dr. Kelkar -- just to  
09:49:16 18           keep us moving, I am not going to ask you about Dr. Hsieh.  
09:49:22 19           Dr. Kelkar uses a rock compressibility value of 12. What's the  
09:49:28 20           impact of that on this case?

09:49:30 21           A. Yeah. So, roughly speaking, the impact of Dr. Kelkar using 12  
09:49:36 22           microsips rather than the measured value of 6 is about one million  
09:49:41 23           stock-tank barrels in his estimate of oil released.

09:49:43 24           Q. Now, let's talk about the way in which you came to your  
09:49:50 25           conclusion that the compressibility of the rock is in the range of

09:49:58 1 6. How did you calculate that value? And I'll just ask you, if  
09:50:03 2 you can start with D-23541, to explain to Judge Barbier the first  
09:50:10 3 step in the process.

09:50:11 4 A. Yeah. I mean, following best scientific practice, you go back  
09:50:15 5 to the primary material and the primary material are the  
09:50:18 6 measurements. So Weatherford Laboratories measured the pore volume  
09:50:24 7 compressibility on rock samples from Macondo. Weatherford is a  
09:50:29 8 well-respected service laboratory. I use them myself, for  
09:50:33 9 experimental measurements, and the best determination of the  
09:50:37 10 average of those measurements is 6.35 microsips.

09:50:40 11 Q. You also referenced Professor Zimmerman in your report. The  
09:50:46 12 Court has heard a little bit about Dr. Zimmerman. Who is  
09:50:50 13 Dr. Zimmerman and what is -- why is it that you refer to  
09:50:58 14 Dr. Zimmerman in your report?

09:51:00 15 A. Dr. Zimmerman is, in my opinion, the world's foremost expert on  
09:51:06 16 rock mechanics. He's even written the -- literally, written the  
09:51:11 17 book on sandstone compressibility. The book is *The Compressibility*  
09:51:15 18 *of Sandstones*. So the number 6.35 has been taken from his expert  
09:51:21 19 report, and I deferred to his superior expertise.

09:51:25 20           However, I have my own opinions on pore volume  
09:51:28 21 compressibility outlined in Section 4.2 of my report, because I,  
09:51:33 22 too, have looked at the data and other supporting scientific  
09:51:36 23 evidence.

09:51:36 24 Q. Now, for what purpose have you used or relied on Weatherford  
09:51:43 25 Laboratories' work in this case?

09:51:46 1 A. In this case, I've looked at their measurements of pore volume  
09:51:50 2 compressibility. In fact, drilling down even more into this,  
09:51:55 3 actually, looked at exactly in their experimental procedures how  
09:51:58 4 the pore volume of the rock varied with pressure. I made a  
09:52:03 5 determination of what the correct pore volume compressibility for  
09:52:06 6 my calculations would be.

09:52:07 7 Q. Now, when you use the term "pore volume compressibility," just  
09:52:12 8 for the record, are you referring to the compressibility of rock  
09:52:15 9 now?

09:52:15 10 A. Yes.

09:52:16 11 Q. Now, have you utilized Weatherford data in your work?

09:52:25 12 A. Yes.

09:52:25 13 Q. Separate and apart from Macondo?

09:52:28 14 A. Apart from Macondo, yes, as I think I already referred to.  
09:52:31 15 Personally, I have great respect for Weatherford Laboratories.  
09:52:35 16 Routinely in my laboratories at Imperial, we send out core samples  
09:52:41 17 for testing from Weatherford.

09:52:42 18 Q. And have you found their work to be reliable and accurate?

09:52:46 19 A. Yes. I mean, we've used quite frequently data measured by  
09:52:52 20 Weatherford in our scientific publications, for instance.

09:52:55 21 Q. Now, you mentioned earlier in your examination work that you  
09:53:00 22 had done for -- with regard to the Kuwaiti sandstone reservoir over  
09:53:05 23 the past few years, I think you mentioned you had looked at lots of  
09:53:11 24 cores as part of that engagement as well as in other areas.

09:53:15 25 I just ask you, in your experience, have you analyzed

09:53:22 1 rock compressibility tests?

09:53:24 2 A. Yes. I mean, I've looked at the test protocols. I've looked  
09:53:29 3 at the test protocols for Weatherford as part of my review for  
09:53:34 4 Kuwait Oil Company, I also looked at the test protocols that they  
09:53:38 5 used to measure compressibility.

09:53:39 6 Q. And in your experience, under what conditions were those tests  
09:53:43 7 conducted?

09:53:44 8 A. Well, my understanding is both the Weatherford tests and  
09:53:47 9 certainly all of the Kuwaiti tests were performed at the  
09:53:52 10 appropriate pressure conditions, so the appropriate stress  
09:53:55 11 condition because that's really very important to reproduce; but  
09:53:59 12 they were performed at room temperature.

09:54:02 13 Q. And is that appropriate for the analysis that you do?

09:54:06 14 A. I would consider it appropriate. There is evidence in the  
09:54:12 15 scientific literature that there is a small correction that may  
09:54:15 16 need to be applied to the pore volume compressibility value if you  
09:54:19 17 look at elevated temperatures, but it's a small correction.

09:54:23 18 MR. CERNICH: Your Honor, we are going to object. None  
09:54:25 19 of these opinions are contained in Professor Blunt's report. This  
09:54:29 20 is the first time we've heard about his discussions -- about his  
09:54:32 21 opinions on Weatherford Labs or any of these types of discussions.

09:54:36 22 MR. BROCK: He is talking about his experience and why he  
09:54:39 23 is relying on these values, which we're about to show, your Honor.

09:54:44 24 MR. CERNICH: And the literature that Professor Blunt is  
09:54:47 25 referring to is surrebuttal that has been specifically excluded



09:54:53 1 from Professor Zimmerman that he gave in his deposition.

09:54:55 2 MR. BROCK: He is talking about his experience. He's  
09:54:57 3 described his experience in looking at samples of Weatherford and  
09:55:02 4 why he considers these to be reliable. He's not done anything more  
09:55:05 5 than that.

09:55:09 6 MR. CERNICH: And he quantified the attempt of  
09:55:12 7 temperature, your Honor, and that is not contained in his report.

09:55:15 8 THE COURT: That is more of an opinion. As long as he's  
09:55:20 9 talking about factual experience and not opinions I guess in that  
09:55:23 10 area he's okay.

09:55:25 11 BY MR. BROCK:

09:55:25 12 Q. Let's look at D-24469, and I think you mentioned this in  
09:55:30 13 general terms, but did you analyze the cores from Macondo?

09:55:35 14 A. Yes. I looked at all of the data, and also, as shown here,  
09:55:41 15 looked at both the core photographs. And, in fact, these pictures,  
09:55:45 16 these are actually X-ray images looking inside the rock to look at  
09:55:50 17 their internal structure.

09:55:52 18 Q. Now, on this chart here from the Weatherford files, do you see  
09:55:58 19 that there are three measured values for rock compressibility?

09:56:02 20 A. Yes.

09:56:03 21 Q. Did you consider the range of values?

09:56:08 22 A. Yes, I did. Your Honor, I think I need to clarify because the  
09:56:13 23 testimony of Dr. Kelkar and Dr. Pooladi-Darvish said that I used  
09:56:18 24 just one value of 6. That's actually not correct. As in my expert  
09:56:23 25 report, 6 is the base case. I think it's the best estimate of what

09:56:29 1 the real pore volume compressibility is. But I didn't just stick  
09:56:33 2 with 6, I looked at range of data. So I have a low case, which was  
09:56:38 3 about four, but I also considered, and I carried through in all of  
09:56:42 4 my calculations, a high case, right, of about 8.5. I consider that  
09:56:48 5 a reasonable range of pore volume compressibility. That's the  
09:56:51 6 range of the measurements.

09:56:52 7 Q. What, if anything, did your analysis of the cores tell you  
09:56:59 8 about the Macondo formation?

09:57:01 9 A. The analysis of the core certainly as illustrated in this  
09:57:06 10 picture, certainly my experience, again, in looking at probably  
09:57:10 11 hundreds, if not thousands, of X-ray images of core samples is that  
09:57:14 12 this looks very uniform sand. It's a quartz sand, and it has what  
09:57:21 13 I would say uniformly internal structure. What that means  
09:57:25 14 specifically in relevance to this case is you would expect the  
09:57:29 15 properties measured in one direction to be very similar to  
09:57:32 16 properties measured in another direction.

09:57:34 17 Q. And I believe you said that 6 microsips is an average  
09:57:37 18 compressibility?

09:57:38 19 A. It's the average of the three values that are shown here.

09:57:46 20 MR. CERNICH: Objection. Your Honor, Professor Blunt's  
09:57:50 21 continuing to opine on areas that aren't included in his report.  
09:57:54 22 The discussion of orientation of sidewall cores is not discussed in  
09:57:58 23 his report. I think that BP is trying to push the bounds here with  
09:58:02 24 Professor Blunt well beyond his report. He's already --

09:58:04 25 THE COURT: Did he express that opinion in his report?

09:58:07 1 MR. BROCK: I don't know if that is specifically in his  
09:58:09 2 report. I do know that he has said that these values are reliable  
09:58:12 3 and he is telling the reasons why.

09:58:13 4 THE COURT: That's a different opinion. I am going to  
09:58:15 5 strike that last part of that answer about whether properties  
09:58:20 6 measured in one direction are similar to properties measured in  
09:58:23 7 another direction.

09:58:24 8 MR. BROCK: Fine. Okay.

09:58:26 9 BY MR. BROCK:

09:58:26 10 Q. Now, let's look, Dr. Blunt, at the next Exhibit, D-23544. Did  
09:58:41 11 you look at other measured data that support your rock  
09:58:44 12 compressibility value?

09:58:45 13 A. Yes. What I did was I considered the measured data in the  
09:58:50 14 light of the totality of the scientific evidence. So what's shown  
09:58:54 15 here is a photograph blown up, microscope photograph, taken from  
09:59:02 16 one of the papers that I reference in my expert report.

09:59:07 17 And what you take away from this is that Macondo has a  
09:59:14 18 very high quartz content, almost entirely quartz fused together.  
09:59:19 19 And that's represented, though it's not Macondo, it's another high  
09:59:23 20 quartz content rock on the right. And here you've got basically a  
09:59:28 21 hard material. Quartz is essentially glass fused together so that  
09:59:31 22 gives you quite hard rock.

09:59:33 23 On the other hand, if you had a mineralogy with more  
09:59:37 24 ductile easily compressed material such as clay, you might expect  
09:59:42 25 the pore volume compressibility to be higher, but Macondo seems to

09:59:46 1 be more on the pure quartz end.

09:59:47 2 Q. And what is the significance of being higher in quartz as  
09:59:52 3 relates to the compressibility of the Macondo rock as well as your  
09:59:58 4 evaluation of that issue?

10:00:01 5 A. Well, what this would suggest is you would be expecting from  
10:00:09 6 Macondo or you would not be surprised from Macondo to see  
10:00:12 7 relatively low value of pore volume compressibility.

10:00:16 8 Q. Let's look at D-23545. And I'll just ask you, first of all,  
10:00:28 9 before we get into a discussion of this, if you would describe for  
10:00:32 10 the Court what is referred to on this axis porosity, and then we  
10:00:39 11 have pore volume compressibility over here. I think we talked  
10:00:41 12 about this one a good bit. What is porosity?

10:00:44 13 A. Porosity is a number which is how much of the total volume of  
10:00:49 14 the rock is pore space, so basically how open is the rock. And  
10:00:55 15 porosity was measured in two ways from Macondo, both from the  
10:00:59 16 samples of rock that were taken from the field, but also in what's  
10:01:03 17 called a log analysis; essentially measurements that were taken  
10:01:06 18 while they were drilling or after you drilled the well.

10:01:09 19 So what this is -- this is, again, a figure from my  
10:01:13 20 expert report but it was prepared by BP, and it was prepared by BP  
10:01:18 21 before drilling. So what it shows on the Y axis is the pore volume  
10:01:24 22 compressibility. And you see there's a wide range of values,  
10:01:27 23 right. This goes from zero all the way up to 70.

10:01:30 24 And on this axis, the X axis, we have the porosity. And  
10:01:34 25 the values here -- there have been a lot of discussion about other

10:01:38 1 wells. This is the data, this is the measured data that BP had  
10:01:43 2 acquired on other fields in the Gulf of Mexico. And what BP's  
10:01:48 3 geomechanics expert has done here is said, "Well, we anticipate a  
10:01:53 4 porosity here of about 22 percent."

10:01:55 5 Q. Is that the red line here (INDICATING)?

10:01:57 6 A. That's the red one, which is more or less what was measured.

10:02:01 7 And looking at this trend, this is sort of a trend line he puts

10:02:07 8 here. He says, "I think I'm going to get a pore volume

10:02:10 9 compressibility of about 6 microsips."

10:02:13 10 Now, again, what does that mean? It means if you, then,  
10:02:18 11 measure the pore volume compressibility and get 6, it's not a  
10:02:21 12 surprise; but there is a lot of scatter in this graph. You  
10:02:25 13 wouldn't just use this graph and take a number with any reliability  
10:02:30 14 because, as you can see, you know, other values are also plausible.

10:02:35 15 So what it shows in context is that the measured value of  
10:02:40 16 about 6 microsips is not the least bit surprising, it's consistent  
10:02:43 17 with other wells in the Gulf of Mexico of similar porosity, but you  
10:02:46 18 do need to make the measurements in order to reduce your  
10:02:50 19 uncertainty.

10:02:50 20 Q. This value for porosity, what is the value that you used?

10:02:55 21 A. The value for porosity that I've used in my quantitative  
10:03:00 22 determinations comes from the log analysis, that's considered best  
10:03:03 23 practice in reservoir engineering, and that's 21.7 percent.

10:03:05 24 Q. And is that the same value that Dr. Kelkar uses in his  
10:03:09 25 analysis?

10:03:09 1 A. Yes.

10:03:10 2 Q. Let's turn to the issue of published literature on the topic.

