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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 Tuesday, October 8, 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 5, MORNING SESSION  
TRANSCRIPT OF NON-JURY TRIAL PROCEEDINGS  
HEARD BEFORE THE HONORABLE CARL J. BARBIER  
UNITED STATES DISTRICT JUDGE

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P R O C E E D I N G S

(TUESDAY, OCTOBER 8, 2013)

(MORNING SESSION)

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5 (OPEN COURT.)

6 THE COURT: Good morning, everyone. Before we resume,  
7 let me announce the chess clock results from yesterday. According  
8 to our calculations, the United States used four hours and  
9 12 minutes, has 40 hours and 48 minutes remaining; BP used three  
10 hours and 36 minutes, has 41:24 remaining.

11 MS. SARGENT: Your Honor, good morning, Amelia Sargent  
12 for Transocean, and on behalf of the Aligned Parties. I would like  
13 to file, offer and ask to have introduced the exhibits that were  
14 used in the cross-examination of Adam Ballard and Iain Adams. The  
15 exhibits have been circulated and we've received no objections.

16 THE COURT: All right. Any remaining objections?  
17 Hearing none, those are admitted.

18 MS. SARGENT: Thank you.

19 MR. REGAN: Good morning, your Honor. Matt Regan on  
20 behalf of BP. I am here to offer the exhibits we used in the  
21 cross-examination of Dr. Tom Hunter.

22 THE COURT: Any objections? Without objection, those are  
23 admitted.

24 MR. REGAN: Thank you, your Honor.

25 THE COURT: Sure.

08:07:57 1 MR. O'ROURKE: Good morning, your Honor, Steve O'Rourke.  
08:08:00 2 I wanted to talk about the order of witnesses for today and  
08:08:02 3 tomorrow.

08:08:02 4 THE COURT: Okay.

08:08:03 5 MR. O'ROURKE: We have three live witnesses planned for  
08:08:06 6 today plus one ten-minute video, that's Dr. Hsieh, a video,  
08:08:10 7 Dr. Griffiths, Dr. Zick.

08:08:11 8 THE COURT: Okay.

08:08:12 9 MR. O'ROURKE: So there is a chance that we could end a  
08:08:14 10 little early if they don't run to six o'clock, maybe four or five.  
08:08:18 11 We have got two witnesses left, we would call Kelkar first,  
08:08:21 12 Pooladi-Darvish last, and that would be the end of our case, plus  
08:08:24 13 one video tomorrow.

08:08:25 14 THE COURT: Okay.

08:08:25 15 MR. O'ROURKE: What I want to ask permission for is,  
08:08:27 16 Kelkar has just got here and we don't really have him ready to go  
08:08:31 17 today, so we would like to ask permission to break early today if  
08:08:34 18 we end after the three, tomorrow call Kelkar in the morning,  
08:08:38 19 Pooladi-Darvish in the afternoon.

08:08:39 20 THE COURT: In other words, if we finish with Hsieh,  
08:08:41 21 Griffiths and Zick, we would just -- whatever time that is, we  
08:08:45 22 would recess until the morning.

08:08:47 23 MR. O'ROURKE: Yes, sir.

08:08:48 24 THE COURT: That sounds reasonable to me.

08:08:50 25 MR. O'ROURKE: Thank you very much.



08:08:51 1 THE COURT: Looks like there's a good likelihood you will  
08:08:53 2 actually finish your case this week, right?

08:08:55 3 MR. O'ROURKE: It's quite possible we will be finished  
08:08:57 4 tomorrow by six. We can't control the cross, of course, but that  
08:09:02 5 would be my guess.

08:09:03 6 THE COURT: All right.

08:09:05 7 MR. BROCK: And Mr. O'Rourke and I have discussed this  
08:09:07 8 this morning. And I have witnesses in transit, and I've advised  
08:09:11 9 him that I will be ready with either Dr. Johnson or Dr. Blunt on  
08:09:15 10 Thursday morning. Dr. Johnson is here, Dr. Blunt is en route.

08:09:21 11 So the one thing I would like to do is that if the  
08:09:24 12 testimony, for whatever reason, spills over into Thursday, I would  
08:09:29 13 prefer not to start Dr. Blunt in the afternoon because that would  
08:09:33 14 put him here for four additional days, so I'll -- I can make it  
08:09:38 15 work with Dr. Johnson, I'll try to squeeze him in in the time that  
08:09:42 16 would allow for that. And assuming I can get Dr. Blunt here, he is  
08:09:47 17 in transit, we'll try to go with him Thursday morning. But I'll  
08:09:50 18 keep them apprised and the Court as it develops.

08:09:53 19 THE COURT: Okay. Thank you. Any other preliminary  
08:09:56 20 matters?

08:09:57 21 MR. BROCK: I was just going to, while I am here, your  
08:10:00 22 Honor, let you know that I would like to offer the exhibits that  
08:10:02 23 were used in the Dr. Chu deposition. These have been circulated  
08:10:06 24 and there are no objections.

08:10:07 25 And then with regard to Adam Ballard, I'll also offer his

08:10:11 1 exhibits. There were some objections to these. They have been  
08:10:15 2 resolved. And the list that I am presenting now is the list that  
08:10:21 3 was worked out between the parties.

08:10:23 4 THE COURT: Any remaining objections? Hearing none,  
08:10:25 5 those are all admitted.

08:10:31 6 MR. BROCK: The Chu video clip, yes.

08:10:33 7 THE COURT: Okay. Yes.

08:10:36 8 MS. HARVEY: Your Honor, Judy Harvey for the U.S. We are  
08:10:39 9 just going to go get Dr. Hsieh.

08:10:41 10 THE COURT: Okay. Do we have anyone here from Georgia?  
08:11:12 11 No lawyers from Georgia. Okay. I was going to offer my  
08:11:16 12 condolences to you, too, after last night.

08:11:20 13 (WHEREUPON, PAUL HSIEH, WAS SWORN IN AND TESTIFIED AS  
08:11:25 14 FOLLOWS:)

08:11:25 15 THE DEPUTY CLERK: Take a seat. If you'll state and  
08:11:27 16 spell your name for the record.

08:11:31 17 THE WITNESS: Paul Hsieh, my last name is spelled  
08:11:35 18 H-S-I-E-H.

08:12:03 19 THE COURT: All right, Ms. Harvey.

08:12:05 20 MS. HARVEY: Your Honor, may it please the Court, Judy  
08:12:07 21 Harvey on behalf of the United States.

08:11:39 22 DIRECT EXAMINATION

08:11:39 23 BY MS. HARVEY:

08:12:08 24 Q. Dr. Hsieh, can you please introduce yourself to the Court.

08:12:11 25 A. Yes. My name is Paul Hsieh. I work as a research hydrologist

08:12:15 1 for the U.S. Geological Survey. My office is Menlo Park,  
08:12:19 2 California.

08:12:20 3 Q. And can you briefly describe your educational background.

08:12:23 4 A. I received my undergraduate degree, my bachelor's degree in  
08:12:27 5 civil engineering from Princeton University, and I received my  
08:12:31 6 master's and Ph.D. degrees in hydrology and water resources from  
08:12:37 7 the University of Arizona.

08:12:38 8 Q. And how long have you been with the U.S. Geological Survey, or  
08:12:42 9 USGS?

08:12:43 10 A. For about 35 years.

08:12:44 11 Q. And what are your job responsibilities at the USGS?

08:12:48 12 A. I carry out research on fluid flow in the subsurface. I  
08:12:54 13 develop computer simulation models to simulate fluid flow and I  
08:12:59 14 develop field methods to make these measurements in the field.

08:13:02 15 Q. Let's turn to Demonstrative D1301, please, and turn to your  
08:13:11 16 involvement in the *Deepwater Horizon* oil spill. Dr. Hsieh, can you  
08:13:16 17 please describe the nature of your involvement with the *Deepwater*  
08:13:18 18 *Horizon* Oil Spill Response.

08:13:20 19 A. Yes. My involvement with the Oil Spill Response is summarized  
08:13:24 20 in three -- these three bullets, which describe three types of work  
08:13:29 21 that I did. The first type of work was from late June to  
08:13:35 22 July 15th, so this was before the well was capped, and this work  
08:13:40 23 was to develop criteria, or we call it the shut-in criteria, to  
08:13:44 24 determine whether the well was -- or had integrity or not and,  
08:13:51 25 therefore, whether the well should stay shut in or not after the

08:13:55 1 well was closed.

08:13:57 2           The second part of my work went from July 15th when the  
08:14:01 3 well was shut in to early August, and this work was to develop a  
08:14:07 4 model to simulate oil flow in the reservoir. And this model known  
08:14:13 5 as the leak detection model was used to determine whether there was  
08:14:19 6 leak coming from the well.

08:14:20 7           And the third part of my work was done from late July  
08:14:26 8 into early August, and that was to estimate the flow rate from the  
08:14:31 9 Macondo well and the total quantity of oil that was discharged from  
08:14:36 10 the reservoir. And this was done by modifying the leak detection  
08:14:39 11 model so that it can be actually used for calculating oil flow  
08:14:45 12 rates and total quantity, and that is called the flow rate  
08:14:50 13 estimation model.

08:14:51 14 Q. And when did your involvement in the response activities begin?

08:14:55 15 A. My involvement began in late June, around June 20th, and that's  
08:15:01 16 when I was involved.

08:15:03 17 Q. And who asked you to become involved?

08:15:06 18 A. At that time, the director of the U.S. Geological Survey,  
08:15:11 19 Marcia McNutt, asked me to be involved.

08:15:14 20 Q. And do you know why you were asked to become involved in the  
08:15:17 21 response?

08:15:17 22 A. Yes. The government science team needed somebody with  
08:15:20 23 expertise in modeling fluid flow in the subsurface, and I have that  
08:15:25 24 expertise.

08:15:25 25 Q. And let's turn specifically to the first phase of your work in

08:15:29 1 developing criteria to determine whether the capping stack could  
08:15:34 2 stay closed. Could you please explain what you were asked to do  
08:15:37 3 with respect to that task?

08:15:39 4 A. Yes. So stopping the oil flow was, of course, the primary  
08:15:43 5 objective, but stopping the oil flow by capping the well at the top  
08:15:49 6 ran a certain risk. The thinking at that time was that the initial  
08:15:55 7 explosion on April 20th could have damaged the well, this damage  
08:15:59 8 would be ruptured disks in the casing could have been blown open,  
08:16:04 9 and if that were the case, then shutting in the well from the top  
08:16:07 10 would cause oil to leak out of the casing into the sediments.

08:16:13 11 This could hydrofrac the sediment and break into the  
08:16:17 12 seafloor, that's called broaching, and that could lead to an  
08:16:21 13 underground blowout.

08:16:23 14 So to evaluate the integrity of the well, it was decided  
08:16:28 15 to shut it in for a brief period, measure the pressure and  
08:16:33 16 determine whether the well had integrity. It was called a well  
08:16:37 17 integrity test. And our job was to develop criteria to make the  
08:16:42 18 determination for whether the well had integrity or not.

08:16:45 19 Q. And did you work with anyone else on this task?

08:16:49 20 A. Yes. I worked in the team of government scientists, which was  
08:16:54 21 composed of my colleagues from the USGS, as well as scientists from  
08:17:01 22 the DOE, Department of Energy National Labs. And this team was  
08:17:05 23 called the Well Integrity Team.