10:03:22 3 And this is just a callout here and it's showing in a little more

10:03:26 4 detail where the intersection occurs with the porosity value; is

10:03:31 5 that right?

10:03:32 6 A. Yes, it is, just shows that.

10:03:34 7 Q. So let's turn to one of the articles that relates to this

10:03:42 8 issue, and I'll just ask you: Did you review literature to figure

10:03:46 9 out what compressibility you might expect at Macondo?

10:03:49 10 A. Yes. I mean, I looked at the measured data in the light of the

10:03:54 11 scientific literature, and one of the papers I cite in my expert

10:03:59 12 report is the one that's shown here.

10:04:02 13 Q. And this, when you say, "shown here" we're referring to

10:04:09 14 D-24471. Can you see that in the bottom corner here (INDICATING)?

10:04:13 15 D-24471, is that right?

10:04:15 16 A. Yes, yes. Sorry, yes.

10:04:17 17 Q. Thank you. Now, Dr. Kelkar testified yesterday on redirect

10:04:26 18 examination that he was not the primary author on this paper after

10:04:32 19 he had been questioned about it. And I'll just ask you: Do you

10:04:36 20 have an understanding of what it means to be the last author listed

10:04:40 21 on a paper?

10:04:40 22 A. Let's put it this way, if this was a similar situation and I

10:04:51 23 was publishing a paper, you would normally expect that first

10:04:54 24 author, which Dr. Kelkar described as the primary author, was the

10:04:58 25 student, you know, who did the work. The last author is normally

10:05:02 1 the Senior author. What I mean by that is that is the professor  
10:05:07 2 who is supervising and is in charge of the research.

10:05:10 3 Q. What is the responsibility of the professor who supervises and  
10:05:14 4 is in charge of the work as to the reliability and the rigor with  
10:05:22 5 which the paper is written?

10:05:24 6 A. Well, if it were a paper of mine and I were the senior author,  
10:05:30 7 it would indicate that I had designed the research study, I framed  
10:05:36 8 what the paper would be about, I had reviewed carefully every  
10:05:40 9 detail of the research, I had been involved in writing the paper,  
10:05:44 10 and essentially, I would take responsibility for all of the  
10:05:48 11 contents of the paper.

10:05:49 12 Q. Now, let's turn to -- back to the issue of this well. Not  
10:05:59 13 ready for that yet.

10:06:03 14 Dr. Kelkar testified yesterday that his value of 12  
10:06:05 15 microsips for rock compressibility was based on BP documents, and  
10:06:12 16 I'll just ask this question of you, sir. Did you consider and  
10:06:17 17 evaluate whether a rock compressibility value of 12 microsips could  
10:06:22 18 possibly be consistent with the actual data related to Macondo?

10:06:28 19 A. Yes, I did. There's essentially a final check, something  
10:06:38 20 that's standard in reservoir engineering and which is discussed in  
10:06:41 21 Section 5 of my expert report. And it's about tying all of the  
10:06:45 22 pieces of data together. So, of course, I am aware of the BP  
10:06:48 23 e-mails. I am aware, of course, of uncertainty and that there is  
10:06:53 24 some scatter in the data. So it's not unreasonable to consider  
10:06:59 25 hypothetically other values, even though that doesn't appear to be

10:07:04 1 direct scientific evidence to support them. But it's this  
10:07:06 2 consistency check that's absolutely key to that.

10:07:09 3 Q. So let me turn to our next demonstrative. And let me just get  
10:07:26 4 you to say, first of all, for the record, Dr. Blunt, what is the  
10:07:31 5 consistency check that you performed with regard to the Macondo  
10:07:36 6 well to understand the issue of rock compressibility?

10:07:43 7 A. Okay. So what we see here in a graphic is, again, schematic of  
10:07:50 8 the pressure. And as I said, I've determined where the barriers to  
10:07:57 9 flow are in the reservoir, where that sort of connected area is.  
10:08:01 10 But in doing that, I needed to input a number for compressibility.

10:08:08 11 Now, what I mean by "reservoir engineering consistency  
10:08:11 12 check" is, if I use my number of 6 microsips and my analysis to  
10:08:20 13 pressure data, do I get an extent of the reservoir that makes  
10:08:23 14 geological sense? And the answer is, it does. Because we seem to  
10:08:29 15 see an extent to the reservoir that more or less is the extent of  
10:08:32 16 the reservoir geologically speaking.

10:08:35 17 The fact that it isn't the width of the reservoir and  
10:08:37 18 there are other channels is, again, perfectly plausible  
10:08:40 19 geologically and supported by the literature. But -- there's a but  
10:08:47 20 to this. What about if it's 12 microsips?

10:08:51 21 Q. And if it's 12 microsips, what does that do to the analysis in  
10:08:56 22 terms of the consistency check?

10:08:58 23 A. In the consistency check, if you assume a larger  
10:09:03 24 compressibility, then, essentially, the pressure wave moves slower.  
10:09:10 25 And what that would mean is that this connected box here would be



10:09:15 1 smaller.

10:09:18 2 Now, that has two consequences. The first is you can't  
10:09:23 3 just bump up the compressibility number and say you've got more oil  
10:09:28 4 released, because if the connected area was lower, then your end  
10:09:34 5 number, your oil volume number, must go down. And those two  
10:09:39 6 effects partially cancel. As I said, it's not you can't just pick  
10:09:42 7 each number in isolation.

10:09:44 8 The second problem is that if the boundaries, the no-flow  
10:09:50 9 boundaries of your box are sort of cut halfway through the channel,  
10:09:55 10 I won't say that's impossible. There are lots of reasons,  
10:09:59 11 sub-seismic faults, shale drapes that could restrict connectivity;  
10:10:03 12 but not it's such a neat, not such a consistent geological picture.  
10:10:08 13 So basically, 6 fits, 12 doesn't, and that's the reserve  
10:10:13 14 engineering analysis.

10:10:13 15 Q. When we talk about this issue here of increased compressibility  
10:10:19 16 slows down the pressure wave, I think you have designed maybe a  
10:10:25 17 teaching tool that we might use with Judge Barbier or show to Judge  
10:10:30 18 Barbier that would describe while you can't change one value  
10:10:35 19 without considering how that affects others?

10:10:37 20 A. Yes, yes, I have.

10:10:39 21 MR. BROCK: Your Honor, would it be okay if I approach  
10:10:41 22 and just grab this. I have permission from the staff to put this  
10:10:53 23 right here, if that's okay, just so you can see it.

10:10:55 24 THE COURT: Okay.

10:10:58 25 BY MR. BROCK:

10:10:58 1 Q. So if you will, first of all, Dr. Blunt, describe for Judge  
10:11:04 2 Barbier what's represented by the slinky, and then what's  
10:11:09 3 represented by the coil that is wound a little tighter.

10:11:15 4 A. Okay. Yes, your Honor, I am trying to sort of illustrate this  
10:11:18 5 because it is important. As I've said, I devoted a whole section  
10:11:22 6 of my expert report to this issue. The slinky spring is clearly  
10:11:28 7 quite compressible, you can easily squeeze it.

10:11:31 8 MR. BROCK: Keep talking while I move our exhibit around.

10:11:35 9 THE WITNESS: That, if you like, for illustrative  
10:11:39 10 purposes, is a highly compressible model, say 12 microsips.

10:11:42 11 The other spring, the smaller spring, is clearly a lot  
10:11:44 12 stiffer, you can't compress it so easily. So that has a lower  
10:11:48 13 compressibility. So for illustrative purposes, if you like, we'll  
10:11:51 14 call that 6 microsips.

10:11:54 15 Now, I've done a pressure analysis, and the pressure  
10:11:59 16 analysis tells me how long it takes to see these barriers to flow,  
10:12:04 17 but to locate them physically on my geological model or the seismic  
10:12:10 18 maps so I have a picture in my head of exactly what the reservoir  
10:12:12 19 is like, I need to know the speed with which the pressure moves.

10:12:16 20 Q. What affects speed?

10:12:18 21 A. What affects speed is compressibility. So if Mr. Brock will  
10:12:21 22 give this a wiggle, that's a pressure wave. And if you look at  
10:12:25 23 that, it takes -- make it more vigorous. As you can see, it takes  
10:12:25 24 about --

10:12:33 25 Q. I was really good at this when I was a kid. I loved these

10:12:36 1 things.

10:12:37 2 A. What I am trying to illustrate here is it takes a couple of  
10:12:41 3 seconds for the wave to move from one end to the next.

10:12:45 4 Now let's do it with the stiffer spring. What you notice  
10:12:49 5 is when Mr. Brock moves one end, more or less instantly, the other  
10:12:53 6 end is affected. So with a higher compressibility, the wave moves  
10:12:57 7 fast -- with a low compressibility, the wave moves fast, it goes  
10:13:03 8 further; with a high compressibility, the wave moves slower, it  
10:13:08 9 goes less far.

10:13:10 10 And the consequence here is, if I stick to the measured  
10:13:15 11 data, everything makes sense. I have the size of the box, it goes  
10:13:19 12 from one end of the reservoir to the other, completely consistent  
10:13:23 13 with good connectivity along these channel sands. It fits. Any  
10:13:28 14 reservoir engineer would say that's fine.

10:13:29 15 If instead we think, well, what happens if it's 12? What  
10:13:35 16 that would mean is the box would be smaller, the consequence in my  
10:13:39 17 calculations would be I would have to dial down my end number.

10:13:44 18 Q. Your reservoir size?

10:13:45 19 A. My reservoir size. But it's also not such a good picture.  
10:13:49 20 It's not so geologically consistent. It's not impossible, but it's  
10:13:53 21 not so consistent and I can't just bump -- the point is I can't  
10:13:59 22 just bump up C and get a bigger number. It's not consistent.

10:14:03 23 Q. Does this consistency check give you confidence about your  
10:14:07 24 opinion on the compressibility of rock at Macondo?

10:14:12 25 A. Yes.

10:14:13 1 Q. And why is that?

10:14:15 2 A. Because this is an additional check using additional data at  
10:14:20 3 the field scale. And, you know, if I may, you know, refer to the  
10:14:25 4 BP e-mails, my interpretation as a reservoir engineer is these  
10:14:30 5 reservoir engineers are trying to perform a calculation and they're  
10:14:34 6 asking for input from rock mechanics experts, that's fine. But  
10:14:37 7 it's the reservoir engineers who make the final call on the number  
10:14:40 8 in the light of all of the data. But at the time of the  
10:14:45 9 discussion, there wasn't the capping stack data; or, at most, there  
10:14:48 10 was only a couple of days of data.

10:14:50 11 In order to make a determination of where the no-flow  
10:14:55 12 boundaries at the end of the field is, you need all 19 days. So  
10:14:57 13 this consistency check that says 6 fits, 12 doesn't, is only  
10:15:03 14 possible once you have all of the capping stack data.

10:15:06 15 So it's perfectly legitimate to have a discussion among  
10:15:09 16 experts about plausible values and there is a range of uncertainty.  
10:15:13 17 But this check -- and this is the essence of reservoir  
10:15:16 18 engineering -- helps narrow that uncertainty and it makes me very  
10:15:19 19 confident that the range of pore volume compressibility -- and it's  
10:15:23 20 still a range of about two, from about four to eight and a half --  
10:15:27 21 is indeed the right databased range that is consistent with the  
10:15:32 22 totality of the evidence.

10:15:33 23 Q. Let me have D-23547, please. I'm just having trouble locating,  
10:15:46 24 sorry, Judge Barbier.

10:15:48 25 So just to sum up on the issue of compressibility, when

10:15:54 1 you look at your analysis based on the data and the consistency  
10:15:58 2 check, compared to Dr. Kelkar, have you evaluated what difference  
10:16:04 3 that makes in your outcomes?

10:16:08 4 A. Yes. So in Dr. Kelkar's analysis, because he doesn't perform  
10:16:13 5 this consistency check, he is, I want to say, able to put in any  
10:16:16 6 number and see what effect it is. And so if you take his 12  
10:16:21 7 microsips and put in 6, it makes a difference of about 1 million  
10:16:25 8 stock-tank barrels. And indeed Dr. Kelkar himself has performed a  
10:16:29 9 similar calculation and arrived at a similar conclusion.

10:16:31 10 Q. Let's move to the third variable, pressure change.

10:16:39 11 THE COURT: Mr. Brock, why don't we use this transition  
10:16:42 12 to take a 15-minute recess.

10:16:43 13 MR. BROCK: Sure. Thank you, your Honor.

10:16:46 14 THE DEPUTY CLERK: All rise.

10:16:48 15 (WHEREUPON, A RECESS WAS TAKEN.)

10:22:36 16 (OPEN COURT.)

10:32:17 17 MS. HIMMELHOCH: Your Honor, before the witness comes, I  
10:32:19 18 have a short evidentiary matter I can address.

10:32:22 19 THE COURT: All right. Everyone be seated.

10:32:25 20 MS. HIMMELHOCH: Judge, just quickly, in the kerfuffle  
10:32:30 21 over the Ron Dykhuizen objected-to exhibit, we didn't actually  
10:32:32 22 formally move in the remainder of the exhibits. So the United  
10:32:35 23 States is offering and seeking admission of all of the documents on  
10:32:38 24 this list except TREX 11191 and its associated callout TREX 11 --  
10:32:47 25 sorry, TREX 11191.1.1.US. for admission. There are no objections

10:32:53 1 with the exception of those two documents.

10:32:55 2 THE COURT: All right. Without objection, those  
10:32:58 3 documents are admitted.

10:32:59 4 MS. HIMMELHOCH: Thank you, your Honor.

10:33:11 5 MR. BROCK: Judge Barbier, just one issue for the record.

10:33:16 6 Mr. Irpino has helped me out with this. I put on the screen  
10:33:23 7 Document 23523, it's a demonstrative, and then there were two  
10:33:29 8 additional callouts from that same document which were 23524, which  
10:33:36 9 was the pressure signal that went out from the well, and then there  
10:33:40 10 was an additional exhibit, 23525, which I think is when the  
10:33:44 11 rectangle was formed showing the shape of the reservoir. So I just  
10:33:49 12 wanted to note for the record that I had called those out in court,  
10:33:52 13 and he was kind enough to remind me to get that in the record.

10:33:56 14 THE COURT: All right. Very well. Let me just say, we  
10:33:59 15 are going to -- I have a lunch meeting outside the courthouse that  
10:34:04 16 I have to attend, so I am going to -- wherever we are in the  
10:34:08 17 testimony, I am going to have to break, you know, five minutes to  
10:34:12 18 12, something like that.

10:34:14 19 MR. BROCK: Okay. Sure.

10:34:16 20 THE COURT: Go ahead.

10:34:17 21 BY MR. BROCK:

10:34:19 22 Q. Dr. Blunt, we're now going to turn to the third variable in the  
10:34:22 23 material balance equation, which is the issue of pressure change.  
10:34:27 24 And so let's start with the discussion of that. Again, we have  
10:34:32 25 here demonstrative 246 -- excuse me, 23550, and we're talking now

10:34:49 1 about the third variable there, pressure drop. Do you see that?

10:34:51 2 A. Yes, I do.

10:34:52 3 Q. I now am putting up D-24608, and I would like for you to just  
10:35:04 4 state for the record what is your value for the pressure drop at  
10:35:07 5 Macondo?

10:35:08 6 A. My best estimate of the pressure drop is 1,367 psi. But,  
10:35:14 7 again, following the approach the other two variables, I do look at  
10:35:18 8 a range of pressure drops based on the range of the measured fluid  
10:35:22 9 properties.

10:35:22 10 Q. I am going to put up now Demonstrative 23551, and we'll go back  
10:35:30 11 to the analogy of the tire, but what I would like for you to  
10:35:33 12 describe for Judge Barbier now is why does change in pressure make  
10:35:39 13 a difference to the output of the well?

10:35:44 14 A. So we're looking at a decrease in pressure from the initial  
10:35:49 15 pressure to the final pressure. In Macondo, the initial pressure,  
10:35:55 16 as I said, was 11,856 psi to be precise, about 800 times  
10:36:01 17 atmospheric pressure. It went down by about 1,400, so actually  
10:36:06 18 only a small fraction of the total pressure. So the more the  
10:36:09 19 pressure declines, the more the fluids expand, the more the rock  
10:36:13 20 compresses. And the amount of oil that's released is directly  
10:36:18 21 proportional to what this pressure drop is.

10:36:20 22 Q. I want to pull up a new demonstrative to talk a little bit  
10:36:24 23 about where pressure is measured when these pressures were obtained  
10:36:30 24 and how they fit together. D-23554 shows the initial reservoir  
10:36:39 25 pressure of April the 12th, and this is 2010. How, Dr. Blunt, is

10:36:46 1 this pressure obtained?

10:36:49 2 A. This pressure was obtained by downhole measurements taken after  
10:36:56 3 drilling but before the accident using an MDT tool, and the value  
10:37:01 4 more or less in the center of the reservoir, my baseline, is  
10:37:06 5 11,856 psi. And, again, as I think I've already mentioned, there  
10:37:10 6 is no substantive disagreement among the experts in this case over  
10:37:14 7 this value.

10:37:15 8 Q. Now, I am going to click this, and this is still D-23554, which  
10:37:23 9 is the build-out of the slide. And do you see there that we have a  
10:37:28 10 capping stack pressure of 6555 psi on July 15th to August the 3rd?  
10:37:36 11 Do you see that?

10:37:37 12 A. Yes. I think the number that's referred to there is the  
10:37:41 13 pressure at about the time of choke closure. So the pressure was  
10:37:46 14 measured on the capping stack when the well was shut in. And as  
10:37:51 15 I've already mentioned, for 19 days afterwards, the pressure did  
10:37:55 16 rise quite slowly, and I think the final pressure was recorded on  
10:37:59 17 the 3rd of July -- 3rd of August, sorry, was about 6,950 psi, so  
10:38:06 18 about 400 psi greater than this.

10:38:08 19 Q. So the pressure data that you are using here is derived from  
10:38:14 20 information that is obtained at the time of the shut-in of the well  
10:38:18 21 and then for 19 days thereafter?

10:38:21 22 A. That's correct.

10:38:21 23 Q. Now, when we look at the issue of pressure change, are we  
10:38:29 24 concerned with the pressure here at the reservoir or are we  
10:38:33 25 concerned with the pressure here at the BOP?



10:38:37 1 A. This is a reservoir analysis. What we really need to know is  
10:38:44 2 the final reservoir pressure, not the pressure of the capping  
10:38:49 3 stack.

10:38:49 4 Q. Now, if we turn to D-23555, I'll ask you to just describe for  
10:39:06 5 Judge Barbier what this chart reflects and how it is helpful to you  
10:39:11 6 in understanding the issue of final reservoir pressure.

10:39:15 7 A. Right. There are two steps, and I'll say briefly what they are  
10:39:24 8 and then refer to this one. We've got the capping stack pressures  
10:39:28 9 that are increasing over time, and this is what's shown in this  
10:39:31 10 graph here. On the Y axis is the pressured capping stack pressure,  
10:39:35 11 those are the little crosses you've got. And on the X axis at the  
10:39:42 12 time since choke closure, can be a little bit confusing, but  
10:39:45 13 basically that's the time from the 15th of July to August the 3rd.

10:39:49 14 So the first step is we want the final pressure. Now, as  
10:39:55 15 you can see, the pressure at the capping stack is increasing, it's  
10:39:58 16 continuing to increase. Where is it going to end up?

10:40:01 17 Q. Why is that? Explain that.

10:40:03 18 A. The reason physically is you've been withdrawing fluid from the  
10:40:09 19 reservoir for 86 days. Pressure goes from high -- flow goes from  
10:40:15 20 high to low pressure. We talked about the pressure waves. So  
10:40:18 21 there's a region of reduced pressure that extends all the way  
10:40:21 22 across the field. But the pressure's lowest at the well because  
10:40:24 23 the flow goes towards the low pressure point. When you stop the  
10:40:28 24 flow, there's still oil moving, but it's now backing up, so the  
10:40:34 25 pressure of the well builds back up.

10:40:37 1           So the first step and a step that all of the experts in  
10:40:41 2 this case have done, is here is the measured data, where is it  
10:40:46 3 going to end up. How do we predict where we're going to have the  
10:40:52 4 final pressure.

10:40:54 5 Q. This place here where we have this last X, this is the final  
10:40:59 6 pressure measurement that is taken on August the 3rd; is that  
10:41:04 7 right?

10:41:04 8 A. That's correct.

10:41:04 9 Q. So what do you have to do to understand the final reservoir  
10:41:12 10 pressure in terms of what you can see at the BOP or at the capping  
10:41:20 11 stack?

10:41:20 12 A. So best practice in reservoir engineering is to have an  
10:41:26 13 analytic flow model, and what that means is something that can be  
10:41:30 14 written in pen and paper, or in my specific case, an Appendix C of  
10:41:36 15 my expert report. You have a flow model that makes predictions,  
10:41:40 16 there are parameters in the flow model. You match the parameters  
10:41:43 17 of the flow model to match the data as accurately as you can, and  
10:41:47 18 then from that, you can determine what the final pressure is. You  
10:41:51 19 can essentially predict forward in time of where the pressure would  
10:41:54 20 end up.

10:41:54 21 Q. And is that the analysis that you have conducted in this case?

10:41:57 22 A. Yes.

10:41:58 23 Q. Now, just remind us again, this is the exhibit that we were  
10:42:05 24 just referring to, D-23552, how is this analysis of pressure that  
10:42:12 25 we're talking about here related to what we talked about in terms

10:42:16 1 of connectivity earlier?

10:42:18 2 A. So earlier when we talked about connectivity, we looked at the  
10:42:23 3 pressure analysis specifically to look at the time, how long did it  
10:42:26 4 take for the pressure wave to encounter the barriers to flow at the  
10:42:31 5 sides of the channel and how long did it take for the pressure wave  
10:42:35 6 to encounter the barriers to flow of the south and north ends of  
10:42:38 7 the field.

10:42:39 8 That was for the connectivity analysis. Now our emphasis  
10:42:44 9 here is going to shift on what is the final reservoir pressure,  
10:42:47 10 using the same concept, the same flow model, but we're looking at a  
10:42:51 11 different variable here.

10:42:52 12 Q. Now, let's look at an animation that you have helped us pull  
10:42:59 13 together of the Macondo well. This is D-23553. And I guess, first  
10:43:09 14 of all, if you can just describe for Judge Barbier's benefit what  
10:43:14 15 this is and how you are able to develop this animation.

10:43:19 16 A. So, your Honor, what I prepared here is an animation. All of  
10:43:26 17 the data in this animation, incidentally, is my base case -- one of  
10:43:30 18 my base case calculations that are where all of the parameters are  
10:43:38 19 described in Appendix D of my report. What we're going to be doing  
10:43:42 20 here is to illustrate that data, trying to bring it to life.

10:43:45 21 Here we have the reservoir. This is the reservoir box,  
10:43:49 22 so to speak. Mathematically, the flow can be very accurately  
10:43:53 23 described -- at least the pressure response can be very accurately  
10:43:56 24 described as a flow in this box. The red color here is indicating  
10:44:01 25 that initially we have a high reservoir pressure and then you're

10:44:05 1 going to see the Macondo well placed in this box here, that's where  
10:44:08 2 it's located. This is our pressure scale, that's high pressure,  
10:44:13 3 that's low pressure.

10:44:14 4           And we're looking at the 20th of April, and to a good  
10:44:18 5 approximation, we can assume that the pressure was uniform  
10:44:21 6 throughout the reservoir because there was no flow.

10:44:26 7 Q. Now, after shut-in, then what happens?

10:44:29 8 A. Well, actually this isn't the shut-in.

10:44:34 9 Q. I'm sorry. Let's look, first, at pressure signal that you  
10:44:38 10 would see?

10:44:38 11 A. Yes.

10:44:40 12 Q. So now, what's the pressure signal?

10:44:42 13 A. This is the time of the accident. This is my prediction of  
10:44:46 14 what the pressure could be. As you can see, the pressure of the  
10:44:49 15 well continues to decrease. You see these little pressure waves  
10:44:53 16 moving out sort of radially and then linearly, and you are seeing  
10:44:58 17 that there's an affect on the pressure. It gets to the sides here,  
10:45:01 18 it gets to the ends, and, obviously, from the diagnostic signature,  
10:45:05 19 that is what enables us to find the size of the connected volume.

10:45:10 20           And the pressure is continuing to decrease as more and  
10:45:13 21 more oil is coming out of the reservoir.

10:45:15 22           Then on the 15th of July there's a pause. Now, we close  
10:45:20 23 in the reservoir. We actually have high pressure here, low  
10:45:23 24 pressure here and the pressure is going to equilibrate. And I've  
10:45:27 25 shown one pressure contour that's 10,400 psi, and very slowly over

10:45:33 1 time, see almost linear flow here, the straight line pressure  
10:45:35 2 contours moving towards the well, and we are going to end on the  
10:45:39 3 3rd of August, which is when the well was cemented, we were close  
10:45:43 4 to equilibrium, but not quite there. And the final pressure, if we  
10:45:48 5 were to run this animation from that time, would be just above  
10:45:56 6 10,400 psi.

10:45:57 7 Q. And that's what you were showing there at the very end of that  
10:46:00 8 animation?

10:46:00 9 A. Yes.

10:46:01 10 Q. And does that represent your view of what happened with regard  
10:46:09 11 to the pressure in the well?

10:46:10 12 A. Yes. It's one of a number of models I've run, and I consider  
10:46:16 13 it a perfectly plausible representation of the pressure response of  
10:46:20 14 Macondo, and it very accurately matches the measured data.

10:46:25 15 Q. Now, let's look at the next demonstrative. It's D-23556. And  
10:46:32 16 let's turn to the issue that we talked about just a few minutes  
10:46:36 17 ago, which is conversion of the capping stack pressure to reservoir  
10:46:43 18 pressure. Okay. And why is it that we're going to translate those  
10:46:50 19 pressures?

10:46:50 20 A. Right. So, your Honor, we've been talking about the pressure  
10:46:55 21 response and there are different ways of finding that final  
10:46:59 22 reservoir pressure and the different flow models. Myself and  
10:47:04 23 Professor Gringarten have used analytic flow models,  
10:47:08 24 Dr. Pooladi-Darvish did use a simulation technique, Dr. Kelkar did  
10:47:10 25 essentially a curve fitting exercise. I consider what I've done

10:47:15 1 best practice.

10:47:16 2 But in the end, that isn't the thing that causes the big  
10:47:21 3 disagreement in the pressure drop variable. Where, in terms of a  
10:47:25 4 quantitative sense, the big disagreement is, is we've got  
10:47:30 5 measurements here at the capping stack, but of course, we all  
10:47:35 6 agree, everyone agrees that what we want to do is find the final  
10:47:38 7 reservoir pressure, so we have to convert these measurements or  
10:47:42 8 predictions downhole.

10:47:45 9 Q. Now, is it right that at the time of shut-in you have a 13,000  
10:47:55 10 plus foot column of oil in the well?

10:47:59 11 A. Yes.

10:48:00 12 Q. How does that affect what you need to do in terms of making a  
10:48:06 13 calculation for this reservoir pressure using a known capping stack  
10:48:12 14 pressure?

10:48:12 15 A. Well, conceptually it's reasonably straightforward. You know  
10:48:18 16 where the capping stack is, you know where the reservoir is, you  
10:48:22 17 have a wellbore that's full of oil. The oil has a weight.  
10:48:26 18 Essentially, the reservoir pressure is going to be the capping  
10:48:29 19 stack pressure plus the weight of oil.

10:48:31 20 Q. Now, if I scroll ahead or click ahead to D-23557, at the time  
10:48:41 21 of shut-in, generally, what's the makeup or the composition of this  
10:48:48 22 oil that's in the well?