08:17:07 24 Q. And where did you conduct this work?

08:17:09 25 A. This work was conducted both in Houston in the Westlake offices

08:17:15 1 of BP, and also in my office in Menlo Park.

08:17:20 2 Q. And what kind of information did you receive in developing the  
08:17:25 3 well shut-in criteria?

08:17:26 4 A. We received information from BP on a number of subjects, so  
08:17:35 5 this would include well information, the well construction, the  
08:17:41 6 logs that were obtained from well drilling; also geologic  
08:17:46 7 interpretation from 3D seismic and computer simulations of  
08:17:53 8 broaching an underground blowout from oil leaking out of the well.  
08:17:57 9 And also simulations of reservoir, the oil reservoir itself.

08:18:00 10 Q. And you mentioned you received information from BP. Do you  
08:18:06 11 recall who you worked with from BP on this matter?

08:18:09 12 A. We attended many meetings in which BP personnel were present.  
08:18:15 13 But the people that I remember the most in terms of working with  
08:18:20 14 them would include Kelly McAughan and Mike -- Bob Merrill. They  
08:18:28 15 are both BP employees who did reservoir simulation. Mike Levitan,  
08:18:34 16 who did well test analysis. Steve Willson is the BP expert on rock  
08:18:42 17 mechanics, and he did the simulations on broaching and subsurface  
08:18:48 18 blowout. And Mike Mason, who did modeling of flow in the well.

08:18:53 19 Q. And --

08:18:55 20 A. I'm sorry, there are many other people, but those are the names  
08:18:59 21 that I recall the best.

08:19:00 22 Q. And did your team eventually recommend pressure criteria for  
08:19:06 23 the shut-in test?

08:19:07 24 A. Yes. The Well Integrity Team made recommendations on how to  
08:19:14 25 evaluate the pressure to determine whether the well was -- had

08:19:19 1 integrity or not.

08:19:20 2 Q. And can we, please, pull up TREX 141394, titled "Well Integrity  
08:19:26 3 Test." And let's turn to callout 141394.12.2.US. Dr. Hsieh, are  
08:19:38 4 these the final well shut-in criteria?

08:19:40 5 A. Yes, these are the final criteria that were adopted to  
08:19:43 6 determine whether the well had integrity or not. And the criteria  
08:19:48 7 consisted of evaluating the pressure in the capping stack after the  
08:19:52 8 well was shut-in, and this pressure was divided into three ranges.  
08:19:57 9 We call those low pressure range, medium pressure range or high  
08:20:02 10 pressure range.

08:20:03 11 So the low pressure range in this chart is described by  
08:20:07 12 the area in red, and low meaning anything less than 6000 psi; the  
08:20:14 13 medium pressure range is from 6000 psi to 7500 psi, and that's  
08:20:21 14 indicated by the yellow zone; and anything higher than the 7500 psi  
08:20:27 15 would be considered high pressure, and that's described by the  
08:20:32 16 green zone.

08:20:33 17 So if after the well was shut in, the pressure rose into  
08:20:36 18 the low zone, the conclusion would be that the well did not have  
08:20:41 19 integrity and oil would be leaking out of the well. If the  
08:20:45 20 pressure rose into the middle, into medium zone, then it's not  
08:20:51 21 clear whether the well had integrity or not. And if the pressure  
08:20:54 22 rose into the high zone, that would be interpreted that the well  
08:20:59 23 had integrity and a shut-in would not cause oil to leak out of the  
08:21:03 24 well.

08:21:04 25 Q. And can you explain what you mean by loss of well integrity?

08:21:08 1 A. Loss of well integrity refers to the thinking that the initial  
08:21:15 2 explosion could have blown open the ruptured disks installed in the  
08:21:20 3 well casing, and if those ruptured disks were open, then closing  
08:21:26 4 the well would allow oil to leak out into the surrounding  
08:21:31 5 formation, and in that case, the well would have lost its  
08:21:35 6 integrity. Conversely, if the ruptured disks were not open and the  
08:21:41 7 well is able to contain the oil, then the well is said to have  
08:21:45 8 integrity.

08:21:45 9 Q. In the period of time that you and the science team worked on  
08:21:50 10 developing the pressure criteria, did anyone from BP express to you  
08:21:54 11 a concern that high pressures on shutting in the well could cause  
08:21:57 12 the ruptured disks to burst?

08:21:59 13 A. No. That was not a concern; and, in fact, the opposite  
08:22:04 14 assessment was made that closing the well -- closing the well that  
08:22:12 15 had integrity would not cause the well to lose its integrity.

08:22:14 16 Q. And do you recall whether you had any discussions with Bob  
08:22:19 17 Merrill, who indicated that high pressure wasn't a concern upon  
08:22:24 18 causing the ruptured disks to burst?

08:22:26 19 A. No. I don't have a clear recollection of Bob Merrill making a  
08:22:34 20 point about well -- about the ruptured disks, but in preparing for  
08:22:39 21 this trial, I did review my notebook where I kept my notes, and in  
08:22:44 22 my notebook, I did write down at a meeting on June 28th Bob Merrill  
08:22:52 23 made a presentation, and in that presentation, he pointed out that  
08:22:56 24 if the well had integrity, keeping the well -- or capping the well  
08:23:02 25 would not cause it to lose its integrity.



08:23:03 1 Q. And can we pull up TREX 008659.13.1.US, please. Dr. Hsieh, are  
08:23:15 2 these your notes from the June 28th conversation that you had with  
08:23:19 3 Dr. Merrill?

08:23:20 4 A. Yes, these were my notes. But it was not a conversation, it  
08:23:24 5 was a meeting that -- I, at that time, was in Menlo Park, so I  
08:23:29 6 attended this meeting through conference call and WebEx, and so  
08:23:36 7 these were the notes that I kept during -- while the meeting was  
08:23:39 8 going on.

08:23:39 9 Q. And can you please point us to the portion of your notes  
08:23:46 10 discussing Bob Merrill's comments.

08:23:49 11 A. Yes. The portion that -- of the note that I am referring to is  
08:23:53 12 the third yellow highlighted section that says, "shut-in will not  
08:24:00 13 further damage the well integrity if ruptured disk is intact."

08:24:05 14 Q. And during the period in which you were developing the pressure  
08:24:08 15 criteria, did you have any one-on-one meetings with individuals  
08:24:13 16 from BP?

08:24:13 17 A. Yes. I had a one-on-one meeting with Kelly McAughan, who is a  
08:24:18 18 BP employee who did reservoir modeling.

08:24:21 19 Q. And why did you have this meeting?

08:24:23 20 A. I had asked for additional -- okay. So first of all, Kelly  
08:24:29 21 McAughan made some presentations of reservoir modeling results  
08:24:34 22 during meetings that I attended. I had asked for additional  
08:24:38 23 information on those reservoir modeling, and either Bob Merrill or  
08:24:43 24 Cindy Yeilding -- Cindy Yeilding is a BP employee who was a liaison  
08:24:50 25 between BP and the government science team. Either Bob Merrill or

08:24:55 1 Cindy Yeilding arranged for me to talk to Kelly McAughan to get  
08:24:59 2 additional information on reservoir modeling.

08:25:01 3 Q. And do you recall the date of this meeting with Kelly McAughan?

08:25:05 4 A. Yes. The date was July 8th, 2010.

08:25:09 5 Q. And what was discussed at this meeting on July 8th?

08:25:12 6 A. I asked Kelly McGowan to provide me with more detailed  
08:25:16 7 information on input parameters that she was using for her  
08:25:22 8 modeling. And she provided me with these parameters, which  
08:25:26 9 included reservoir parameters and fluid parameters. So reservoir  
08:25:32 10 parameters would include porosity, permeability, rock  
08:25:38 11 compressibility. Fluid parameters would include the oil density,  
08:25:43 12 viscosity, formation volume factor. So those are the -- that's the  
08:25:47 13 information that Kelly McAughan provided to me.

08:25:50 14 Q. And did Kelly McAughan provide you with a value that BP was  
08:25:53 15 using in its reservoir modeling for rock compressibility?

08:25:56 16 A. Yes, she did provide me with a value for rock compressibility.  
08:26:01 17 She said that initially she was using 6 microsips for rock  
08:26:08 18 compressibility, and I understood that that 6 microsips came from a  
08:26:13 19 sidewall core. However, their later evaluation was that 6  
08:26:19 20 microsips was an underestimate, and 12 microsips was more  
08:26:24 21 representative of oil reservoirs in the Gulf of Mexico region. So  
08:26:29 22 they revised their model and changed the 6 microsips to 12  
08:26:34 23 microsips for rock compressibility in their model.

08:26:38 24 Q. And after this meeting, did you present your pressure criteria  
08:26:44 25 recommendations?

08:26:46 1 A. Yes. The Well Integrity Team presented its analysis and  
08:26:51 2 conclusions and recommendation at a meeting on July 9th. The  
08:26:56 3 meeting was attended by both government scientists and BP  
08:27:02 4 personnel.

08:27:02 5 Q. And what was the purpose of the July 9th meeting?

08:27:05 6 A. The purpose of the July 9th meeting was to review all of the  
08:27:12 7 analysis and data that was done up to that point. The meeting was  
08:27:17 8 focused on shut-in, so the purpose of the meeting was to make a --  
08:27:23 9 after reviewing all of that information, make a decision on whether  
08:27:27 10 the well should be shut in to test its integrity or not.

08:27:32 11 Q. And where was this meeting?

08:27:34 12 A. This meeting was held in Houston in the BP Westlake offices.

08:27:41 13 Q. And you were physically present at the meeting?

08:27:44 14 A. Yes, I was physically present.

08:27:45 15 Q. And were PowerPoint slides distributed at the meeting?

08:27:49 16 A. Yes. PowerPoint slides were shown and paper copies were  
08:27:55 17 distributed.

08:27:55 18 Q. And I would like to pull up TREN 008660N, please. Dr. Hsieh,  
08:28:06 19 do you recognize these slides?

08:28:08 20 A. Yes. This is the power -- the slide pack of the presentations  
08:28:17 21 that were being -- that were given during this meeting.

08:28:22 22 Q. And does this document include the slides that your team  
08:28:24 23 presented?

08:28:25 24 A. Yes, I believe this -- the entire -- all of the presentations  
08:28:32 25 were contained in this document.

08:28:35 1 Q. And you mentioned that BP gave presentations. Do you recall  
08:28:40 2 whether Dr. Merrill gave a presentation on July 9th?

08:28:43 3 A. Yes, Dr. Merrill gave a presentation.

08:28:45 4 Q. And let's pull up TREX 008660N.8.1.US, please -- sorry, back  
08:28:57 5 one to seven. Dr. Hsieh, can you describe what this slide is?

08:29:07 6 A. Yes. This is the slide, a set of slides that Dr. -- that was  
08:29:14 7 shown during Dr. Merrill's presentation.

08:29:16 8 Q. And can we go forward one slide, please, to page 8. And the  
08:29:24 9 slide is entitled "Characteristics of Reservoir Depletion/Build  
08:29:28 10 Up," correct?