10:48:49 23 A. So the time of shut-in we need to make a conversion. Again,  
10:48:55 24 all of the experts in this case have made this conversion. It's  
10:48:58 25 not controversial that you need to do it, it's just how you do it

10:49:02 1 that's the issue.

10:49:04 2           So what we have here is we've been producing for 86 days.  
10:49:09 3 As I said, the oil in the reservoir is hot. It's boiling hot,  
10:49:13 4 about 240 degrees F, and so that hot oil has been flowing up  
10:49:18 5 through the well and it's been heating the surrounding rock. And  
10:49:23 6 so at the time of shut-in, we have a column of hot oil sitting  
10:49:29 7 there in the wellbore.

10:49:30 8 Q. I am calling up now D-23558, and the title of this  
10:49:40 9 demonstrative is "The Second Law of Thermodynamics, Hot Things Cool  
10:49:47 10 Down." Why, Doctor, does that matter to this analysis?

10:49:54 11 A. Turns out it's absolutely crucial to the analysis.

10:50:01 12           So you've got this column initially of hot oil. Hot  
10:50:07 13 things tend to be lighter, so in the beginning, relatively  
10:50:13 14 speaking, the weight of the oil is not that high. All of the U.S.  
10:50:18 15 experts have calculated what it is. They're all, as we know,  
10:50:22 16 measurements of what the oil density is, it's a function of  
10:50:25 17 temperature and pressure, but they've assumed a fix conversion.  
10:50:28 18 They've essentially assumed that the oil stays hot.

10:50:32 19 Q. What's the effect of that?

10:50:33 20 A. The effect of that -- there are two effects: One is the oil's  
10:50:39 21 going to cool down, that's what we're going to talk about, or at  
10:50:43 22 least that's what I discuss in my expert report. So it tends to  
10:50:47 23 understate what the weight of oil is, and that tends to say the  
10:50:52 24 reservoir pressure is too high and your pressure drop is too low.  
10:50:55 25 So it's a bias that understates the oil released.

10:51:00 1           It also distorts your interpretation of pressure  
10:51:03 2 response, and that's also very significant.

10:51:05 3 Q. If you have a cool column -- if you have a hot column of oil  
10:51:11 4 and you're using that for your measurement, it will result in a  
10:51:18 5 lower final reservoir pressure than if you account for the changes  
10:51:24 6 that were to occur to that oil over time?

10:51:26 7 A. Yes.

10:51:27 8 Q. And a lower final reservoir pressure means that you have a  
10:51:33 9 larger pressure drop?

10:51:35 10 A. Yes.

10:51:36 11 Q. And a larger pressure drop results in more oil, in a general  
10:51:42 12 sense, flowing from the Macondo well?

10:51:45 13 A. Yes.

10:51:45 14 Q. So understanding the change in temperature is important to your  
10:51:51 15 analysis?

10:51:51 16 A. Yes. Not only is it important, it's not as though we're  
10:51:58 17 introducing here anything unusual. Everyone has recognized that  
10:52:02 18 this is a phenomenon, it's just I've actually gone ahead and  
10:52:07 19 analyzed it using some very fundamental principles.

10:52:12 20           The reason why the oil cools down is, it starts off hot,  
10:52:18 21 it's coming out of the reservoir, but of course, the capping stack  
10:52:21 22 you have cold ocean, it's 40 degrees F. As you go down, as you go  
10:52:26 23 underground, the temperature essentially varies more or less at any  
10:52:30 24 depth from 40 degrees at the seabed to 240 degrees at ocean depths.  
10:52:37 25 So if you wait long enough, if you wait for infinite time, what's



10:52:41 1 the temperature going to be? It has to vary nearly from 40 to 240.  
10:52:44 2 There's no other possibility. So you know it's got to cool. It  
10:52:49 3 can't be 240 everywhere.

10:52:51 4 Q. Now, do the experts for the United States agree that this is  
10:52:54 5 something that should be accounted for?

10:52:57 6 A. Yes, as far as I can tell. I mean, there's no disagreement.  
10:53:00 7 Everyone knows hot things cool down.

10:53:03 8 Q. And do any of the United States experts make provision for hot  
10:53:07 9 things cooling down and making the proper adjustment to the weight  
10:53:12 10 of the head in order to calculate a final reservoir pressure?

10:53:18 11 A. No, they do not. They all use a fixed conversion.

10:53:21 12 Q. Now, have you prepared for the Court's benefit a demonstrative  
10:53:27 13 to show the cooling over time? And I am going to pull this up as  
10:53:34 14 D-23559. I would like to just answer the question as to whether or  
10:53:38 15 not you've done it; and then before we get into it, I would like  
10:53:42 16 for you to describe for the Court also the basis for this work.

10:53:49 17 A. Okay. So, your Honor, again, we're going to have a little  
10:53:53 18 animation, but the animation is based on data that's presented in  
10:53:59 19 Appendix B of my expert report.

10:54:02 20 So what we're showing here is at the time of choke  
10:54:07 21 closure, in fact, just before the time of choke closure here, we  
10:54:12 22 have the oil sitting here. It's shown in red, which represents it  
10:54:17 23 being hot. The ocean is cold, that represents 40 degrees F. And  
10:54:24 24 way away from the well, the temperature goes from about 40 degrees  
10:54:29 25 F down to 240 in the way I described.

10:54:33 1           So what we show here is the temperature. It's not the  
10:54:36 2 temperature at any location, it's actually the temperature just  
10:54:38 3 below the seabed when I calculate. So it's the temperature just  
10:54:42 4 below the seabed in the oil as a function of time, and in  
10:54:47 5 particular, from the 15th of July when the well was shut-in to the  
10:54:50 6 3rd of August when the well was cemented.

10:54:55 7 Q. You tell me when you're ready to go forward. Is this a good  
10:54:58 8 time to click forward?

10:54:59 9 A. Yes, let's run.

10:55:01 10 Q. So what are we showing here?

10:55:04 11 A. So what we're showing here, this is the temperature profile in  
10:55:06 12 the well and here we have the time. We're slowing down for the  
10:55:09 13 first day. Notice in the first day, right, the oil is really hot,  
10:55:13 14 it cools down really quite rapidly. And now it's speeding up the  
10:55:17 15 video, and you can see subsequently we get more and more cooling  
10:55:21 16 but it's much slower.

10:55:23 17           So as you would expect, if you got a boiling hot cup of  
10:55:26 18 coffee, it's going to cool down quite rapidly to begin with. When  
10:55:30 19 it's lukewarm, the rate of cooling is going to be much less.

10:55:35 20 Q. Have you conducted the calculation as to what the final  
10:55:43 21 reservoir pressure will be if we take into account the second law  
10:55:50 22 of thermodynamics, hot things cool down.

10:55:53 23 A. Yes. I mean, the calculation, the details, the mathematical  
10:55:58 24 details are in Appendix B of my report, but the principles are  
10:56:01 25 really very sound. And actually, they're well established and

10:56:05 1 recognized in petroleum engineering.

10:56:07 2 All I'm doing here, your Honor, is conserving energy.  
10:56:10 3 We've got energy in the formation, heat energy in the formation,  
10:56:15 4 we've got heat energy in the oil, and I'm simply conserving energy.  
10:56:18 5 Mathematically, the equations are actually rather similar to what  
10:56:23 6 you see in the pressure analysis.

10:56:25 7 Q. You take account of the second law of thermodynamics, and the  
10:56:30 8 experts for the government use a constant hydrostatic head as I  
10:56:34 9 appreciate it?

10:56:34 10 A. That's correct.

10:56:35 11 Q. And let's look at D-23560. What difference does it make in the  
10:56:48 12 analysis that you have conducted versus Drs. Kelkar and  
10:56:56 13 Pooladi-Darvish?

10:56:56 14 A. So as I said, there are two components. One is what model do  
10:57:00 15 you use, essentially, to move the capping stack pressures further  
10:57:03 16 in time. But that's not the big difference, the big difference is  
10:57:05 17 how you do this conversion. And because I am allowing for this  
10:57:08 18 cooling, in general, as things cool down they get denser, the  
10:57:16 19 weight of oil is larger. I'm accounting for that. And of course,  
10:57:20 20 that's the major difference in our pressure drop calculations.

10:57:24 21 So if you compare with Dr. Kelkar, Dr. Kelkar has already  
10:57:29 22 shown this in his testimony, he does get a slightly larger pressure  
10:57:33 23 drop. But the difference, to be honest, I mean, it's 220,000  
10:57:37 24 stock-tank barrels, isn't the biggest disagreement between us. So  
10:57:41 25 there is a difference, but it's not as significant as the others.

10:57:45 1 But for Dr. Pooladi-Darvish, it is very significant.

10:57:49 2 What I've shown here is his pressure drop for his base case. And  
10:57:53 3 in my opinion, he is using an implausibly small weight of oil, a  
10:58:00 4 small and fixed weight of oil to do his conversion. And that's the  
10:58:04 5 principle reason for the disagreement between us, and that does  
10:58:07 6 have a significant impact on the calculations.

10:58:09 7 Q. Does this slide reflect the calculations that you have made as  
10:58:13 8 to the difference that this factor makes in the outcomes of  
10:58:20 9 Drs. Kelkar and Pooladi-Darvish?

10:58:21 10 A. Yes.

10:58:25 11 Q. Let me now turn to just the basic issue of differences between  
10:58:30 12 your approach and Dr. Kelkar's material balance approach. This is  
10:58:36 13 slide D-23561. And, Dr. Blunt, I don't think we need to go through  
10:58:46 14 every one of these, but if you could quickly walk through the  
10:58:49 15 differences that exist between your values and those of the United  
10:58:55 16 States and why they matter.

10:58:57 17 A. Okay. There are essentially differences in our approach to the  
10:59:02 18 three key variables. And the things that are ignored in  
10:59:08 19 Dr. Kelkar's analysis, and to some extent in Dr. Pooladi-Darvish's  
10:59:14 20 analysis, also introduce a bias. So if we're looking at the  
10:59:17 21 connected oil volume, if you just take the full seismic volume,  
10:59:21 22 you're assuming 100 percent connectivity. Well, connectivity can't  
10:59:25 23 be greater than a hundred percent, and it really is highly unlikely  
10:59:30 24 that it is a hundred percent. So that overstates that.

10:59:34 25 When we look at compressibility, we discussed this,

10:59:39 1 rather than going to the primary source material, which is the  
10:59:44 2 measured data, they're looking at sort of upsides on  
10:59:47 3 compressibility that I don't consider supported by the scientific  
10:59:50 4 evidence. And again, that introduces a bias.

10:59:55 5 And then, when it comes to the pressure analysis, the  
10:59:58 6 principle thing is that assuming that this wellbore oil doesn't  
11:00:01 7 cool down or ignore the cooling in the calculations, and that, too,  
11:00:06 8 introduces a bias.

11:00:09 9 Q. Dr. Blunt, just one final slide on this looking at Dr. Kelkar's  
11:00:14 10 approach. Does this slide reflect -- and this is Demonstrative  
11:00:21 11 D-23562. Does this reflect the values that you have described for  
11:00:29 12 the Court today in terms of your outcome as well as what  
11:00:36 13 Dr. Kelkar's outcome would be in terms of total barrels if the  
11:00:40 14 appropriate adjustments were made?

11:00:42 15 A. Yes, it does. His mid range value is about five million  
11:00:46 16 barrels of oil. What I've shown here is if, instead, we put in the  
11:00:52 17 values that come out in my analysis, these are what the corrections  
11:00:56 18 would be. The most significant correction is, I think we've  
11:01:00 19 already talked about, is the rock compressibility number. But  
11:01:03 20 there are also other corrections for the oil volume and the  
11:01:07 21 pressure depletion.

11:01:09 22 Q. Thank you, Dr. Blunt. I want to come back, now, and explore  
11:01:13 23 just a couple of topics in a little more detail. First of all,  
11:01:17 24 this is in the area of consistency checks and work that you've  
11:01:22 25 done. There's been discussion in the case about reservoir

11:01:27 1 simulation by experts for the United States. And I'll just ask you  
11:01:31 2 in the context of that, and this slide that we have here, which is  
11:01:35 3 D-23563, what input is typically used in those flow rate  
11:01:43 4 calculations?

11:01:47 5 A. Yes. Another rock property that we've already heard a lot of  
11:01:51 6 discussion about is permeability. And Dr. Pooladi-Darvish has  
11:01:55 7 presented a reservoir simulation model, and what you do in  
11:02:02 8 reservoir simulation model is you're predicting flow rates over  
11:02:05 9 time. And in the reservoir, for a given pressure drop, the flow  
11:02:10 10 rate is proportional to permeability. So permeability is a very  
11:02:15 11 important input into a reservoir simulation. Essentially, you  
11:02:20 12 double the permeability, you're going to double the flow rate.

11:02:24 13 Q. We've heard the statement that permeability is proportional to  
11:02:28 14 flow rate. Is that the same thing that you're saying?

11:02:31 15 A. That is correct. For the same pressure drop. But  
11:02:35 16 Dr. Pooladi-Darvish, as I am and as other experts are doing, he is  
11:02:38 17 matching the pressure data. So we've got the same pressure data,  
11:02:42 18 that isn't changing; but if you change the permeability, you're  
11:02:45 19 going to change your predictions of flow rate.

11:02:47 20 Q. So let's just do just a very short tutorial on the issue of  
11:02:55 21 permeability, what it is and how it affects flow. And I've put up  
11:03:00 22 D-23564. And, Dr. Blunt, can you use this to describe the context  
11:03:07 23 of permeability and how it relates to the values that you are  
11:03:14 24 looking at when you are trying to ascertain total flow from a well?

11:03:18 25 A. Yes. So I think we talked about this concept of the Macondo

11:03:23 1 reservoir being this sand where the grains have been fused  
11:03:27 2 together, but permeability is how easily the oil can flow between  
11:03:33 3 these fused grains. And it's very subtly dependent on the details  
11:03:40 4 of the pore structure. What we show on the left with these arrows  
11:03:44 5 being blocked is that the grains are arranged such that we don't  
11:03:48 6 really get much flow, so that would be a low permeability.  
11:03:52 7 Essentially, it's like, you know, driving along a road network  
11:03:55 8 where there are lots of road works and everywhere you try and go  
11:03:59 9 you're blocked.

11:04:00 10           The high permeability is more where the nice freeways and  
11:04:05 11 there's access to flow. There are connected pathways through the  
11:04:10 12 pore space. So we are looking here at the microscopic level,  
11:04:13 13 that's fundamentally what controls permeability, and it is an  
11:04:16 14 important number and absolutely vital number to get right in any  
11:04:20 15 reservoir simulation.

11:04:21 16 Q. And how is this number derived in the context of the  
11:04:25 17 information that's available to you and others to evaluate this  
11:04:30 18 reservoir?

11:04:30 19 A. There are a number of different ways in which permeability can  
11:04:36 20 be evaluated being such important concept. It's not a surprise  
11:04:41 21 that that's the case. So, your Honor, the most direct way is take  
11:04:47 22 a sample of rock from the reservoir and you measure permeability in  
11:04:51 23 the laboratory. And that was done for Macondo. It was done on, I  
11:04:55 24 think, 16 different core samples. And the average permeability,  
11:04:59 25 again, looking at the data, is about 360 millidarcies.

11:05:03 1 But there are two other methods. The other is actually  
11:05:05 2 to use the logs. The reason why there's the downhole measurements  
11:05:10 3 after drilling the well, the reason why I use those is, rather than  
11:05:14 4 just looking at 16 small core samples, you get a permeability  
11:05:18 5 through the 93 feet that you encounter. BP got a value of about  
11:05:23 6 220 millidarcies.

11:05:25 7 And then you're thinking, well, that's actually quite  
11:05:28 8 different. We haven't really pinned this number down.

11:05:32 9 So the gold standard in reservoir engineering is the  
11:05:35 10 permeability controls the flow out to the well. So what you should  
11:05:39 11 be using to measure permeability is information from flow. So what  
11:05:47 12 you do is you do a pressure analysis of oil flow, and from that you  
11:05:54 13 get a permeability that isn't measured on a small rock sample,  
11:05:58 14 isn't even just looking near the well, it's giving you an average  
11:06:03 15 around the well. And an average that may extend out hundreds or  
11:06:07 16 even thousands of feet. And that's the gold standard. That's the  
11:06:10 17 best number to use.

11:06:13 18 Q. So this test that allows you to measure flow, how is that done?

11:06:17 19 A. There are two ways: The first was before the accident there  
11:06:25 20 was what's called this MDT tool.

11:06:27 21 Q. April 12th?

11:06:28 22 A. April 12th. And that extracted oil from the formation and the  
11:06:33 23 pressures and the rates and the flow rates were measured from which  
11:06:37 24 you can make a determination of permeability. I have not done  
11:06:40 25 that, your Honor. That's the expert analysis of Professor



11:06:45 1 Gringarten.

11:06:46 2 Q. Okay. Now, let's talk about the government's analysis here.

11:06:54 3 What, if anything, is wrong with the government's estimates of

11:06:56 4 permeability? And I'll cite you to D-23565A, please.

11:07:02 5 A. So the other method -- and again, this is standard well test

11:07:09 6 analysis -- is you look at the measured pressures from the well

11:07:13 7 when you close in the well. That's exactly what was done with the

11:07:18 8 capping stack.

11:07:20 9 So what I am showing in this graph -- and again, it's a

11:07:23 10 replot, actually, of one of the graphs we've shown earlier, your

11:07:27 11 Honor. This is the increase in pressure, so from choke closure,

11:07:34 12 this is the increase, how much did the pressure go up? The red is

11:07:39 13 just the data. It's the data on the capping stack. So the

11:07:43 14 pressure went up, as I've said, by about 400 psi.

11:07:48 15 This is time, this logarithmic axis so it sort of

11:07:54 16 stretches out the early time and compresses the late time. So this

11:07:57 17 is about 1 hour, 10 hours, 100 hours, and this goes out now to two

11:08:02 18 weeks.

11:08:04 19 Q. Why do you have 300 millidarcies with wellbore cooling and

11:08:09 20 greater than 500 millidarcies when cooling is ignored? What is the

11:08:14 21 significance of that?

11:08:16 22 A. This is very significant in the sense that what the government

11:08:20 23 experts have done is they've taken the capping stack data and

11:08:26 24 they've converted to the reservoir with a fixed number, so the

11:08:31 25 increase that they think they see in the reservoir is the same

11:08:34 1 increase that you see at the capping stack.

11:08:36 2           What's the consequence of that? So they think the  
11:08:39 3 reservoir pressure is increasing slowly. What does that mean  
11:08:44 4 physically? For a given flow rate, let's assume, which there is,  
11:08:52 5 there is a flow rate on the final day. So let's consider that  
11:08:56 6 fixed.

11:08:58 7           If you've got a high permeability reservoir, it's easy to  
11:09:05 8 flow, which means the pressure drop is low. So the pressure in the  
11:09:10 9 reservoir doesn't decrease that much, and then when you stop the  
11:09:13 10 flow, the pressure doesn't build up that much. So what you see is  
11:09:17 11 a pretty gradual rise. So this gradual rise means high  
11:09:22 12 permeability.

11:09:23 13           So Dr. Pooladi-Darvish, for instance, in his simulation  
11:09:26 14 models, he does match the capping stack pressure; and when he  
11:09:31 15 matches the capping stack pressure, he gets permeabilities of  
11:09:35 16 around 500 millidarcies or more. That's entirely consistent with  
11:09:39 17 him ignoring wellbore cooling.

11:09:42 18           It's also entirely wrong. Because as I showed in that  
11:09:46 19 little animation, your Honor, in the first day, certainly in the  
11:09:51 20 early periods, there's this rapid cooling of the oil. What does  
11:09:56 21 that mean? That means the oil is getting heavier and it's getting  
11:09:59 22 heavier faster. So imagine that weight of oil pushing down on the  
11:10:03 23 reservoir. Over time it's pushing down more and it's pushing down  
11:10:07 24 more quickly.

11:10:08 25           What does that lead to? It leads to the reservoir

11:10:11 1 pressure, which is in green. This is my conversion. The reservoir  
11:10:15 2 pressure is increasing faster. What does that mean physically for  
11:10:20 3 the given flow rate? If the permeability is low, right, you have  
11:10:24 4 to have a big pressure drop. It's like trying to suck a straw with  
11:10:28 5 a thick milkshake. When you close in the well, the pressure  
11:10:32 6 bounces back up rapidly.

11:10:34 7           So the true pressure response in the reservoir, if you  
11:10:39 8 obey conservation of energy, basic physics, is actually the  
11:10:44 9 reservoir pressure is rising quite rapidly. The permeability is  
11:10:48 10 almost certainly no more than 300 millidarcies; but by ignoring  
11:10:53 11 this, this is where the government experts have, I would have to  
11:10:57 12 say, mislead themselves, even though they've matched the pressure,  
11:11:00 13 into thinking that the reservoir permeability must be 500  
11:11:03 14 millidarcies.

11:11:04 15 Q. Let's look at D-23566 and talk just for a minute about  
11:11:14 16 permeability in terms of your view and that of the other experts.  
11:11:20 17 So I want to ask you, first of all, with regard, Dr. Blunt, to your  
11:11:24 18 pressure analysis of 300. How did you make this calculation?

11:11:30 19 A. So this calculation was using the industry standard. Almost  
11:11:36 20 the textbook analysis of what's called this radial flow period.  
11:11:43 21 Now, so that gives me approximately 300 millidarcies.

11:11:48 22 Q. Then, in your report, I believe, that you used the value of  
11:11:56 23 329, higher than what you evaluated it as. Why are you using 329  
11:12:04 24 to evaluate the reservoir?

11:12:05 25 A. Well, this is all part of my conservative approach, so as

11:12:11 1 not -- if anything, to err on the side of more oil released.

11:12:15 2 As I said, I used a textbook pressure analysis, but I do  
11:12:22 3 need to assume a final day flow rate. And of course, there are  
11:12:26 4 uncertainties in that determination. A determination incidentally  
11:12:28 5 that I have not made.

11:12:29 6 The advantage with Professor Gringarten is that this is  
11:12:32 7 an independent measurement made before the accident. But erring on  
11:12:36 8 the conservative side, I don't take his mid range case, I take his  
11:12:40 9 highest possible case. It's totally consistent with what I see.  
11:12:44 10 There's no disagreement because there's a range of values, but I've  
11:12:48 11 taken the highest possible value of permeability that is consistent  
11:12:51 12 with the evidence.

11:12:52 13 Q. If you used your calculated value of 300 instead of  
11:12:57 14 Dr. Gringarten's value of 329, what would that do to your  
11:13:07 15 calculation on the most likely flow from the Macondo well?

11:13:09 16 A. It would decrease my value. But I do have to emphasize, unlike  
11:13:14 17 the reservoir simulation models, my determination of oil released  
11:13:18 18 isn't proportional to permeability. So if you make a 10 percent  
11:13:22 19 decrease in permeability, you might see about a one percent change  
11:13:26 20 in my determination of oil released. So it will make a difference,  
11:13:28 21 but a small difference.

11:13:30 22 Q. New topic. Aquifer. There was discussion yesterday about the  
11:13:39 23 possibility of an aquifer at the Macondo reservoir, and testimony  
11:13:43 24 that you assumed that there was no flow contribution from an  
11:13:49 25 aquifer without investigating the issue. I'll ask you, Dr. Blunt,

11:13:54 1 did you look into the issue of aquifer?

11:13:58 2 A. Yes, I did.

11:14:01 3 Q. Could we see TRES 1553.47 at page 47. And just in the interest  
11:14:16 4 of time, if you could go to the paragraph -- the sentence that  
11:14:22 5 begins, "The clear signal of channel flow." I'll just ask you,  
11:14:29 6 Dr. Blunt, to look at this callout and then explain to the Court  
11:14:33 7 what work did you in order to understand the issue of possible  
11:14:37 8 aquifer.

11:14:37 9 A. Yes. There are two main pieces of evidence. The first one is  
11:14:45 10 my own pressure analysis. I was only able to get an accurate  
11:14:50 11 representation of the pressure response by having no-flow  
11:14:55 12 boundaries; by which, I mean barriers to flow on all sides of the  
11:15:01 13 reservoir.

11:15:02 14 So that strongly indicates that there is no aquifer  
11:15:05 15 support. There's no evidence that we're seeing a drainage region  
11:15:09 16 that extends beyond the oilfield. You would see a different  
11:15:12 17 pressure signature, particularly when you look after 19 days.

11:15:17 18 The second piece of evidence is not an analysis that I've  
11:15:20 19 performed, but that of the expert report of Professor Gringarten.  
11:15:24 20 Professor Gringarten is probably the world's greatest expert on  
11:15:28 21 pressure transient analysis and he's pioneered a method called  
11:15:33 22 deconvolution. What that allows him to do is not just look at  
11:15:36 23 19 days of data, but essentially to look at the whole period, so 19  
11:15:40 24 plus 86 days. So he is looking at over 100 days effectively.

11:15:46 25 And there he sees the diagnostic X-ray signature of the

11:15:49 1 pressure response, a clear signal that you are producing oil from a  
11:15:54 2 contained box. So that essentially excludes aquifer support. It's  
11:15:58 3 not an assumption, it's a determination from the data.

11:16:03 4 Q. Let's go to D-23567. I'll just ask you -- 23567.

11:16:25 5 MR. CERNICH: Your Honor, I am going to object. This  
11:16:29 6 doesn't appear in Professor Blunt's report. He doesn't rely on  
11:16:34 7 Professor Zaldivar at all for flow rate schedule.

11:16:39 8 MR. BROCK: I believe this document is in his report,  
11:16:46 9 isn't it?

11:16:46 10 THE COURT: Is this an exhibit from your report?

11:16:48 11 THE WITNESS: It's a graph from my report where I've  
11:16:51 12 simply scaled the Y axis by multiplying all of the numbers by  
11:16:56 13 45,000 stock-tank barrels a day, and I've included the box from  
11:17:01 14 Dr. --

11:17:01 15 THE COURT: Is this exactly what was in your report or  
11:17:03 16 did you add something?

11:17:04 17 THE WITNESS: I've added things to it, your Honor.

11:17:07 18 THE COURT: Okay. That's the question.

11:17:09 19 MR. CERNICH: And your Honor, Dr. Zaldivar's work is not  
11:17:12 20 anywhere cited in Professor Blunt's report and it's not on his  
11:17:15 21 considered list.

11:17:16 22 MR. BROCK: Your Honor, this is a demonstrative we expect  
11:17:20 23 to elicit evidence that will demonstrate the range of flow that  
11:17:26 24 occurred with slug flow when Dr. Zaldivar testifies. So I will not  
11:17:34 25 discuss that with Dr. Blunt, I don't need to discuss that with him

11:17:39 1 to make the point I need to make with this slide. But this is a  
11:17:43 2 demonstrative that will show a fact that will be proved in the case  
11:17:49 3 and his consistency with that.

11:17:52 4 MR. CERNICH: I would like it to be clear on the record,  
11:17:54 5 your Honor, that Professor Blunt didn't rely on Dr. Zaldivar's work  
11:18:00 6 and that he did not use that in any way in his analysis.

11:18:03 7 THE COURT: Is that correct?

11:18:05 8 THE WITNESS: That is indeed correct. Yes.

11:18:07 9 MR. BROCK: I don't have any problem with that. That's  
11:18:11 10 fine.

11:18:17 11 BY MR. BROCK:

11:18:18 12 Q. Dr. Blunt, I'll just ask you to use this diagram here to  
11:18:22 13 describe for the Court how your calculation applies to the final  
11:18:30 14 day flow rate and how this diagram here is relevant to your  
11:18:36 15 analysis.