08:29:29 11 A. Yes. These are the slides that show the reservoir simulation  
08:29:35 12 results presented by Dr. Merrill.

08:29:39 13 Q. And did Dr. Merrill indicate his assumptions for reservoir  
08:29:44 14 parameters in BP's modeling?

08:29:45 15 A. Yes. The assumptions are shown -- well, Dr. Merrill presented  
08:29:49 16 them and they're shown on this slide under the section  
08:29:54 17 "Assumptions." The assumptions consist of  $C_R$ , which is rock  
08:29:58 18 compressibility; aquifer, which is aquifer size, that is the amount  
08:30:02 19 of volume of water connected to the volume of oil; and also  $Q$  sub  
08:30:10 20 zero, which was the flow rate. So the quantities in red are the  
08:30:16 21 assumptions used by Dr. Merrill.

08:30:18 22 Q. And did Dr. Merrill indicate why these are in red?

08:30:22 23 A. Yes. These are in red, these values are used to simulate the  
08:30:28 24 pressure in the reservoir and the simulations using these  
08:30:35 25 parameters he called the base case.

08:30:39 1 Q. And did BP -- or Dr. Merrill also present other reservoir runs  
08:30:45 2 with different parameters?

08:30:46 3 A. Yes. So in the base case run, it was used to simulate the  
08:30:53 4 reservoir pressure, and then Dr. Merrill did what are called  
08:30:59 5 sensitivity runs which are bracketing runs, so these runs would  
08:31:04 6 vary the parameters to higher or lower values. So, for example,  
08:31:09 7 under sensitivity for  $c_r$ , rock compressibility, the rock  
08:31:14 8 compressibility was reduced to 6 microsips and also increased to 18  
08:31:19 9 microsips, and similar procedures were done for the other  
08:31:24 10 parameters.

08:31:25 11 And these were bracketing calculation that gave a higher  
08:31:30 12 and lower pressures to bracket the base case. Here is 11,350 psi.  
08:31:41 13 That was the simulated pressure in the reservoir after the well was  
08:31:46 14 closed and after the reservoir has come to equilibrium. And using  
08:31:51 15 the bracketing values, then a lower pressure was computed and a  
08:31:56 16 higher pressure was computed to bracket the base case value.

08:31:59 17 Q. And with respect to Dr. Merrill's base case of rock  
08:32:05 18 compressibility, what value did he provide?

08:32:07 19 A. He used 12 microsips.

08:32:09 20 Q. Did Dr. Merrill indicate that 12 microsips was a worst case  
08:32:14 21 number?

08:32:14 22 A. No. Dr. Merrill did not indicate that 12 microsips was a worst  
08:32:18 23 case number.

08:32:19 24 Q. And did your team rely on Dr. Merrill's base case modeling in  
08:32:23 25 developing your pressure criteria?

08:32:25 1 A. Yes. We relied on his model reservoir -- reservoir modeling  
08:32:32 2 results to develop our pressure ranges, low, medium, and high.

08:32:36 3 Q. And what happened after the July 9th meeting?

08:32:39 4 A. After the July 9th meeting the decision was made to shut in the  
08:32:47 5 well to do this test; to test whether the well had integrity or  
08:32:51 6 not. The shut-in criteria were finalized, and then the capping  
08:32:57 7 stack was installed on the BOP and the well was shut-in on  
08:33:03 8 July 15th to start the well integrity test.

08:33:07 9 Q. Now, I would like to discuss the second phase of your work,  
08:33:10 10 your model to detect a possible leak after shut-in. So let's call  
08:33:15 11 out 141394.12.2.US, the final pressure criteria developed. Can you  
08:33:25 12 tell me what happened after the well was shut-in on July 15th?

08:33:29 13 A. Yes. The well was shut-in by gradually choking back the flow.  
08:33:35 14 And as the flow was being choked back, the pressure in the capping  
08:33:39 15 stack rose through the low range, and when the choke was fully  
08:33:47 16 closed, the pressure was in the bottom range of the middle range,  
08:33:53 17 and that was about 2:30 in the afternoon on July 15th.

08:33:58 18 The pressure rose a little bit more but stopped in the  
08:34:02 19 middle of the middle range. So by about six o'clock the pressure  
08:34:07 20 was at about 6600 psi, almost smack in the middle of the middle  
08:34:12 21 range; so this indicated that there was uncertainty in whether the  
08:34:17 22 well had integrity or not.

08:34:20 23 Q. And was any further analysis done to investigate what to do  
08:34:24 24 next?

08:34:25 25 A. Yes. The leaders of the government science team wanted some

08:34:30 1 additional analysis to be done. This was possible because there  
08:34:35 2 was an extra piece of information which is how the pressure rose as  
08:34:40 3 the shut-in -- as the well was shut-in. And I was given the  
08:34:46 4 assignment to analyze this shut-in pressure to see if an additional  
08:34:53 5 determination can be made on well integrity.

08:34:54 6 Q. And did you develop that model?

08:34:58 7 A. Yes. I had very little time to develop that model because  
08:35:04 8 according to the shut-in criteria, when the well -- when the  
08:35:08 9 pressure rose into the middle zone, the well integrity test should  
08:35:13 10 only last for 24 hours. So basically, I had overnight to do this  
08:35:18 11 analysis, but I put together an oil reservoir simulation model to  
08:35:24 12 simulate the oil pressure. And although I couldn't make a  
08:35:29 13 definitive conclusion, the results of my analysis supported the  
08:35:34 14 interpretation that the well was -- the well had integrity and that  
08:35:40 15 was what I reported the next day.

08:35:42 16 Q. And let's turn to TREX 8639. And, Dr. Hsieh, do you recognize  
08:35:54 17 this document?

08:35:55 18 A. Yes, this document is the compendium of all of the PowerPoint  
08:36:02 19 slide presentation on July 16th, the day after shut-in.

08:36:05 20 Q. And this is where you presented your modeling?

08:36:08 21 A. Yes. These slides included the slides from my overnight  
08:36:13 22 analysis.

08:36:13 23 Q. And did BP also provide a presentation at this meeting?

08:36:18 24 A. Yes. BP also presented analysis or simulations, oil reservoir  
08:36:27 25 simulations.

08:36:28 1 Q. What was the purpose of the meeting that you had on July 16th?

08:36:31 2 A. The purpose of the meeting was to come to a decision on whether  
08:36:36 3 the well should be kept closed or whether it should be reopened,  
08:36:41 4 because the pressure rose into this intermediate zone where it was  
08:36:47 5 difficult to determine its integrity, and so there was still a risk  
08:36:52 6 of an underground blowout.

08:36:54 7 Q. And let's turn to TREX 008639.0015. And, Dr. Hsieh, can you  
08:37:08 8 tell me what this slide is?

08:37:10 9 A. This slide is the slide containing the input parameters that I  
08:37:20 10 used in my model that I developed overnight to evaluate the capping  
08:37:26 11 stack pressure.

08:37:26 12 Q. And where did you -- what is the source of the inputs to your  
08:37:30 13 model?

08:37:31 14 A. The source of the input were data that were provided to me by  
08:37:36 15 BP personnel.

08:37:37 16 Q. And what was your input for rock compressibility?

08:37:41 17 A. The input for rock compressibility was 12 microsips.

08:37:45 18 Q. And when you presented this model on July 16th, did anyone from  
08:37:50 19 BP indicate that that was the wrong rock compressibility to use?

08:37:53 20 A. No, nobody from BP commented it was the wrong compressibility.  
08:38:02 21 This value was provided to me in my meeting with Kelly McAughan and  
08:38:09 22 also was the same value used in Bob Merrill's presentation on  
08:38:13 23 July 9th.

08:38:14 24 Q. And did Dr. Merrill do a presentation at the July 16th meeting?

08:38:19 25 A. Yes. Dr. Merrill also presented reservoir simulations results



08:38:24 1 on this meeting of July 16th, yeah.

08:38:28 2 Q. And let's turn to TREX 8639.0010, just the page, not the  
08:38:36 3 callout. And, Dr. Hsieh, is this part of Dr. Merrill's  
08:38:44 4 presentation?

08:38:44 5 A. Yes, this slide is from Dr. Merrill's presentation.

08:38:46 6 Q. And did Dr. Merrill indicate the reservoir inputs that he was  
08:38:50 7 using in the base case?

08:38:52 8 A. The -- yes, the inputs for these results are indicated on the  
08:39:01 9 slide, and these were the same inputs that he presented on the  
08:39:07 10 meeting of July 9th.

08:39:10 11 Q. And what was the base case for rock compressibility?

08:39:13 12 A. The base case for rock compressibilities were 12 microsips.

08:39:19 13 Q. As a result of the meeting on July 16th, were any decisions  
08:39:25 14 made as to whether to keep the capping stack on?

08:39:27 15 A. Yes. After the meeting on July 16th after I presented my  
08:39:33 16 results and Dr. Merrill also presented his results, both suggesting  
08:39:38 17 that the interpretation is that the well had integrity. The  
08:39:43 18 decision was to keep the well closed for another six hours. During  
08:39:50 19 the six hours, there would be monitoring to monitor for leaks from  
08:39:54 20 the well. And if no leaks were detected, then the well would be  
08:40:00 21 extended, the closure would be extended for another six hours,  
08:40:04 22 additional monitoring, and this would be repeated as we go forward  
08:40:09 23 in time.

08:40:10 24 Q. And after the meeting on July 16th, did you continue to work on  
08:40:15 25 your leak detection model?

08:40:17 1 A. Yes. As additional data from the capping stack was available,  
08:40:22 2 I used these data to update my leak detection model.

08:40:28 3 Q. And did you subsequently make any presentations of your leak  
08:40:32 4 detection model?

08:40:32 5 A. Yes. I made three presentations of the updates that I made to  
08:40:39 6 the model. These presentations were made on July 26, July 29th or  
08:40:45 7 30th, and then the final one in early August.

08:40:48 8 Q. And did you ever publish the results of your leak detection  
08:40:54 9 model?

08:40:55 10 A. Yes. I published the results of the leak detection model were  
08:41:01 11 in a professional journal, *Groundwater*, and that paper was  
08:41:08 12 published in 2011.

08:41:11 13 Q. And let's pull up TREX 8618. And, Dr. Hsieh, is this the  
08:41:18 14 publication you just referred to?

08:41:20 15 A. Yes. This is -- the title of this publication is "Application  
08:41:25 16 of MODFLOW for Oil Reservoir Simulation During the *Deepwater*  
08:41:29 17 *Horizon Crisis*." MODFLOW is a fluid flow simulation model  
08:41:36 18 developed by the USGS. MODFLOW was primarily developed for  
08:41:42 19 simulating water flow in aquifers, but in this paper I show that  
08:41:48 20 the equations for simulating water flow in aquifers is the same as  
08:41:54 21 the equation used to simulate oil flow in the Macondo reservoir.  
08:41:58 22 So by a process of conversion, one can convert MODFLOW and apply it  
08:42:08 23 to reservoir simulation.

08:42:09 24 Q. And now, I would like to turn to a discussion regarding the  
08:42:13 25 facts surrounding your work on the flow rate model. When did you

08:42:18 1 start work on the flow rate model?

08:42:19 2 A. I started work on the flow rate model on July 28th.

08:42:25 3 Q. And who asked you to work on an estimation of flow rate?