11:18:37 16 A. So, your Honor, in Appendix E of my report, I devote a whole  
11:18:44 17 appendix to addressing one of the concerns that's been raised by  
11:18:49 18 Dr. Pooladi-Darvish and Dr. Kelkar concerning flow rate history.  
11:18:56 19 It is true that the pressure response is affected by the flow rate  
11:19:02 20 history. So what I, first of all, did is I checked out if we look  
11:19:05 21 at different possible flow rate histories, and this is one of a  
11:19:09 22 number of cases that I do examine in my expert report, it does not  
11:19:14 23 affect my quantitative calculations, so I am not hinging my  
11:19:19 24 analysis on a particular assumption of what the flow rate schedule  
11:19:25 25 might be.

11:19:26 1 But what I am simply illustrating here -- and I am not  
11:19:29 2 advancing an opinion on what the flow rate history should be, is we  
11:19:33 3 have here a flow rate history that starts low, reaches a maximum,  
11:19:39 4 declines by the time flow is stopped, with a final flow rate that  
11:19:46 5 is broadly consistent with expert analysis and which has a  
11:19:51 6 cumulative flow consistent with my material balance analysis.

11:19:54 7 So all I am trying to say here, your Honor, is there may  
11:19:58 8 or may not be erosion of a particular form. There may be a final  
11:20:03 9 flow rate, but that doesn't invalidate my analysis. There are  
11:20:07 10 possible flow rate schedules that I've put through my analysis that  
11:20:10 11 give me the same cumulative oil release that are entirely  
11:20:13 12 consistent with that.

11:20:15 13 Q. The Court will be glad to know I am not going to use any backup  
11:20:20 14 slides.

11:20:22 15 So just to summarize, Dr. Blunt, your opinion is that the  
11:20:30 16 best analysis would reflect that 3.26 million stock-tank barrels of  
11:20:38 17 oil flowed from the Macondo well; that higher cumulative flow  
11:20:45 18 rates, that is outside your bounds, such as higher rock  
11:20:51 19 compressibility would not honor the data that we have in this case;  
11:20:57 20 and that data from sources before and after the incident avoid the  
11:21:03 21 difficulties and complexities of calculating daily flow rates and  
11:21:10 22 give the best estimate, from your perspective, of the total flow  
11:21:14 23 from the Macondo well?

11:21:16 24 A. Yes. I agree with that.

11:21:19 25 MR. BROCK: Thank you, Dr. Blunt.



01:21:20 1 THE COURT: All right. Mr. Cernich.

01:21:31 2 We will go for about 30, 35 minutes and then we will  
01:21:41 3 recess for lunch.

01:21:43 4 MR. CERNICH: Thank you, your Honor.

01:22:30 5 THE COURT: Go ahead.

01:22:31 6 MR. CERNICH: May it please the Court, Scott Cernich for  
01:22:34 7 the United States, your Honor.

01:22:36 8 CROSS-EXAMINATION

01:22:37 9 BY MR. CERNICH:

01:22:38 10 Q. Good afternoon, Dr. Blunt. I have you on cross-examination.

01:22:41 11 Isn't it true that BP has named you its principal  
01:22:44 12 testifying expert in this case?

01:22:45 13 A. It's the title you mentioned to me at my deposition, so I am  
01:22:48 14 aware of it, yes.

01:22:49 15 Q. And you weren't aware of that before I mentioned it to you at  
01:22:53 16 your deposition?

01:22:54 17 A. Actually, I wasn't.

01:22:54 18 Q. What does it mean to be BP's principal testifying expert?

01:22:58 19 A. Honestly, I don't know. If you take the word principal  
01:23:03 20 literally, I suppose I come first.

01:23:05 21 Q. And your best estimate is 3.26 million barrels were released  
01:23:12 22 from the Macondo reservoir?

01:23:13 23 A. Yes, it is.

01:23:14 24 Q. And in your report, you say that yours and Professor  
01:23:18 25 Gringarten's determinations of cumulative flow are independent and

11:23:21 1 involve distinct approaches, don't you?

11:23:23 2 A. I think that's what I said in my report.

11:23:25 3 Q. But that's not quite accurate, is it?

11:23:28 4 A. I think I also state that we have some methodology in common.

11:23:32 5 We both perform a well test analysis, for instance.

11:23:35 6 Q. Could we go to D-21165. In fact, you rely explicitly on

11:23:44 7 Professor Gringarten's permeability calculations for your analysis;

11:23:48 8 isn't that right?

11:23:49 9 A. That is correct, but I've also advanced my own opinions on the

11:23:51 10 permeability of Macondo.

11:23:53 11 Q. Right, a permeability based on an assumed flow rate?

11:23:56 12 A. Yes, to do the capping stack calculation, I did need to have to

11:24:03 13 have a flow rate. But I've also discussed other numbers for

11:24:07 14 permeability based on other sources of data that do not require a

11:24:10 15 flow rate.

11:24:11 16 Q. But the 300 millidarcies that you testified to on direct with

11:24:14 17 Mr. Brock was based on an assumed flow rate of 45,000 barrels per

11:24:20 18 day?

11:24:20 19 A. That is correct.

11:24:20 20 Q. And Professor Gringarten also calculated the total amount of

11:24:26 21 oil released from the Macondo reservoir, didn't he?

11:24:28 22 A. Yes.

11:24:29 23 Q. And --

11:24:32 24 THE COURT: Excuse me, Mr. Cernich, let me ask Dr. Blunt.

11:24:36 25 Where did you get the 45,000 barrels per day, where did that come

11:24:39 1 from?

11:24:41 2 THE WITNESS: At the time I wrote my expert report, I  
11:24:46 3 didn't know what the final day flow rate was, but I did have the  
11:24:49 4 expert report of Dr. Pooladi-Darvish. So what I did is I took the  
11:24:52 5 final day flow rate from his base case, but there's a technical  
11:24:57 6 issue, your Honor. To calculate permeability, it's not a flow rate  
11:25:02 7 in stock-tank barrels that I need but a reservoir condition flow  
11:25:08 8 rate because it's flowed from the reservoir.

11:25:09 9 So what I did was I took Dr. Pooladi-Darvish's base case,  
11:25:13 10 I converted it to reservoir conditions using his conversion, and  
11:25:17 11 then I converted it back using my conversion.

11:25:19 12 Now, I didn't get exactly 45,000 barrels a day, I think  
11:25:23 13 it was something like 46,000, I don't know the exact number. I  
11:25:28 14 didn't know whether or not that was right, so I used a round number  
11:25:31 15 as my assumption. So broadly speaking, I would consider it  
11:25:35 16 consistent with the final day flow rate determination from  
11:25:39 17 Dr. Pooladi-Darvish.

11:25:42 18 MR. CERNICH: Your Honor, I am going to move to strike  
11:25:44 19 that testimony. I asked Dr. Blunt during his deposition where he  
11:25:47 20 got his flow rate. He did not tell me that he got it from  
11:25:51 21 Dr. Pooladi-Darvish's work.

11:25:52 22 THE COURT: I prompted, I asked the question, so you  
11:25:55 23 can't blame him for giving the answer.

11:25:57 24 MR. CERNICH: I understand.

11:25:59 25 THE COURT: But if he said something different in his

11:26:02 1 deposition, you can certainly bring that out.

11:26:04 2 MR. CERNICH: I will.

11:26:05 3 BY MR. CERNICH:

11:26:06 4 Q. Professor Blunt, I asked you in your deposition where you got  
11:26:08 5 the 45,000-barrel-per-day flow rate, didn't I?

11:26:11 6 A. Yes, you did, and I said it was a round number, which indeed it  
11:26:14 7 was. It's not directly from Dr. Pooladi-Darvish.

11:26:18 8 Q. And you didn't mention Dr. Pooladi-Darvish when I asked you  
11:26:21 9 where you got that flow rate?

11:26:24 10 A. I don't recall mentioning Dr. Pooladi-Darvish. That was the  
11:26:27 11 motivation why I chose, say, 45,000 rather than 30,000 or 60,000,  
11:26:33 12 your Honor. But it was a round number. I am not suggesting that I  
11:26:36 13 did it exactly strictly from the calculation of  
11:26:39 14 Dr. Pooladi-Darvish, but as a, as one would say, a  
11:26:41 15 back-of-the-envelope calculation, it seemed broadly consistent with  
11:26:45 16 the expert -- with the expert reports that I had seen at the time.

11:26:49 17 Q. And that conversion is based on you using single-stage FVF  
11:26:54 18 rather than a multi-stage FVF, correct?

11:26:57 19 A. Yes.

11:26:57 20 Q. Now, Dr. Gringarten started with an assumed flow rate schedule,  
11:27:01 21 didn't he?

11:27:05 22 A. I think he did, yes. I don't recall every detail of his expert  
11:27:08 23 report.

11:27:08 24 Q. Do you recall agreeing with me at your deposition that he  
11:27:13 25 started with an assumed flow rate schedule?

11:27:15 1 A. Again, that's perfectly reasonable, yes.

11:27:18 2 Q. Can we go to D-22100. Professor Blunt, this is a flow rate  
11:27:29 3 schedule that Dr. Gringarten assumed in preparing his analysis;  
11:27:33 4 isn't that right? This is from his report?

11:27:36 5 A. I will assume it is. I can't recall it directly, but I have no  
11:27:41 6 reason to disagree with you.

11:27:41 7 Q. You read Dr. Gringarten's report, didn't you?

11:27:44 8 A. I have, yes.

11:27:45 9 Q. And this flow rate schedule here assumes 30,000 stock-tank  
11:27:49 10 barrels per day for April 20th to May 31st and 45,000 stock-tank  
11:27:54 11 barrels per day from June 1st until shut-in; isn't that right?

11:27:58 12 A. That's what I can see, yes.

11:28:00 13 Q. And the integral for that assumed flow rate schedule is  
11:28:03 14 3.26 million barrels, isn't it?

11:28:06 15 A. I don't think that's quite right. I think if you do the  
11:28:11 16 calculation properly, it's not 41, it's 42 days.

11:28:18 17 Q. So it's just a little more than 3.26 million barrels, isn't it?

11:28:24 18 A. I think doing the math, it's 3.29, yes.

11:28:27 19 Q. Do you know the basis for this step rate change in flow rate  
11:28:36 20 from 30,000 to 45,000 barrels on Day 41?

11:28:39 21 A. I don't actually, no.

11:28:41 22 Q. You were retained by BP in this matter in September 2011, a  
11:28:45 23 year after the Macondo well was cemented in, correct?

11:28:50 24 A. Yes.

11:28:50 25 Q. And isn't it true that Imperial College conducts research for

11:28:54 1 BP in the areas of reservoir characterization?

11:28:57 2 A. Yes, sir.

11:28:58 3 Q. And seismic --

11:29:00 4 A. Yes, and seismic. I definitely know in seismic, yes.

11:29:04 5 Q. And so you said you assumed so on reservoir characterization?

11:29:08 6 A. As I sit here today I'm afraid, Mr. Cernich, I can't remember a  
11:29:13 7 specific project involving reservoir characterization, but I  
11:29:17 8 certainly can recall a specific project on seismic.

11:29:20 9 Q. Professor Blunt, weren't you chair of the Imperial College  
11:29:23 10 earth science and engineering department from 2006 to 2011?

11:29:26 11 A. I was, yes.

11:29:26 12 Q. And your specialty is reservoir engineering, isn't it?

11:29:28 13 A. Yes.

11:29:28 14 Q. Now, BP also -- I'm sorry. Imperial College also conducts  
11:29:37 15 research for BP in process modeling and climate change?

11:29:39 16 A. Again, I am aware of research in climate change, not  
11:29:42 17 specifically on process modeling.

11:29:43 18 Q. And BP touted that relationship in a press release last year  
11:29:48 19 about donating \$100 million to UK universities, including Imperial  
11:29:52 20 College, didn't they?

11:29:53 21 A. I think I understand the context of what you're saying, but  
11:29:59 22 again, I don't recall the details. I am not involved in that  
11:30:01 23 project.

11:30:01 24 Q. Can we go to TREX 130539, and this is a BP press release  
11:30:07 25 entitled "BP Pledges 100 Million to UK-led Universities to Create

11:30:12 1 Industry Changing Materials." Did I read that correctly?

11:30:16 2 A. Yes.

11:30:16 3 Q. And Imperial College is one of those UK universities?

11:30:20 4 A. I think it is, but as I said, I'm afraid I am not involved in  
11:30:24 5 this project.

11:30:25 6 Q. Can we go to TREX 130539.0002. And here it says, "Imperial  
11:30:34 7 College London, conducts a wide range of research for BP including  
11:30:37 8 in the areas of reservoir characterization, process modeling,  
11:30:41 9 climate change, seismic imaging and urban energy systems." Did I  
11:30:45 10 read that correctly?

11:30:46 11 A. Yes.

11:30:46 12 Q. And isn't it true that three of BP's other experts in this case  
11:30:50 13 are also professors at Imperial College, Professor Gringarten,  
11:30:53 14 Professor Zimmerman and Professor Trusler?

11:30:56 15 A. That's correct.

11:30:57 16 Q. And you explicitly rely on your colleagues from Imperial  
11:31:01 17 College for the key inputs into your analysis; isn't that right?

11:31:04 18 A. I do use some of their expert analysis in my determination.

11:31:10 19 Q. Can we go to D-21162. You already testified that you directly  
11:31:20 20 input Professor Gringarten's permeability into your analysis; is  
11:31:23 21 that right?

11:31:24 22 A. That is correct. But I also have my own opinion on  
11:31:27 23 permeability.

11:31:28 24 Q. But the one that you used to do your cumulative flow rate  
11:31:32 25 calculation is Professor Gringarten's P90 permeability from his MDT

11:31:38 1 analysis; isn't that right?

11:31:39 2 A. That's correct. I think we need -- these P90, P10s can get a  
11:31:45 3 bit confusing. It's his upper bound permeability.

11:31:49 4 Q. I'm sorry, his P10. I did have that reversed. His P10 number.  
11:31:53 5 You used that specific number, 329 millidarcies, put it into your  
11:31:56 6 calculation and you come up with your cumulative flow rate?