08:42:29 4 A. Art Ratzel of Sandia Lab asked me to do that.

08:42:32 5 Q. And were you able to create a model to estimate flow rate and  
08:42:36 6 cumulative flow?

08:42:37 7 A. Yes. I revised the leak detection model so that the model  
08:42:42 8 could actually be used to estimate flow rate. And I used this  
08:42:47 9 revised model, which I would call the flow estimation model, to  
08:42:52 10 estimate the flow rate from the Macondo well. And by summing up  
08:42:56 11 the flow, we can get the cumulative volume discharged from the  
08:43:01 12 reservoir also.

08:43:01 13 Q. And what is the source of the inputs for your flow rate model?

08:43:06 14 A. The source of inputs from the flow rate model is also  
08:43:11 15 information that I obtained from BP while I was in Houston.

08:43:14 16 Q. And that includes the input for rock compressibility?

08:43:17 17 A. Yes.

08:43:18 18 Q. And did you present the results of your flow rate model at any  
08:43:22 19 point?

08:43:23 20 A. Yes. I presented the results of the flow rate model on  
08:43:29 21 July 30th in a meeting that was attended by government scientists  
08:43:35 22 and including Secretary Chu.

08:43:37 23 Q. And what was the purpose of the July 30th meeting?

08:43:40 24 A. The purpose of that meeting was to review all of the flow rates  
08:43:47 25 that had been estimated from earlier periods all the way up to

08:43:54 1 July 30th, and come up with a revised flow rate. And that was the  
08:44:00 2 purpose of the meeting.

08:44:01 3 Q. Do you recall at that meeting any pressure, political pressure  
08:44:06 4 to come up with a flow rate?

08:44:08 5 A. It was apparent to me that there was an urgency in coming up  
08:44:16 6 with a consensus value for the flow rate. However, there was no  
08:44:23 7 pressure to come up with a particular value.

08:44:26 8 Q. And do you recall any discussion regarding uncertainty bounds  
08:44:32 9 for the flow rate?

08:44:33 10 A. Yes. During the second day of the meeting, July 31st, there  
08:44:40 11 was a discussion on the uncertainty of the flow rate. And after  
08:44:47 12 the discussion, there was a consensus reached on the uncertainty.

08:44:50 13 Q. After the meeting in July did you eventually publish the  
08:44:56 14 findings of your flow rate model?

08:44:59 15 A. Yes. After -- well, after that meeting, I did no more work on  
08:45:05 16 the flow rate estimation model until October of 2010. I was asked  
08:45:11 17 to write a report on the flow rate estimation model. And at that  
08:45:18 18 time, I -- in the early -- in the meeting of July 30th, the flow  
08:45:24 19 rate model used pressure data only up to July 28th, and there were  
08:45:32 20 six additional days of pressure data up to July -- up to August the  
08:45:37 21 3rd.

08:45:37 22 So in October, I took all of the data and did a revision  
08:45:41 23 of the model; and also refined -- made some refinements on the time  
08:45:47 24 stepping. And I published that model as an -- as a standalone USGS  
08:45:54 25 report, but that report was also combined as an appendix to the

08:46:02 1 report by the Flow Rate Technical Group.

08:46:04 2 Q. And can we, please, pull up TREX 008804. And, Dr. Hsieh, does  
08:46:14 3 this -- can you tell me what this report is?

08:46:16 4 A. Yes, this is the report from the Flow Rate Technical Group.

08:46:22 5 Q. And does this report contain the results of your flow rate  
08:46:25 6 model?

08:46:26 7 A. Yes. There was -- my report on the flow rate was incorporated  
08:46:35 8 as Appendix, either A or 1, into this report.

08:46:40 9 Q. Dr. Hsieh, we've talked this morning about various reservoir  
08:46:44 10 models that you did in support of the response efforts. In each of  
08:46:47 11 the models that you were doing, were you using input data provided  
08:46:50 12 by BP?

08:46:51 13 A. Yes. All of the input data for all of my modeling work came  
08:46:57 14 from BP.

08:46:58 15 Q. And at any point during the presentations or meeting that you  
08:47:02 16 had with BP or afterwards, did BP indicate that you were using the  
08:47:06 17 wrong numbers for any of your inputs?

08:47:09 18 A. No, BP did not say that I was using the wrong numbers or any of  
08:47:15 19 the numbers were wrong in my input.

08:47:17 20 Q. Dr. Hsieh, at the conclusion of your work on the *Deepwater*  
08:47:22 21 *Horizon* Oil Spill Response, did you receive any recognitions?

08:47:25 22 A. Yes, I received three awards in 2010. I received an award from  
08:47:32 23 the USGS, it was called the Director's Award for Exemplary Service  
08:47:39 24 to the Nation. In 2011, I received the Service to America Medal  
08:47:45 25 from the Partnership for Public Service, which is an independent

08:47:49 1 organization; and I received this medal as the 2011 Federal  
08:47:55 2 Employee of the Year. And in 2012, I received an award from the  
08:48:01 3 National Ground Water Association. That award was for Excellence  
08:48:06 4 in Engineering and Science.

08:48:10 5 MS. HARVEY: Thank you, Dr. Hsieh. No further questions  
08:48:12 6 at this time.

08:48:14 7 THE WITNESS: Excuse me, your Honor, may I have a glass  
08:48:21 8 of water?

08:48:22 9 THE COURT: Should be right to your left.

08:48:28 10 THE WITNESS: Thank you.

08:48:28 11 MR. BROCK: Your Honor, I meant to do this this morning,  
08:48:33 12 at the taking care of issues session. My colleague Martin Blunt is  
08:48:38 13 going to conduct this examination, I just wanted to -- Martin Boles  
08:48:41 14 is going to conduct this examination. He is as smart as Martin  
08:48:46 15 Blunt, but Martin Boles is going to conduct this examination.

08:48:49 16 THE COURT: I thought we had two Mr. Martin Blunts in  
08:48:55 17 this case.

08:48:55 18 MR. BROCK: I brought my expert in to do the cross.

08:48:58 19 THE COURT: Okay.

08:48:58 20 MR. BROCK: I've done this to him before, so. Sorry  
08:48:58 21 about that.

08:48:59 22 THE COURT: All right. Mr. Boles, right, B-O-L-E-S?

08:49:01 23 MR. BOLES: Yes, your Honor.

08:49:02 24 THE COURT: All right. Thank you. Good.

08:49:04 25 MR. BOLES: I only wish I was as smart as Martin Blunt.

## CROSS-EXAMINATION

08:49:28 1

08:49:44 2 BY MR. BOLES:

08:49:45 3 Q. Good morning, your Honor. Martin Boles for BP and Anadarko.

08:49:49 4 Good morning, Dr. Hsieh.

08:49:50 5 A. Good morning, Mr. Boles.

08:49:51 6 Q. Good to see you again.

08:49:53 7 A. Likewise.

08:49:54 8 Q. I am going to be, as you might imagine, talking to you a little  
08:50:01 9 bit about rock compressibility. And I just want to start with, for  
08:50:06 10 Judge Barbier's benefit, getting to sort of the bottom line effect  
08:50:12 11 of these microsips that we keep hearing about.

08:50:17 12 In that final report that we just saw that you published,  
08:50:21 13 you had a bottom line cumulative flow number of 4.9 million barrels  
08:50:28 14 from the Macondo well; is that right?

08:50:30 15 A. Yes. I am not sure what the description "bottom line" is, but  
08:50:37 16 that is the number that I came up with and reported in that report.

08:50:44 17 Q. That's what I was getting at.

08:50:47 18 A. Okay, yeah.

08:50:48 19 Q. And in that analysis, to come up with that number, your input  
08:50:52 20 for rock compressibility was 12 microsips, right?

08:50:57 21 A. That is correct.

08:50:58 22 Q. Now, in the modeling that lies behind that report, you also  
08:51:03 23 looked at what would be the effect of if you input 6 microsips,  
08:51:09 24 correct?

08:51:11 25 A. No, I did not. In that modeling, I did not look at the effects

08:51:16 1 of 6 microsips. Okay. Let me back up. In that report, there was  
08:51:24 2 no report on what is the effect of using 6 microsips. In the  
08:51:30 3 meeting of August 30th, I did report on what would happen if you  
08:51:36 4 use 6 microsips.

08:51:38 5 Q. And what was the total cumulative flow that you came up with  
08:51:42 6 when you used 6 microsips?

08:51:44 7 A. The total cumulative flow reported on July 30th in that meeting  
08:51:52 8 was 2.9 million barrels with a starting flow rate at 3.8 or  
08:52:04 9 38,000 barrels per day dropping down to 32,000 barrels per day.

08:52:07 10 Q. So the effect of going from 12 microsips, which you used, down  
08:52:12 11 to 6 microsips is almost 2 million barrels of estimated cumulative  
08:52:18 12 flow?

08:52:21 13 A. That's correct. If 6 microsips were used -- I did use 6  
08:52:29 14 microsips as a bounding calculation, and using 6 microsips I would  
08:52:33 15 get 2.9 million stock-tank barrel.

08:52:38 16 Q. Let's rewind and go back over. You talked a lot on direct  
08:52:42 17 examination about information you had gotten from BP.

08:52:47 18 A. Yes.

08:52:47 19 Q. So let's start at the beginning. Initially, BP told you that  
08:52:53 20 the data from measurements on rock cores from the Macondo sandstone  
08:53:02 21 showed rock compressibility to be 6 microsips?

08:53:06 22 A. Yes. The sidewall core data gave a value of 6 microsips.

08:53:13 23 Q. And let's just take a quick look at TREC 8627.2. You received  
08:53:25 24 this BP Macondo technical note in early July 2010 getting this  
08:53:34 25 information about BP's modeling of the Macondo reservoir?



08:53:36 1 A. That's correct.

08:53:37 2 Q. And on page 2, 8627.3.2, it reported that BP was using  
08:53:48 3 6 microsips. That's the last bullet point there, correct?

08:53:53 4 A. That's correct. And that's consistent with what Kelly McAughan  
08:53:57 5 told you that initially they used 6 microsips.

08:54:00 6 Q. Now, there was somebody else whose studies you had seen at this  
08:54:07 7 point who -- outside of BP who used 6 microsips as well for the  
08:54:12 8 Macondo well; isn't that right?

08:54:13 9 A. Could you tell me who somebody else is?

08:54:17 10 Q. Yes, we talked about this in your deposition. This was a  
08:54:21 11 person who is going to testify tomorrow as an expert for the United  
08:54:24 12 States, Dr. Mohan Kelkar, he had done a study of the Macondo well  
08:54:29 13 before he became a litigation expert, correct?

08:54:33 14 A. Yes. I believe Mr. Kelkar -- Professor Kelkar had a report  
08:54:40 15 that was submitted to the Mineral Management Service.

08:54:44 16 Q. He was retained by the United States as part of a Flow Rate  
08:54:49 17 Technical Group study, correct?

08:54:53 18 A. That I am not exactly sure, but he did work for the Mineral  
08:54:57 19 Management Service, which is in the federal government, yes.

08:55:01 20 Q. And you received a copy of his report to the federal government  
08:55:06 21 during your work on the Macondo reservoir?

08:55:09 22 A. Yes, I did.

08:55:09 23 Q. And when he looked at the rock core data measurements, he, too,  
08:55:17 24 deduced a rock compressibility of around 6 microsips, didn't he?

08:55:22 25 A. I did not read that report in detail, so I don't remember that

08:55:29 1 aspect of it.

08:55:30 2 Q. Let's take a look at 9859.19.2. You have a copy of

08:55:45 3 Dr. Kelkar's report in your files, don't you, sir?

08:55:47 4 A. Yes, I do.

08:55:48 5 Q. And in it he reports an average rock compressibility of 5.61

08:55:57 6 microsips; is that correct?

08:56:00 7 A. Well, that's what it says. I mean, I won't argue with you

08:56:03 8 that -- okay, so this work was done probably in May of 2010, and I

08:56:09 9 won't argue with you that at the time, prior to July 7th or

08:56:15 10 July 8th, when I talked to Kelly McAughan, she had indicated to me

08:56:19 11 that the initial reservoir simulations used a rock compressibility

08:56:25 12 of 6 microsips.

08:56:27 13 Q. Let's talk a little bit about your conversation with Kelly

08:56:31 14 McAughan that you mentioned. And that's what led -- that's one of

08:56:36 15 the things that led to you using 12 microsips in your modeling just

08:56:41 16 prior to the shut-in, correct?

08:56:47 17 A. That is the reason that I used 12 microsips for my modeling. I

08:56:51 18 don't quite know what you mean by "just prior to shut-in." My

08:56:55 19 modeling modelled the entire period from the initial blowout to

08:57:01 20 shut in to -- until the well was killed by the static kill

08:57:06 21 operation on August 3rd.

08:57:08 22 Q. We'll look at some of the modeling you did and what rock

08:57:11 23 compressibility number you used after the shut-in. But let's just

08:57:16 24 first focus on the early July time period. Now, Kelly McAughan is

08:57:22 25 not a rock mechanics specialist, is she?

08:57:26 1 A. I don't believe she is a rock mechanic specialist.

08:57:29 2 Q. The rock mechanic specialist at BP working with her was someone  
08:57:34 3 named Steve Willson?

08:57:35 4 A. He is one of the experts in rock mechanics, yes.

08:57:38 5 Q. You mentioned him on your direct examination?

08:57:41 6 A. Yes.

08:57:41 7 Q. You never talked to him about his assessment of what the right  
08:57:45 8 rock compressibility number would be for the Macondo reservoir?

08:57:49 9 A. No, I never talked to him. The main information we obtained  
08:57:54 10 from him was his simulations of underground blowout.

08:57:58 11 Q. And the Senior BP Reservoir Engineer overseeing the work that  
08:58:03 12 included Kelly McAughan was another person you mentioned on direct  
08:58:07 13 examination, Dr. Robert Merrill?

08:58:12 14 A. He also did work on reservoir simulation. I don't know if  
08:58:22 15 senior was in his title or not. I don't know the work titles of  
08:58:28 16 the BP personnel that I interacted with.

08:58:31 17 Q. Well, he is come here to testify, so we will get that straight  
08:58:34 18 with him.

08:58:35 19 A. Okay.

08:58:35 20 Q. You never talked to Dr. Merrill about why he was including a  
08:58:42 21 higher rock compressibility case of 12 microsips, along with 6 and  
08:58:47 22 18, in that presentation that we will look at again that we saw and  
08:58:52 23 talked about in your direct examination?

08:58:54 24 A. Could you ask that question again?

08:58:56 25 Q. Sure. Did you ever talk to Dr. Merrill and ask him, "What do

08:59:01 1 you think the rock compressibility of Macondo reservoir really is"?

08:59:04 2 A. No, I didn't talk to him about that. I mean, it was clear in  
08:59:08 3 his presentation that 12 was the number that was representative of  
08:59:14 4 the reservoir.

08:59:15 5 Q. Well, we'll look at that. But, in fact, let's take a look at  
08:59:18 6 that presentation now. This is the Bob Merrill July 9  
08:59:27 7 presentation. And before we go on, the cover slide for the total  
08:59:42 8 group of BP presentations that were made on that day, says,  
08:59:47 9 "Shut-in the well on paper; benefits and risks." Doesn't it,  
08:59:52 10 Dr. Hsieh?

08:59:52 11 A. Yes, that was Paul Tooms presentation, yes.

08:59:56 12 Q. But part of Dr. Merrill's presentation was also to evaluate the  
09:00:02 13 risks or the potential risks from shutting in the capping stack?

09:00:05 14 A. Not -- that was not my understanding. His presentation was his  
09:00:12 15 presentation on his reservoir simulations.

09:00:14 16 Q. Well, you understood that there were some people of importance  
09:00:20 17 in terms of this analysis of Macondo well shut-in who were worried  
09:00:25 18 about possible effects of shutting in the well?

09:00:29 19 A. Oh, yes, there was definitely a risk of shutting in the well  
09:00:32 20 and the risk was the underground blowout.

09:00:35 21 Q. And you talked on your direct examination of the risk that  
09:00:41 22 there might have been an underground blowout caused by the initial  
09:00:45 23 Macondo blowout, right?

09:00:47 24 A. The initial Macondo blowout could have blown out the rupture  
09:00:55 25 disks that would later allow -- upon well shut-in, allow oil to

09:01:02 1 leak out of the well, and that would cause an underground blowout.

09:01:06 2 So the initial blowout does not cause the underground blowout or

09:01:10 3 would not lead to an underground blowout on its own.

09:01:13 4 Q. And the concern was that when you shut in the well, pressure is  
09:01:18 5 going to start building up?

09:01:19 6 A. Yes.

09:01:19 7 Q. And that increasing pressure could force reservoir fluids into  
09:01:26 8 other formations and cause what's sometimes known as a subsea  
09:01:31 9 blowout?

09:01:31 10 A. That's right.

09:01:32 11 Q. Now, there were some people concerned that even if there was  
09:01:40 12 not a leak already in the well, that just by putting on the capping  
09:01:46 13 stack and shutting it in, that could cause pressures to build up  
09:01:50 14 and cause a subsea blowout, weren't there?

09:01:52 15 A. No. That was not my understanding. There were a number of  
09:01:57 16 meetings that I attended between July -- June 28th and July 1st.

09:02:05 17 These meetings were chaired by Mike Mason, and it was stated a  
09:02:10 18 number of times where -- that the initial -- the rupturing of the  
09:02:18 19 rupture disk could only cause by the initial blowout and no other  
09:02:23 20 scenario envisioned could cause that.

09:02:27 21 Also in July, early July I received a BP technical memo,  
09:02:33 22 a copy of it from Steve Willson. And Steve Willson in this memo  
09:02:37 23 expressly stated that capping the Macondo well, if the well had  
09:02:44 24 integrity, would not in on its own cause blowout of the rupture  
09:02:50 25 disk and a leak into the surrounding formation.

09:02:55 1           So I would say the opposite. The thinking, BP's  
09:03:00 2 assessment was that capping the well will not cause a well with  
09:03:04 3 integrity to lose its integrity.

09:03:06 4 Q. Well, there was a concern, wasn't there, sir, that the pressure  
09:03:10 5 could build up high enough that it could rupture the capping stack  
09:03:14 6 itself?

09:03:16 7 A. That I don't know. The only information that I dealt with was  
09:03:24 8 whether the rise in pressure would cause rupture disks that had not  
09:03:28 9 ruptured to rupture during shut-in.

09:03:31 10 Q. Do you know Dr. Dykhuizen from the Department of Energy  
09:03:37 11 National Laboratories?

09:03:38 12 A. Yes, I know -- I mean, I don't know him personally, but I  
09:03:46 13 interacted with him during the Macondo oil spill response.

09:03:48 14 Q. Did you interact with him prior to the shut-in decisions?

09:03:53 15 A. Prior to the shut-in decision --

09:03:56 16 Q. In early July or June of 2010?

09:03:59 17 A. Yes.

09:04:01 18 Q. Now, he testified yesterday, "We didn't want the pressures to  
09:04:07 19 be so large that it would blow apart the capping stack." Did he  
09:04:12 20 ever express that concern to you, or did you hear anybody from the  
09:04:16 21 government express that concern in the time period of installing  
09:04:19 22 the capping stack and deciding whether or not to shut it in?

09:04:22 23 A. No. I have not heard any of those concerns. The only concern  
09:04:27 24 that I dealt with was whether the rupture disks in the casing were  
09:04:35 25 blown by the initial explosion and, therefore, risking a leak from

09:04:41 1 the well if the well were shut in.

09:04:43 2 Q. Let's look at the document we looked at in your direct  
09:04:53 3 examination about that risk, which is TREX 141394.12. This is the  
09:05:16 4 red, yellow, green. Should be on page 12. There it is.

09:05:32 5 Now, if I understood your testimony this morning  
09:05:34 6 correctly, sir, this was a way you looked at possible danger of a  
09:05:42 7 subsea leak from shutting in the Macondo well?

09:05:46 8 A. That's correct. If the rupture disks were open.

09:05:51 9 Q. So if the rupture disks were open at the time the well was shut  
09:05:57 10 in and the pressures then didn't build up high enough, that could  
09:06:02 11 indicate there was a leak down there, right?

09:06:04 12 A. Let me just start that over again. This was to make a  
09:06:10 13 determination of whether the rupture disks were open. So if the  
09:06:15 14 pressure rose into the low zone, the interpretation would be that  
09:06:20 15 the rupture disks were open; if the pressure rose into the green  
09:06:24 16 zone, it would be an indication that the rupture disks weren't  
09:06:28 17 open; and if the pressure rose into the middle zone, it was not  
09:06:32 18 clear whether they were open or not.

09:06:33 19 Q. And the reason that a low zone pressure could indicate the  
09:06:38 20 rupture disks were blown and there could be a possible leak was  
09:06:42 21 that the pressure wouldn't build up as high because the fluids  
09:06:46 22 would be leaking out the rupture disks into surrounding formations?

09:06:50 23 A. That's correct. The well wouldn't hold pressure.

09:06:52 24 Q. Now, if somebody was concerned before shut-in that maybe the  
09:07:01 25 rupture disks aren't blown yet but if the pressure builds up too

09:07:07 1 high they could blow, then they would be concerned about pressure  
09:07:10 2 rising too high; isn't that correct?

09:07:15 3 A. Yes. But that was never a concern in developing this criteria.  
09:07:19 4 So, for example, there is no super high-pressure range that says  
09:07:25 5 this is actually a danger range. So high pressure was interpreted  
09:07:30 6 as a desirable feature. High pressure would mean that the well was  
09:07:36 7 not leaking and had integrity. And there was no discussion that  
09:07:42 8 high pressure would actually cause the well to lose its integrity.

09:07:48 9           So if that were the case, that would be another region at  
09:07:52 10 a high pressure that would be a danger region, but that is not what  
09:07:57 11 is shown in this graphics.

09:07:58 12 Q. Yes, I realize that's not shown here. And apparently you  
09:08:02 13 didn't have that concern. But let me just ask you to bear with  
09:08:05 14 me --

09:08:06 15 A. I don't believe that I didn't have that concern. As I stated,  
09:08:09 16 in several meetings BP's assessment was that it was not a concern  
09:08:13 17 either.