11:31:59 7 A. That's correct. And as I've described, there are other  
11:32:02 8 possible numbers I could have done, and I erred on the side of  
11:32:06 9 having the highest permeability that was consistent with the data.

11:32:09 10 Q. And you used pressure data that was developed by Professor  
11:32:13 11 Trusler, correct?

11:32:14 12 A. Yes.

11:32:14 13 Q. And you needed that pressure data to do your analysis?

11:32:16 14 A. Well, I needed pressure data before Professor Trusler's data  
11:32:21 15 was available. There was other data actually that I had analyzed  
11:32:25 16 before I wrote the final version of my report. But you're right,  
11:32:30 17 the data I used was that interpreted by Professor Trusler.

11:32:34 18 Q. And you used Professor Zimmerman's rock compressibility  
11:32:38 19 numbers; is that right?

11:32:39 20 A. Again, that's correct. I have my own opinion on rock  
11:32:43 21 compressibility, but as I've said already, I defer to his superior  
11:32:47 22 expertise in that area.

11:32:47 23 Q. But just to be clear on the record, you have your own opinions,  
11:32:53 24 but what you use in your quantitative, cumulative flow rate  
11:32:58 25 calculation is Professor Zimmerman's number?



11:33:00 1 A. Yes, that's right.

11:33:01 2 Q. Now, you were first contacted on BP's behalf by your Imperial  
11:33:09 3 College colleague professor Geoff Hewitt; isn't that right?

11:33:13 4 A. Yes.

11:33:13 5 Q. Isn't it true, Professor Blunt, that BP hired Professor Hewitt  
11:33:17 6 in July of 2010 to provide an independent assessment of flow rate  
11:33:20 7 at the time of Macondo well integrity test?

11:33:22 8 A. Mr. Cernich, you did mention that at my deposition. Actually,  
11:33:28 9 I am not aware of that, or I wasn't aware of that.

11:33:31 10 Q. Can we go to Exhibit 11224. If we could call out the top of  
11:33:39 11 the e-mail, please. And this is an e-mail from Cheryl Grounds of  
11:33:45 12 BP to a number of individuals, including Trevor Hill, from whom we  
11:33:50 13 heard in court yesterday, subject "Independent analysis of flow  
11:33:54 14 rate range," did I read that correctly?

11:33:56 15 MR. BROCK: I am going to object on foundation. Unless  
11:33:58 16 there's some foundation shown for this witness's knowledge of this,  
11:34:01 17 I don't think this is appropriate.

11:34:03 18 MR. CERNICH: Your Honor, I think I can explore the  
11:34:05 19 retention of Professor Blunt.

11:34:06 20 THE COURT: Is this in evidence already?

11:34:08 21 MR. BROCK: It's not in evidence that I know of, and it's  
11:34:10 22 certainly not something on his reliance list.

11:34:13 23 MR. CERNICH: It's in Trevor Hill's bundle, it's been  
11:34:15 24 authenticated and has foundation on Trevor Hill --

11:34:18 25 THE COURT: It's an exhibit in Trevor Hill's deposition

11:34:20 1 bundle?

11:34:21 2 MR. CERNICH: Yes, your Honor.

11:34:22 3 THE COURT: And he -- well, he was a recipient of it, so  
11:34:25 4 he authenticated it?

11:34:27 5 MR. CERNICH: Yes, your Honor.

11:34:28 6 THE COURT: Overrule the objection.

11:34:28 7 BY MR. CERNICH:

11:34:31 8 Q. And there's an attachment here that says "Estimating Flow Rate  
11:34:34 9 Range V1.doc." Did I read that correctly?

11:34:38 10 A. Yes.

11:34:38 11 Q. Can we go to the attachment, please, Dawn.

11:34:41 12 And here the title of this attachment is "Estimating Flow  
11:34:45 13 Rate Range based on Well Integrity Test Data." Is that right?

11:34:48 14 A. Yes.

11:34:49 15 Q. And then number three says, "Contact 2 universities to offer  
11:34:54 16 independent assessment of estimated flow rate range," and the  
11:34:58 17 second university there is your university, Imperial College of  
11:35:02 18 London, isn't it?

11:35:03 19 A. That's correct.

11:35:03 20 Q. And there's G. Hewitt, that's Professor Geoff Hewitt?

11:35:07 21 A. Yes.

11:35:07 22 Q. And he is an expert in multiphase flow?

11:35:10 23 A. He is an expert in multiphase flow in pipes, yes.

11:35:13 24 Q. Did Professor Hewitt share with you his independent assessment  
11:35:17 25 of the estimated flow rate range?

11:35:19 1 A. No.

11:35:20 2 Q. I would like to talk about your specific expertise. You're not  
11:35:24 3 a geologist?

11:35:25 4 A. No, I wouldn't describe myself as a geologist, although the  
11:35:28 5 work that I've done for my analysis constructing geological models  
11:35:32 6 and using it one's engineering calculations is part of my  
11:35:36 7 expertise.

11:35:36 8 Q. It's a simple question, though, Professor Blunt, you are not a  
11:35:40 9 geologist?

11:35:40 10 A. No, I am not a geologist.

11:35:41 11 Q. And you didn't draw on the work of an expert geologist to  
11:35:45 12 perform your analysis of the Macondo reservoir, did you?

11:35:48 13 A. Well, I did to the extent that I read the BP reports and also  
11:35:54 14 read the relevant scientific literature on the possible structure  
11:35:58 15 of the deepwater turbidite.

11:36:00 16 Q. So you relied on BP's in-house experts' analysis of the Macondo  
11:36:04 17 reservoir to do your work?

11:36:05 18 A. Not exclusively. As I said, I also read the open literature to  
11:36:09 19 get an understanding of the likely arrangements of sandstone  
11:36:13 20 channels in Macondo.

11:36:14 21 Q. And there was nothing about specifically the Macondo reservoir  
11:36:17 22 in that literature that you read?

11:36:19 23 A. There was nothing about Macondo, but they were talking about  
11:36:23 24 geologically similar reservoirs of which there are quite a number  
11:36:27 25 in the Gulf of Mexico.

11:36:28 1 Q. You're not a petrophysicist, are you?

11:36:30 2 A. Again, I wouldn't describe myself as a petrophysicist, but I do  
11:36:35 3 have expertise in some areas of petrophysics; and petrophysics is  
11:36:39 4 simply the physics of rock, understanding core samples, making  
11:36:42 5 measurements, analyzing those, making predictions.

11:36:50 6 Q. And you're not an expert in rock mechanics, are you?

11:36:54 7 A. Again, I wouldn't describe myself as a rock mechanics expert  
11:36:59 8 like Professor Zimmerman, but as has already been discussed, I do  
11:37:03 9 have expertise in taking rock mechanics data, analyzing that data  
11:37:07 10 and using it in reservoir engineering calculations, just as I've  
11:37:09 11 done in my expert report.

11:37:11 12 Q. So, Professor Blunt, the answer is no, you're not a rock  
11:37:14 13 mechanics expert?

11:37:15 14 A. I wouldn't put it as strongly as that. I do have the expertise  
11:37:23 15 for the calculations I performed in my expert report and the  
11:37:27 16 expertise, for instance, that Kuwait Oil Company to look at their  
11:37:31 17 data.

11:37:32 18 Q. You were deposed in July in this case, weren't you?

11:37:34 19 A. Yes.

11:37:34 20 Q. And do you recall me asking you, "Are you an expert in rock  
11:37:41 21 mechanics?" And your answer was, "No, but I do have sufficient  
11:37:45 22 expertise for the analysis that I presented in my report." Was  
11:37:48 23 that your answer?

11:37:48 24 MR. BROCK: Your Honor, that's not impeachment, that's  
11:37:51 25 what he just said. I object to that.

11:37:53 1 MR. CERNICH: Your Honor, all I was asking for was a no  
11:37:56 2 instead of a yes or no --

11:37:58 3 THE COURT: He just didn't insert the word "no."

11:38:01 4 THE WITNESS: I will go with the answer I gave in the  
11:38:03 5 deposition.

11:38:04 6 MR. CERNICH: Thank you.

11:38:05 7 BY MR. CERNICH:

11:38:05 8 Q. You've never taught a course in rock mechanics?

11:38:07 9 A. No.

11:38:07 10 Q. You've never published a paper in rock mechanics?

11:38:10 11 A. No, I don't recall.

11:38:15 12 Q. And you defer to Professor Zimmerman as a rock mechanics  
11:38:19 13 expert?

11:38:19 14 A. Yes, there is no doubt whatsoever that he has superior  
11:38:23 15 expertise in this area to me.

11:38:24 16 Q. He is the real deal, in your mind?

11:38:26 17 A. That would imply that I don't have sufficient expertise for my  
11:38:32 18 calculations, and that wouldn't be correct. He is certainly the  
11:38:35 19 real deal when it comes to rock mechanics, though.

11:38:39 20 Q. You're not an expert in multiphase flow and pipes and  
11:38:42 21 production systems, are you?

11:38:43 22 A. No.

11:38:43 23 Q. And you're not an expert in computational fluid dynamics in  
11:38:49 24 pipes?

11:38:50 25 A. No.

11:38:50 1 Q. I think you already testified on direct you are not an expert  
11:38:53 2 in erosion?

11:38:54 3 A. No, I am not offering any opinions on the rate of erosion,  
11:38:59 4 except to say from my analysis, it's likely that it occurred.

11:39:03 5 Q. So you're offering an opinion based on your analysis on erosion  
11:39:10 6 even though you are not an expert in erosion?

11:39:11 7 A. Let me clarify. In Appendix E of my report, I evaluate what's  
11:39:17 8 called the skin factor at the beginning of the accident based on  
11:39:23 9 the Emilsen report. So I have an analysis that says that there was  
11:39:27 10 a significant skin at the beginning of the blowout period, and then  
11:39:30 11 I do an analysis of the injectivity test just before cementing that  
11:39:35 12 shows that those impediments to flow are not there. So I know  
11:39:39 13 there are impediments to flow to begin with and I know they're not  
11:39:42 14 there at the end. But I am not offering an opinion about what  
11:39:45 15 caused those necessarily or the rate at which they eroded.

11:39:48 16 Q. You referred to Mr. Emilsen. We'll come back to that later on.  
11:39:52 17 You're not an expert in cement?

11:39:54 18 A. No.

11:39:54 19 Q. And you have no opinions about the failure mode of the Macondo  
11:39:58 20 cement or whether it was set or not?

11:39:59 21 A. No, I don't.

11:40:00 22 Q. Now, isn't it true that 90 percent of your reservoir  
11:40:03 23 engineering analyses have been student research projects?

11:40:06 24 A. Yes, I would say that is correct. The vast majority of, one  
11:40:13 25 might say, the practical field-specific reservoir engineering

11:40:17 1 studies have been work in collaboration with students.

11:40:20 2 Q. And only 10 percent of your work has been actual consultancy?

11:40:26 3 A. Generally speaking, I would say that's a fair --

11:40:30 4 Q. And that's what you told me at your deposition?

11:40:32 5 A. Yes.

11:40:34 6 Q. Now, your specialty -- your specialty is actually pore scale  
11:40:41 7 modeling of reservoirs, isn't it?

11:40:43 8 A. It's one of my specialties, yes.

11:40:44 9 Q. And you published a variety of peer-reviewed papers and journal  
11:40:47 10 articles on that type of reservoir modeling?

11:40:50 11 A. Yes.

11:40:50 12 Q. And that involves using microscope images to examine pieces of  
11:40:55 13 reservoir rock, and you can create models of how fluid flows  
11:40:58 14 through those rocks?

11:40:59 15 A. Yes.

11:41:00 16 Q. Is that a fair way to put it?

11:41:02 17 A. That's a fair characterization.

11:41:03 18 Q. According to you, one of the great things about pore scale  
11:41:05 19 modelling is that you can create a model as long as you have just  
11:41:08 20 one little piece of rock?

11:41:09 21 A. Yes. Yes, you don't need -- even need a piece of rock this big  
11:41:16 22 (INDICATING).

11:41:16 23 Q. Actually, those three little Macondo rotary sidewall cores  
11:41:22 24 about the size of my thumb would have been sufficient for you to do  
11:41:25 25 pore scale modeling of the Macondo reservoir, right?

11:41:27 1 A. Yes, hypothetically, but I didn't need to, I would say, for  
11:41:31 2 this analysis because we had directly measured data.

11:41:33 3 Q. And using those pore scale images of those cores from the  
11:41:40 4 Macondo would have given you additional data?

11:41:42 5 A. There's no doubt that had X-ray images of sufficient  
11:41:52 6 resolutions, say, for instance, to see the pore structure of the  
11:41:57 7 rock would be additional data. But it wasn't necessary for my  
11:41:59 8 analysis. I didn't need to do modeling when I had direct data  
11:42:03 9 available.

11:42:03 10 Q. But it was available direct data that you ignored?

11:42:07 11 A. The data doesn't exist. I did look at the images of the  
11:42:14 12 Macondo cores that were available and I studied those carefully.

11:42:17 13 Q. But I am saying the Macondo cores were at Weatherford and you  
11:42:22 14 could have gotten pore scale images and that would have been  
11:42:26 15 additional data to add to your analysis, additional data in your  
11:42:29 16 specialty area, and you didn't pursue that, did you?

11:42:32 17 A. No, I didn't. I didn't need to for my analysis. We had  
11:42:35 18 directly measured data that was reliable. If I had done this,  
11:42:40 19 hypothetically, all you do is you would have a model, you compare  
11:42:43 20 it with the data. If it was the same as the data, you would say  
11:42:45 21 the model is good, but then you're using the same numbers as the  
11:42:49 22 measurements. And if the model disagreed with the measurements,  
11:42:53 23 you wouldn't know what to do and you would end up using the  
11:42:57 24 measurements.