09:08:14 18 Q. Let's -- let me have you take your mind back to this time  
09:08:19 19 period of early June -- July 2010, and let's look at the concern  
09:08:26 20 that Dr. Dykhuizen had, that we didn't want the pressures to be so  
09:08:31 21 large that they could blow apart the capping stack.

09:08:35 22           You understand that concern, even if you didn't have it  
09:08:39 23 at the time?

09:08:39 24 A. Yes. I mean, I understand that concern as you stated it.

09:08:43 25 Q. Now, if someone had that concern, that might affect what



09:08:48 1 numbers they put in to try to look at the potential high side of  
09:08:52 2 pressure as a worst-case scenario, wouldn't it?

09:08:57 3 MS. HARVEY: Objection, that's calling for speculation.

09:08:59 4 THE COURT: Overruled.

09:09:02 5 THE WITNESS: Could you restate that again?

09:09:04 6 BY MR. BOLES:

09:09:05 7 Q. Sure. If you put in a higher number of microsips for rock  
09:09:11 8 compressibility, that will cause the model to predict a higher  
09:09:16 9 pressure?

09:09:18 10 A. Yes, that's correct.

09:09:19 11 Q. So if someone doing a modeling of the potential effects of the  
09:09:25 12 shut-in of the Macondo well wanted to know the potential high side  
09:09:31 13 of pressure buildup, they would increase the number that they put  
09:09:35 14 in for rock compressibility from what the measured number in the  
09:09:38 15 data was?

09:09:39 16 A. I mean, if you want to simulate a higher pressure by increasing  
09:09:51 17 the rock compressibility, that is what you get. But I don't see a  
09:09:58 18 clear line of thinking from that to the shut-in criteria that we  
09:10:07 19 developed.

09:10:07 20 Q. Let's look at the presentation Dr. Merrill did from BP on  
09:10:18 21 July 9, the risk -- let's start with back at the cover page of the  
09:10:24 22 series of presentations, TREX 9324.3. This is Tooms lead-in  
09:10:34 23 presentation on Shut the Well in on Paper, Benefits and Risks,  
09:10:39 24 correct?

09:10:39 25 A. Yes.

09:10:39 1 Q. You saw this presented at the same meeting where you saw  
09:10:42 2 Dr. Merrill's presentation?

09:10:43 3 A. Yes.

09:10:44 4 Q. And now let's look at a page from Dr. Merrill's presentation  
09:10:47 5 that we looked at on your direct examination, TREX 9324.17. This  
09:10:58 6 is where you saw, and it's highlighted in red, the rock  
09:11:02 7 compressibility -- that's what  $C_R$  stands for?

09:11:05 8 A. That's correct.

09:11:05 9 Q. -- of 12 microsips?

09:11:08 10 A. Yes.

09:11:08 11 Q. And it says to the left of it "Assumptions" --

09:11:11 12 A. Yes.

09:11:12 13 Q. -- doesn't it? And two lines down, it also says  $Q_0$  or  $Q$  sub  
09:11:21 14 zero, correct?

09:11:21 15 A. Yes.

09:11:21 16 Q. And it says 35 -- what looks to me like 35 -- is that thousand  
09:11:28 17 barrels per day?

09:11:29 18 A. That's correct.

09:11:29 19 Q. So that was an assumption about a possible flow rate to look at  
09:11:36 20 what might happen if the well is shut in?

09:11:38 21 A. Those are the numbers that Dr. Merrill used to calculate the  
09:11:49 22 final pressure in the reservoir after the well is shut in, yes.

09:11:57 23 Q. Sure. But when you saw that on the slide and you saw that he  
09:12:00 24 is assuming a flow rate of 35,000 barrels per day, you didn't think  
09:12:04 25 to yourself, that's it, that's the flow rate, I am going to take

09:12:08 1 that and use that from now on in all of my modeling in Macondo, did  
09:12:13 2 you?

09:12:13 3 A. No. In fact, he used two flow rates, 35- and 60,000 barrels  
09:12:20 4 per day, in his calculations.

09:12:23 5 Q. And he also used different values for rock compressibility,  
09:12:27 6 didn't he?

09:12:27 7 A. Yes.

09:12:28 8 Q. Including 6 microsips?

09:12:30 9 A. Yes. As a bounding calculation, yes.

09:12:33 10 Q. Did he say at that presentation don't believe the six, that's  
09:12:38 11 not a possible value for the actual rock compressibility of the  
09:12:43 12 Macondo reservoir?

09:12:44 13 A. No, he didn't say that.

09:12:45 14 Q. And you would understand from looking at this that that was a  
09:12:48 15 possible correct value for rock compressibility of the Macondo  
09:12:53 16 reservoir?

09:12:53 17 A. I would say that six was his bracketing -- used in his  
09:13:01 18 bracketing calculations.

09:13:02 19 Q. It's used in bracketing calculations because it brackets the  
09:13:06 20 range of possible truth in nature as to what the Macondo reservoir  
09:13:11 21 actually is, isn't it?

09:13:13 22 A. I agree. So six is possible, yes.

09:13:17 23 Q. And this wasn't the last that you heard from BP that they  
09:13:24 24 thought 6 microsips was indeed a possible value for rock  
09:13:30 25 compressibility of the Macondo reservoir, was it?

09:13:35 1 A. No. I mean, 6 microsips were used in various other  
09:13:39 2 presentations as well as other numbers.

09:13:42 3 Q. So -- and you didn't take the fact that BP used 6 microsips in  
09:13:47 4 subsequent presentations or in subsequent meetings with you or in  
09:13:50 5 subsequent transmittals to you and say, that's it, I am going to  
09:13:54 6 rely on that and I'm going to use that forever more, that must be  
09:13:57 7 the truth?

09:13:58 8 A. No. That was -- BP or Dr. Merrill never indicated to me that  
09:14:04 9 6 microsips was the number to use for calculate -- for reservoir  
09:14:10 10 calculations.

09:14:11 11 Q. Let's see what he said to you seven days after this  
09:14:14 12 presentation. Let's look at TREX 142325.1.3. This is an e-mail he  
09:14:23 13 sent you on July 16th. Do you remember getting that e-mail?

09:14:28 14 A. Yes. I had asked him where the 6 microsips that Kelly McAughan  
09:14:35 15 referred to came from, and he told me that it came from sidewall  
09:14:41 16 cores.

09:14:41 17 Q. And he told you it came from measurements on those sidewall  
09:14:46 18 cores, correct?

09:14:47 19 A. Yes.

09:14:48 20 Q. This is what the data indicated was the value of rock  
09:14:53 21 compressibility for the Macondo reservoir?

09:14:56 22 A. This is a measurement from a sidewall core of the  
09:15:01 23 compressibility, yes.

09:15:02 24 Q. You never saw any other measurements or data that would lead  
09:15:12 25 to -- that analyzed and concluded that there would be 12 microsips.

09:15:17 1 You never saw any analysis or measurements of core data that  
09:15:22 2 would -- that any geomechanic ever said the average value here is  
09:15:26 3 12 microsips?

09:15:28 4 A. I didn't see any data. As I said, Kelly McAughan told me that  
09:15:34 5 12 microsips was more representative of the reservoir than  
09:15:40 6 6 microsips.

09:15:40 7 Q. More representative of reservoirs in the Gulf of Mexico  
09:15:45 8 generally?

09:15:45 9 A. Yes.

09:15:46 10 Q. And you knew prior to publishing your article on Macondo flow,  
09:15:52 11 you knew that the range of rock compressibilities in the Gulf of  
09:15:59 12 Mexico extends into the low single digits, correct?

09:16:06 13 A. I considered that a reasonable statement. I mean, I don't know  
09:16:10 14 what you mean by "knew," but I would agree that compressibilities  
09:16:18 15 of reservoirs in the Gulf of Mexico area could be in the low single  
09:16:22 16 digits.

09:16:23 17 Q. What I meant was, you knew that at the time you were doing your  
09:16:28 18 work in the Summer and fall of 2010 on the Macondo reservoir?

09:16:32 19 A. Yes, I do.

09:16:33 20 Q. Now, around about within one a week of Dr. Merrill calling you  
09:16:45 21 and telling you that the measurements were 6 microsips and then  
09:16:48 22 sending you that e-mail you just looked at --

09:16:51 23 A. He didn't call me, he just sent me the e-mail.

09:16:55 24 Q. Let's look at that exhibit again. 142325.1.3, said in the  
09:17:02 25 beginning of the e-mail, "to confirm our call," and then he tells

09:17:05 1 you what the measured compressibility is?

09:17:08 2 A. I think the call was my question to him of what the 6 microsips  
09:17:12 3 value that Kelly McAughan had referred to that she used in the  
09:17:18 4 initial reservoir modeling came from, so this was his reply.

09:17:22 5 Q. Well, BP's use of 6 microsips wasn't just in the initial  
09:17:26 6 modeling, was it? It continued on after this statement?

09:17:30 7 A. Well, I was referring to Kelly McAughan's presentation where --  
09:17:39 8 or my conversation with her where she said that initially they used  
09:17:44 9 6 microsips. Upon reevaluation, they used 12 microsips.

09:17:50 10 Now, there are reservoir modeling results after July 15th  
09:17:57 11 that use a range of compress -- of rock compressibility values,  
09:18:02 12 yes.

09:18:02 13 Q. In fact, the one that we looked at from July 16th, for example,  
09:18:09 14 Bob -- Dr. Merrill's presentation -- let's go back to TREX 8639,  
09:18:18 15 just the cover page of that. Let's go to 8639.9. Now, on direct  
09:18:39 16 examination, you talked about this presentation, didn't you?

09:18:42 17 A. Yes.

09:18:43 18 Q. Dr. Hsieh --

09:18:45 19 A. Not this particular graph, but I did refer to his presentation,  
09:18:50 20 yes.

09:18:50 21 Q. And when you talked about it on direct examination, you were  
09:18:52 22 talking about the modeling showing 12 microsips for  
09:18:57 23 compressibility?

09:18:58 24 A. Yes, in those slides that were shown in the direct, 12  
09:19:03 25 microsips were used.

09:19:04 1 Q. And in this slide, which is from the same presentation, we can  
09:19:09 2 see that the modelling also had as an alternative input  
09:19:15 3 6 microsips, right?

09:19:19 4 A. Yes, that's correct. Could I point out the slide itself? Can  
09:19:27 5 I look at the slide itself?

09:19:29 6 Q. Sure.

09:19:30 7 A. Let me try to --

09:19:38 8 THE COURT: Can you blow that up a little bit for him.

09:19:44 9 THE WITNESS: Okay. So in this slide, it shows the  
09:19:50 10 pressure that was modelled by various compressibilities. So this  
09:19:56 11 set of points, which is the third slide from these four, the second  
09:20:05 12 from the bottom, is from a compressibility of 12 microsips, no  
09:20:12 13 aquifer, no leak. And this set of simulation was closest to the  
09:20:20 14 observed pressure of 6600 psi at the time of shut-in.

09:20:26 15 So I was claim that this illustration showed that 12  
09:20:33 16 microsips actually gave the best result compared to what was  
09:20:37 17 observed during shut-in. During the first tens of hours, the  
09:20:43 18 pressure rose up to 6600 psi.