11:42:58 25 So I didn't -- because it is my area of expertise, I can



11:43:01 1 critique where it is appropriate to be used and inappropriate, and  
11:43:05 2 I would say for Macondo that that would not be an appropriate use  
11:43:09 3 of pore scale modeling.

11:43:11 4 Q. You could have calculated permeability from those pore scale  
11:43:15 5 models, correct?

11:43:17 6 A. Yes, indeed that's one of the basic things to do, you take an  
11:43:21 7 image of the rock, your Honor, and do a computation fluid dynamics  
11:43:26 8 simulation and you get a number. You can do this calculation on a  
11:43:29 9 piece of rock that's this size (DEMONSTRATING). Compared to the  
11:43:34 10 determinations of permeability on rotary sidewall cores that are  
11:43:39 11 bigger and, of course, the pressure analysis determinations of  
11:43:42 12 permeability are much, much more robust and reliable.

11:43:46 13 So you're right, I could have done it, but I don't  
11:43:48 14 consider that it would have added any valuable information to my  
11:43:51 15 analysis.

11:43:51 16 Q. But you assumed a flow rate to do your calculation of  
11:43:54 17 permeability?

11:43:55 18 A. For the determination of permeability from the capping stack  
11:43:59 19 pressure, as I've already said, and there's no doubt about that,  
11:44:02 20 you need a flow rate. And I didn't independently determine final  
11:44:07 21 day flow rate, as I've just described. I took a round number,  
11:44:11 22 broadly speaking, based on Dr. Pooladi-Darvish's expert report.

11:44:15 23 Q. You used a unique method and unique equations to do your  
11:44:20 24 analysis here, a method and equations that can't be found in the  
11:44:23 25 published literature; isn't that right?

11:44:25 1 A. That's -- yes, that's right in some respects and not right in  
11:44:31 2 others. There are some of the analysis that's in my appendices  
11:44:37 3 that isn't in the literature, but all along I've applied absolutely  
11:44:43 4 standard best practice in reservoir engineering. There's nothing  
11:44:47 5 wrong to say unique in methodology.

11:44:48 6 Q. We will come back to the details of that a little later on.  
11:44:51 7 But this -- these methods and equations you used, you made those up  
11:44:55 8 for this litigation not to help BP respond to the blowout?

11:45:01 9 A. The analysis I performed has been after the blowout, yes.

11:45:04 10 Q. It's for this litigation?

11:45:06 11 A. The analysis I've done has been for this litigation, you're  
11:45:12 12 right. But I want to say I've applied standard methodologies. And  
11:45:17 13 I think as I've already said, certainly in my deposition, I derived  
11:45:20 14 all of the equations by hand, many of them are standard equations  
11:45:24 15 that are in the literature, I derived them all by hand so I  
11:45:27 16 understood every detail of the analysis. I wanted to be thorough  
11:45:31 17 as possible and I wanted to be able to describe everything as  
11:45:34 18 thoroughly as possible, not to rely on, say, black box  
11:45:38 19 methodologies.

11:45:38 20 Q. We will get back to the details of those equations that you  
11:45:41 21 derived by hand a little later on. Your method's never been  
11:45:45 22 subjected to peer review, correct?

11:45:49 23 A. Well, I am looking at my report and it says highly confidential  
11:45:54 24 on it, so the report itself has not been subjected to peer review.  
11:45:59 25 But I will say a couple of things: First of all, all of the

11:46:02 1 methodologies that I am using are reservoir engineering best  
11:46:06 2 practice, and the report itself has been on the web site for five  
11:46:10 3 months, and I have received feedback, all of it positive. I've not  
11:46:16 4 received any criticisms, say, of a technical nature outside of the  
11:46:20 5 testimony that we've heard on the work that I've done.

11:46:23 6 Q. Actually, I'm glad you raised that point, Professor Blunt. The  
11:46:28 7 government flow rate estimate and a variety of other independent  
11:46:32 8 flow rate estimates have been out in the literature for three years  
11:46:35 9 now, correct?

11:46:38 10 A. Yes.

11:46:38 11 Q. You've reviewed some of those?

11:46:40 12 A. Yes.

11:46:40 13 Q. And you haven't seen any of those articles in the peer-reviewed  
11:46:44 14 literature that contradict the government's flow rate estimate,  
11:46:47 15 have you?

11:46:48 16 A. That's correct. Doesn't mean to say they're right, though.

11:46:52 17 Q. We'll get -- I'm sorry. You're aware that Dr. Griffiths' work  
11:47:02 18 has been published in a peer-reviewed journal, aren't you?

11:47:04 19 A. Yes, I am. I think I've read that paper.

11:47:06 20 Q. And the method you used here for your expert work in this case  
11:47:13 21 is a method you have never used in your career to analyze a  
11:47:15 22 reservoir?

11:47:16 23 A. I don't think that's a fair characterization. As I've said,  
11:47:22 24 I'm using industry standard reservoir engineering techniques, basic  
11:47:26 25 scientific principles in all aspects of the analysis. Macondo is a

11:47:31 1 unique situation and there are some unique features to the analysis  
11:47:34 2 that are Macondo specific. But to describe the analysis as unique  
11:47:39 3 I don't think is a fair characterization.

11:47:40 4 Q. Well, you told me, Professor Blunt, during your deposition that  
11:47:44 5 you never in your career used this method to analyze a reservoir.

11:47:48 6 A. I've used material balance dozens of times to analyze  
11:47:54 7 reservoirs.

11:47:54 8 Q. Right. But your material balance is built on a variety of the  
11:47:59 9 building blocks --

11:48:03 10 MR. CERNICH: Okay, your Honor?

11:48:04 11 THE COURT: I didn't say anything. Well, I was going to  
11:48:06 12 make a suggestion, just as a matter of the way to impeach a witness  
11:48:13 13 with a deposition, you really should put it on the screen and ask  
11:48:16 14 him if that's what he said rather than just -- because, you know...

11:48:21 15 MR. CERNICH: I will.

11:48:21 16 THE COURT: In fairness to the witness, let him see his  
11:48:25 17 testimony.

11:48:25 18 MR. CERNICH: I will, your Honor, and I will get back to  
11:48:27 19 some of the details later and I'll move on. Thank you.

11:48:30 20 THE COURT: All right.

11:48:31 21 BY MR. CERNICH:

11:48:32 22 Q. Now, your material balance equation looks simple, Professor  
11:48:39 23 Blunt, but it took a lot of work to populate those variables in  
11:48:43 24 your equation?

11:48:45 25 A. Yes. Attention to detail is extremely important in this

11:48:49 1 calculation.

11:48:49 2 Q. Can we go to D-21163. And so, Professor Blunt, you relied on  
11:48:56 3 these five experts to do your analysis: Professor Gringarten,  
11:49:03 4 Professor Whitson, Professor Trusler, Professor Zimmerman and a  
11:49:07 5 seismic expert that was withdrawn by BP?

11:49:10 6 A. Well, in my quantitative calculations presented in my report, I  
11:49:17 7 haven't taken any information from this crossed-out seismic expert,  
11:49:23 8 so obviously I'll admit that I've taken information from the four  
11:49:26 9 other experts, but for the fifth expert, it had no impact on my  
11:49:30 10 calculations.

11:49:32 11 MR. BROCK: Your Honor, we have an objection to this  
11:49:33 12 slide, too, so I will state it for the record. I think it's -- I  
11:49:39 13 know this is a nonjury case and I get that, but it's just a bit  
11:49:41 14 argumentative to say we've withdrawn a seismic expert when we're  
11:49:45 15 operating in a world where the Court working with us has determined  
11:49:51 16 the number of experts that will be used in the trial. So I just  
11:49:54 17 don't think that's appropriate.

11:49:55 18 THE COURT: All right. Well, I understand and, again,  
11:50:00 19 since it is a bench trial, I certainly can understand and  
11:50:03 20 appreciate that. We don't have to worry about influencing or  
11:50:08 21 improperly influencing a jury.

11:50:09 22 MR. BROCK: Right, it's just the instinct to object, I  
11:50:13 23 think.

11:50:13 24 MR. CERNICH: Your Honor, I need to be heard on that  
11:50:16 25 point. BP withdrew this seismic expert before the Court imposed a

11:50:22 1 limit on experts in this case. They withdrew this expert two days  
11:50:29 2 before -- or if I'm wrong, about two days, it was somewhere within  
11:50:32 3 two or three days before Professor Blunt's deposition. So it's not  
11:50:36 4 quite right to say that he was removed because of the court's limit  
11:50:41 5 on experts in this case.

11:50:42 6 THE COURT: Okay. All right. Thank you.

11:50:49 7 BY MR. CERNICH:

11:50:49 8 Q. Now, to do your analysis you had to derive your own custom  
11:50:52 9 linear flow model; is that right?

11:50:55 10 A. Part of my analysis has a linear flow model, and for the  
11:50:59 11 reasons I've described, I wanted to understand every single detail,  
11:51:04 12 not rely on black box software that I didn't understand fully. I  
11:51:10 13 derived by hand the equations that I use, and that's in Appendix C  
11:51:14 14 of my report.

11:51:15 15 But the principles, your Honor, are fundamental  
11:51:17 16 principles: Darcy's Law which we talked about, conservation of  
11:51:22 17 mass. Linear flow is a recognized flow phenomenon in well test  
11:51:27 18 analysis. There is nothing fundamentally unusual about what I've  
11:51:32 19 done, except that I've gone and done it thoroughly and gone back to  
11:51:35 20 scratch, gone back to basics.

11:51:37 21 Q. But just to be clear, you derived your own custom linear flow  
11:51:41 22 model for your expert opinions in this case?

11:51:44 23 A. I derived the linear flow model. The use of the word "custom"  
11:51:48 24 sort of assumes that there's something particularly unusual about  
11:51:51 25 it. There isn't. I am using really standard equations and basic

11:51:56 1 scientific principles, and even the methodology for solving the  
11:52:00 2 equations is standard in my well test analysis.

11:52:03 3 Q. Let me try it this way, Professor Blunt. You never used this  
11:52:07 4 linear reservoir model before?

11:52:09 5 A. That's correct. I have performed well test analysis in the  
11:52:16 6 past normally using commercial software. And in that commercial  
11:52:21 7 software you can see a channel or linear flow regime, so I  
11:52:26 8 certainly want to identify that regime from a well test analysis.  
11:52:30 9 But as I said, just for the reasons I described, I went back to  
11:52:33 10 basics, making sure that I understood every nuance and re-derived  
11:52:39 11 all of the equations. Those are in Appendix C of my report.

11:52:46 12 Q. I heard you during your direct testimony use the term "real  
11:52:51 13 oilfield operations;" is that right?

11:52:53 14 A. Yes.

11:52:53 15 Q. This model has never been used in real oilfield operations?

11:52:58 16 A. The analysis of channel flow for a reservoir is completely  
11:53:04 17 standard. Indeed, in my expert report I show field case showing  
11:53:09 18 channel flow.

11:53:10 19 Q. I'm talking about your model. We established that you  
11:53:14 20 developed your own linear flow model, right, Professor Blunt,  
11:53:18 21 that's your testimony?

11:53:21 22 A. Yes. If you put it like that, the specific flow model in  
11:53:26 23 Appendix C has not been published, it has not been applied to real  
11:53:29 24 situations, because as you quite rightly pointed out, I derived it  
11:53:34 25 and presented it for the purposes of this expert report.

11:53:36 1 Q. And the bottom hole pressure analysis that you used, your  
11:53:44 2 wellbore cooling analysis to determine the pressures that you used  
11:53:48 3 in your pressure analysis that determined both your reservoir --  
11:53:54 4 connected reservoir volume and your final average pressure, you had  
11:53:59 5 never conducted that analysis before, had you? That Appendix B in  
11:54:02 6 your report is new work by you for this litigation?

11:54:06 7 A. Yes, it is, but it's using fundamental scientific principles.  
11:54:12 8 I mean, it's conservation of energy, hot things are cooling down.

11:54:17 9 And the basic principle, your Honor, which is that if  
11:54:20 10 you've only got measurements of the wellhead, you need to convert  
11:54:25 11 to the reservoir. And indeed, that there's a problem with that  
11:54:27 12 because of cooling is well recognized in the literature. I cite  
11:54:31 13 classically in the literature and I am applying standard  
11:54:35 14 methodologies.

11:54:35 15 Q. But there are industry tools that can do this type of analysis?

11:54:39 16 A. Yes, indeed, there are, your Honor. There are a number of  
11:54:43 17 commercial packages that, in principle, would enable you to do that  
11:54:48 18 calculation. And there are a couple of important reasons why I  
11:54:52 19 decided not to use them.

11:54:53 20 Q. And those have been peer-reviewed and used in the industry for  
11:54:57 21 years?

11:54:58 22 A. Not necessarily. Commercial software doesn't necessarily have  
11:55:05 23 to be peer-reviewed. I have seen some peer-reviewed papers that  
11:55:09 24 have analyzed similar problems; but actually, I would have to say  
11:55:12 25 not specifically the problem we're looking at here. But neither of



11:55:15 1 those were the main reasons I decided to do my own analysis.

11:55:18 2 Q. To determine your connected reservoir volume, Professor Blunt,  
11:55:24 3 you used -- you derived novel connectivity equations that you've  
11:55:28 4 never ever used in your career before?

11:55:30 5 A. That's correct. Some of the equations in Appendix D have been  
11:55:37 6 applied specifically to Macondo. But the principles, which is use  
11:55:41 7 pressure data to determine connectivity in the light of the seismic  
11:55:45 8 geological evidence, is not only is it standard in reservoir  
11:55:49 9 engineering, I consider it more as the essence of reservoir  
11:55:51 10 engineering.

11:55:52 11 So again, it's standard principles applied to a specific  
11:55:55 12 situation for Macondo.

11:55:56 13 THE COURT: All right. Let's recess for lunch. It's  
11:55:59 14 about five minutes till. We're going to come back at, take a  
11:56:05 15 little bit longer than normal, we'll say 1:20, okay.

11:56:10 16 THE DEPUTY CLERK: All rise.

11:56:11 17 (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.

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

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