09:20:43 19 BY MR. O'ROURKE:

09:20:46 20 Q. And in those two lines you've just highlighted for us, the one  
09:20:49 21 that you say is closer with 12 microsips assumed a flow rate of  
09:20:56 22 50,000 barrels per day?

09:20:57 23 A. That's correct.

09:20:57 24 Q. And the one that you said was a little bit farther away with  
09:21:01 25 6 microsips assumed a flow rate of 45,000 barrels per day?

09:21:08 1 A. Yes, that's correct.

09:21:09 2 Q. Do you have any ideas as you sit here now, sir, which of those  
09:21:14 3 two flow rate assumptions is more accurate?

09:21:18 4 MS. HARVEY: Objection, he is a fact witness, and I think  
09:21:20 5 this is asking him to opine.

09:21:23 6 MR. BOLES: That's true, but he volunteered to opine on  
09:21:26 7 the slide and I let him do that.

09:21:29 8 THE COURT: Overrule the objection.

09:21:31 9 THE WITNESS: My estimates was that the flow rate varied  
09:21:39 10 from 63,600 barrels per day initially dropping down to 53.6 -- or  
09:21:48 11 52,600 barrels per day on the last day. So I would say that is  
09:21:53 12 closest to the 50,000 barrels per day value in this slide  
09:21:59 13 (INDICATING).

09:21:59 14 BY MR. O'ROURKE:

09:22:00 15 Q. Now, if we -- within a few days of this presentation, you had a  
09:22:06 16 meeting with one of those BP scientists you referred to on your  
09:22:13 17 direct examination, Mr. Michael Levitan, correct?

09:22:16 18 A. That's correct.

09:22:17 19 Q. And you went over with him -- let's look at TREX 8643.1. You  
09:22:25 20 went over with him the results of his reservoir modeling that he  
09:22:29 21 was doing at that time?

09:22:30 22 A. Yes. He did a number of reservoir modeling runs and he showed  
09:22:35 23 me one of the ones that he did.

09:22:37 24 Q. And you took notes on some of the inputs that he was using at  
09:22:45 25 this time. And this was July 20th, wasn't it?



09:22:47 1 A. Yes, this was July 20th.

09:22:48 2 Q. So this was after the July 9th presentation that we saw from  
09:22:52 3 Dr. Merrill?

09:22:52 4 A. Yes.

09:22:53 5 Q. And in your notes, 8643.1.1, you noted that for rock  
09:23:03 6 compressibility -- which here is abbreviated R with a subscript C,  
09:23:09 7 correct?

09:23:09 8 A. Yes.

09:23:09 9 Q. -- was 6 microsips?

09:23:11 10 A. Yes.

09:23:12 11 Q. Did you say to him when you saw that he was using that input,  
09:23:17 12 Why are you using that, that's not the right number?

09:23:19 13 A. No. In fact, I didn't even take note of that number. The  
09:23:25 14 purpose of that meeting was Secretary Chu or the science team was  
09:23:32 15 concerned that after two days of the pressure following a straight  
09:23:38 16 line trend, it started to deviate from the straight line trend, and  
09:23:44 17 I was asked to meet with Dr. Levitan to provide an explanation for  
09:23:49 18 that. And we agreed that the explanation was that the reservoir  
09:23:54 19 was a long, skinny channel, and that was the focus of the  
09:23:59 20 discussion.

09:24:01 21 So the exact value of rock compressibility was something  
09:24:06 22 that I didn't even take note of. And our agreement was that using  
09:24:15 23 a range of values, we came to the conclusion that a long, narrow  
09:24:22 24 reservoir shape would explain the reason why the pressure didn't  
09:24:27 25 follow a straight line trend, and that was the concern of the

09:24:32 1 science team.

09:24:33 2           So the particular values used in this particular run was  
09:24:39 3 not of concern to me.

09:24:41 4 Q. You did make a note of it?

09:24:43 5 A. Yes. I copied down everything, but the focus of that work was  
09:24:49 6 that long, skinny rectangle drawn in that sheet of paper where I  
09:24:57 7 kept the notes. That was the central focus of the meeting, and in  
09:25:04 8 fact, that aspect was reported back -- this meeting took place at  
09:25:09 9 about nine o'clock, and that long, skinny channel-shaped reservoir  
09:25:14 10 was reported back in the science team meeting at 11 o'clock.

09:25:19 11 Q. Now, Secretary Chu, who you just mentioned, did within a few  
09:25:24 12 days take a specific and personal interest in what number you were  
09:25:29 13 using for rock compressibility, didn't he?

09:25:32 14 A. He asked me about rock compressibility in early August, so that  
09:25:41 15 was, you know, more than a few days after July 20th when this was  
09:25:47 16 discussed.

09:25:48 17 Q. But it was just a couple of days after that July 30 and July 31  
09:25:54 18 meeting of all of the government scientists that you spoke about on  
09:25:58 19 your direct examination and which we heard about in yesterday's  
09:26:01 20 testimony?

09:26:01 21 A. Yes. There was a meeting over two days on July 30th and 31st  
09:26:08 22 where all of the scientists came together to discuss flow rates and  
09:26:12 23 come up with a final value, updated value. And several days after  
09:26:18 24 that, Secretary Chu asked me about rock compressibilities.

09:26:22 25 Q. And before we get to his question, this July 30, July 31,

09:26:29 1 August 1 timeframe, that was your final presentation, at least that  
09:26:33 2 I know of, of your leak detection model of the Macondo reservoir  
09:26:38 3 and Macondo spill?

09:26:39 4 A. No. The leak detection model was presented in meetings  
09:26:46 5 where -- in regular daily meetings where regular BP personnel and  
09:26:53 6 government personnel met. And the concern was the well was leaking  
09:26:57 7 or not.

09:26:58 8 Q. And that went on through July, didn't it?

09:27:01 9 A. Yes. That went on through beginning of August until the well  
09:27:05 10 was killed by the static kill operation.

09:27:08 11 Q. So that concern about whether or not the well was leaking and  
09:27:14 12 your need to model it accurately was going on at the time you met  
09:27:17 13 with Mr. Levitan and went over his modeling with him, correct?

09:27:23 14 A. Yes, that's correct.

09:27:24 15 Q. And you saw he was using 6 microsips for rock compressibility?

09:27:28 16 A. Yes. At that meeting he showed me one simulation where he was  
09:27:35 17 using six. And as I testified, the purpose of that meeting was to  
09:27:43 18 establish the shape of the reservoir and not to discuss whether six  
09:27:49 19 or some other number was the right rock compressibility.

09:27:53 20 Q. But in this time period of July 30 when we're still very  
09:27:58 21 concerned about modeling the right pressure to know if the well was  
09:28:01 22 leaking, you wrote down, without noting much about it, that rock  
09:28:04 23 compressibility was six as being modelled by Mike Levitan at that  
09:28:09 24 time?

09:28:09 25 A. Yes, that was July 20th, not 30th.

09:28:11 1 Q. And the next day, July 21st, you sent that number of  
09:28:19 2 6 microsips to another scientist working on the Macondo reservoir  
09:28:23 3 on behalf of the government, didn't you?

09:28:25 4 A. No, I did not.

09:28:27 5 Q. Well, is there someone named Professor Flemings from the  
09:28:30 6 University of Texas that worked with you and others to bring  
09:28:35 7 expertise on the geology of the Macondo reservoir?

09:28:39 8 A. Yes, Dr. Flemings was somebody who came to Houston to work with  
09:28:45 9 the government scientists.

09:28:46 10 Q. And let's look at TREX 8642.1.1. On July 21, this is the day  
09:28:56 11 after you met with Mr. Levitan and saw he was using 6 microsips for  
09:29:02 12 rock compressibility, you sent some data to Professor Flemings as  
09:29:06 13 his background for his analysis that he was doing for the  
09:29:10 14 government, correct?

09:29:11 15 A. Yes. Actually, Professor Flemings was in Houston and we were  
09:29:17 16 working in the same room, so we were right there together. And  
09:29:25 17 Professor Flemings asked me for the size -- information of the size  
09:29:30 18 of the reservoir. And that was the information. Rather than  
09:29:35 19 reading it to him so that he can write it down, I put it in a  
09:29:41 20 spreadsheet and e-mailed to him because we were busy doing things,  
09:29:47 21 so it would just be easier.

09:29:49 22 Q. And let's look at that spreadsheet, it's TREX 8642.2. And  
09:29:55 23 let's blow up, first of all, 8642.2.2. You said that the data in  
09:30:04 24 this spreadsheet that you were providing to Professor Flemings for  
09:30:07 25 his analysis for the government was based on discussions with BP

09:30:11 1 reservoir modelers and well test analysts, correct?

09:30:15 2 A. Yes. I was referring to data on reservoir size, so those are  
09:30:23 3 the data under the bold line Estimation of Reservoir Area.

09:30:33 4 Q. Well, it also had -- and let's look at 8642.2.1 -- data on  
09:30:40 5 reservoir properties, correct?

09:30:43 6 A. Yes. But those -- okay. Let me -- there are -- I used these  
09:30:51 7 spreadsheets for calculations and it happened to be in a convenient  
09:30:58 8 format, so rather than starting over and typing each label,  
09:31:06 9 reservoir porosity, reservoir length, I used an existing  
09:31:11 10 spreadsheet, I put in the reservoir size information in the upper  
09:31:15 11 part of the spreadsheet, which is under the bold heading  
09:31:20 12 "Estimation of Reservoir Area."

09:31:22 13 And everything else below were left over from a --  
09:31:26 14 previous numerous other spreadsheets. I used these spreadsheets  
09:31:33 15 because embedded in these spreadsheets are formulas for conversion.  
09:31:38 16 I would use these spreadsheets as a convenient method for  
09:31:43 17 converting from oil field units to units that I use, which are  
09:31:49 18 in -- you know, instead of barrels, cubic meters, and so those  
09:31:54 19 numbers in the lower half of the spreadsheets were numbers left  
09:32:00 20 over from previous conversion calculations.

09:32:07 21 And these were not numbers meant to send to Peter  
09:32:14 22 Flemings, only the upper numbers are. And, in fact, the file name  
09:32:19 23 for this spreadsheet was reservoirvolume.xls, which made it  
09:32:27 24 clear -- and also Dr. Flemings was right there next to me. So I  
09:32:31 25 sent him the spreadsheet and said that the reservoir volume data

09:32:36 1 that he wanted are in this spreadsheet.

09:32:39 2           So the rest of the data are not meant to be described by  
09:32:49 3 the first line based on the discussions with BP -- I can't quite  
09:32:59 4 see the line.

09:32:59 5 Q. Well, the line we're looking at is the one that says formation  
09:33:03 6 rock or pore compressibility, 6 microsips. Do you see that?

09:33:08 7 A. Yes. I mean, I did convert 6 microsips into the units that I  
09:33:14 8 need to work with. But that -- as I said, the values in the lower  
09:33:21 9 half of those spreadsheets were often changed. There are also  
09:33:27 10 numerous spreadsheets that have 12 on there. So these were just a  
09:33:33 11 spreadsheet -- a number of spreadsheets that I had used to do  
09:33:38 12 conversions from an original spreadsheet that has been changed  
09:33:43 13 numerous times. And so, you know, that's my description of that  
09:33:51 14 particular callout.

09:33:53 15 Q. Well, if you had a spreadsheet that said 12 at the time of the  
09:33:57 16 meeting with Professor Flemings on July 21, maybe United States  
09:34:01 17 counsel can show that to us on your redirect.

09:34:03 18           But in any event, when you met with Professor Flemings,  
09:34:06 19 the spreadsheet you sent him said rock compressibility of  
09:34:10 20 6 microsips?

09:34:12 21 A. That is correct, literally. But what he asked me was data  
09:34:18 22 about the size of the reservoir. And what I sent him -- the  
09:34:26 23 information that I meant to send to him were the size of the  
09:34:30 24 reservoir. And there was some extraneous information from previous  
09:34:38 25 calculations. And I can definitely provide you with a spreadsheet

09:34:43 1 with the metadata of sometime prior to July 20th that had 12  
09:34:53 2 microsips in the rock compressibility.

09:34:55 3 Q. Now, actually, in your modeling at this time, you were not  
09:34:59 4 using exclusively 12 microsips for rock compressibility, were you?

09:35:03 5 A. That is correct. For the leak detection model, when I  
09:35:13 6 implemented history matching, I actually used the history matching  
09:35:19 7 to estimate compressibility.

09:35:20 8 Q. Let's take a look at a summary chart from one of those modeling  
09:35:27 9 set of runs, TREX 8640.5.2. This is output from your leak  
09:35:39 10 detection model?

09:35:39 11 A. Yes. I believe this is output for the leak detection model,  
09:35:46 12 probably the first revision, which would be around July 25th, or  
09:35:52 13 the second revision, I am not exactly sure.

09:35:55 14 Q. And the input for rock compressibility is that yellow  
09:35:59 15 highlighted line third from the bottom that says  $C_R$  ( $10^{-10}$  psi<sup>-1</sup>)?

09:36:09 16 A. That was not an input. As you had indicated and I also said,  
09:36:12 17 these were numbers estimated from history matching and this would  
09:36:20 18 probably be history matching of data from July 15th up to maybe  
09:36:28 19 July 23rd or something like that.

09:36:30 20 Q. And when you refer to history matching of data, you're talking  
09:36:33 21 about the pressure data that's coming from the capping stack  
09:36:37 22 measurement following the shut-in?

09:36:39 23 A. Yes. Those pressure data was used or the model was adjusted so  
09:36:47 24 that the model simulated pressure would match the capping stack  
09:36:51 25 pressure.

09:36:51 1 Q. So you matched the capping stack pressure with rock  
09:36:56 2 compressibilities of 15.5 microsips, 9.4 microsips and 7.6  
09:37:02 3 microsips?

09:37:04 4 A. Yes. At this time, the shape of the well was specified in the  
09:37:11 5 model and using different shapes and the location of the well  
09:37:16 6 within these shapes, those were the matches. And this was, as I  
09:37:20 7 said, data from around July, from July 15th to probably around  
09:37:27 8 July 23rd or 24.

09:37:28 9 Q. And you presented this as a part of this ongoing assessment of  
09:37:32 10 whether or not it was safe to keep the well shut-in?

09:37:35 11 A. That's right. So with these various combinations of  
09:37:41 12 parameters, the conclusion was still -- regardless of which one you  
09:37:48 13 use, the well was safe to shut in because it indicated that -- of  
09:37:53 14 these results, indicated that the well was not leaking.

09:37:56 15 Q. You didn't --

09:37:57 16 THE COURT: Let me clarify one thing. I believe you  
09:38:01 17 referred to the shape of the -- the different shapes of the well.  
09:38:07 18 Is this the shape of the well or the shape of the reservoir? The  
09:38:14 19 length and width dimensions.

09:38:18 20 THE WITNESS: Those are the dimensions of the reservoir.  
09:38:21 21 So in the left --

09:38:23 22 THE COURT: That's fine. That answered my question.

09:38:27 23 MR. BOLES: Thanks for clarifying that.

09:38:29 24 BY MR. BOLES:

09:38:29 25 Q. You didn't throw out these results and decline to present them



09:38:32 1 to that group making the decision about leaving the well shut-in  
09:38:36 2 because they indicated rock compressibilities that varied across  
09:38:40 3 that range we're seeing there, did you?

09:38:43 4 A. I didn't -- could you ask that question again?

09:38:47 5 Q. Yes. You presented -- there are three cases shown on this  
09:38:50 6 slide, which indicate three different rock compressibilities could  
09:38:55 7 match the pressure you were seeing from the capping stack.

09:38:57 8 A. That's right. Up to July 20 -- whatever the date was prior to  
09:39:06 9 my doing this analysis, yes.

09:39:09 10 Q. And it was your conclusion at this time, based on your study,  
09:39:12 11 that the rock compressibility could vary even more than is being  
09:39:16 12 shown here in those three cells of the chart?

09:39:20 13 A. I don't think I made that -- I don't think I said that the rock  
09:39:27 14 compressibility could vary even more. Those were the rock  
09:39:30 15 compressibilities that were obtained using these analysis.

09:39:37 16 And, I mean, you asked me, I didn't throw them out.  
09:39:42 17 Obviously, I didn't throw them out because I presented them. But  
09:39:44 18 the conclusion was not what the rock compressibility is, the  
09:39:48 19 conclusion was whether the well was leaking. And regardless of  
09:39:52 20 which one I used, the conclusion was the well was not leaking.

09:39:56 21 Q. But in the bottom of this slide, below the chart, you indicated  
09:40:01 22 for a different flow rate, the same match can be obtained by  
09:40:06 23 proportionally scaling  $K$  and  $C_r$ , correct?

09:40:12 24 A. That's correct. That in this the leak detection model, if you  
09:40:20 25 chose a different flow rate like 60,000 barrels, stock-tank barrels

09:40:25 1 per day or 40,000 stock-tank barrels per day, you would come to the  
09:40:30 2 same conclusion, yes.

09:40:32 3 Q. You would also match the pressure?

09:40:33 4 A. Yes, you would also match the pressure.

09:40:36 5 Q. And  $C_R$  refers to rock compressibility?

09:40:39 6 A. That's correct.

09:40:39 7 Q. And as you indicated, and I think you discussed this on direct  
09:40:44 8 examination, you did a couple more of these presentations at least.

09:40:47 9 Let's look at TREX 8634.3.1. This is another presentation of your  
09:40:56 10 leak detection model?

09:40:58 11 A. Yes, that's correct.

09:41:00 12 Q. Showing, again, three different numbers for rock  
09:41:03 13 compressibility that you found matched the pressure?

09:41:07 14 A. Yes. The way this are shown are always the -- as I noted, at  
09:41:17 15 the time that I did this, I assumed different reservoir dimensions,  
09:41:26 16 and the bottom row of this table shows the degree of mismatch. So  
09:41:33 17 the lower the value, the lower -- the better the match. And the  
09:41:41 18 way this is presented, the center panel usually gave the best  
09:41:49 19 match. I don't know what was blocking the number.

09:41:53 20 But anyway, those three all acceptable matches and the  
09:42:01 21 values shown here are for rock compressibility were the match rock  
09:42:06 22 compressibilities, yes.

09:42:07 23 Q. And that's given the assumptions you made about the size of the  
09:42:10 24 reservoir and the flow rate, correct?

09:42:11 25 A. Yes.

09:42:11 1 Q. And let's look at a third presentation. Let's just skip to  
09:42:16 2 your summary slide, which is 8644.15.1. I think this is  
09:42:29 3 August 1st, so I believe this is at the end of this leak detection  
09:42:33 4 modeling that you did that we've seen a series of presentations on.

09:42:37 5 A. Yes.

09:42:37 6 Q. And your conclusion, your summary conclusion with respect to  
09:42:41 7 rock compressibility was that permeability and rock compressibility  
09:42:45 8 within expected range.

09:42:47 9 A. Yes.

09:42:47 10 Q. And you knew that the range of possible rock compressibilities  
09:42:52 11 in the Gulf of Mexico reservoirs could be down to the single digits  
09:42:59 12 of microsips?

09:42:59 13 A. Yes, that is reasonable.

09:43:00 14 Q. Around this time you -- as you indicated, you switched to a  
09:43:09 15 different kind of model from the leak detection model to the --  
09:43:12 16 what, I think, you called the flow rate model?

09:43:14 17 A. That's right -- well, the leak detection model was presented in  
09:43:22 18 discussions on whether the well was leaking or not; and, yes, I --

09:43:29 19 I am just not sure what you mean by "switch." I had a  
09:43:32 20 different assignment on July -- in late July, and that assignment  
09:43:38 21 was to estimate the flow rate. So I modified the leak detection  
09:43:44 22 model so it can be used to estimate the flow rate.

09:43:46 23 Q. And we're going to talk a little bit later about how you did  
09:43:51 24 that modification. But first, I just want to keep a continuity and  
09:43:55 25 wrap up our discussion of rock compressibility.

09:43:57 1           Let's see. And again, the setting here is the July 30  
09:44:01 2 meeting of all of the government scientists to discuss the Macondo  
09:44:06 3 incident flow rates, correct? You attended that meeting?

09:44:11 4 A. Okay, yeah. But I just want to make sure -- in the beginning  
09:44:16 5 part of your question, you said you wanted to wrap up the leak  
09:44:20 6 detection model and then you said -- and then you went into the  
09:44:24 7 July 30th meeting which has to do with the flow rate estimation  
09:44:28 8 model, so those are different things.

09:44:29 9 Q. Right. So I was trying to make a transition.

09:44:33 10 A. Oh, okay.

09:44:34 11 Q. Sorry if I was unclear.

09:44:35 12           So on July 30 you met with all of the government  
09:44:38 13 scientists; is that right?

09:44:41 14 A. Yes. On July 30th I met with -- I had a meeting where all of  
09:44:49 15 the government scientists involved previously in flow rate  
09:44:52 16 estimation presented their results, yes.

09:44:56 17 Q. And you presented your results?

09:44:58 18 A. That's correct.

09:44:58 19 Q. Let's take a look at TREX 8635.74.1. Is this a summary of your  
09:45:12 20 analysis of the cumulative flow of the Macondo spill that you  
09:45:15 21 presented on July 30?

09:45:17 22 A. Yes, this is what I presented, yes.

09:45:21 23 Q. And it shows that we've got, in the bottom row, the bottom  
09:45:26 24 yellow row is your total volume of estimated spill?

09:45:29 25 A. Yes. These are based on pressure data from July 15th to

09:45:34 1 July 28th, and this presentation was given in July 30th.

09:45:42 2 Q. And the top row, which we've also highlighted in yellow, is the  
09:45:46 3 input for rock compressibility?

09:45:48 4 A. Yes. So I used 12 to do my estimation, and I used 6 and 15 for  
09:45:56 5 bracketing calculations.

09:45:56 6 Q. That's the row that begins with the symbol  $C_R$ ?

09:46:01 7 A. That's correct.

09:46:01 8 Q. Now, did you tell anybody at the meeting that six was not a  
09:46:09 9 possible value for rock compressibility?

09:46:11 10 A. No, I did not tell anybody that six was an impossible value for  
09:46:17 11 rock compressibility.

09:46:17 12 Q. And, in fact, you told all of the government scientists  
09:46:22 13 gathered on July 30 that BP thought the number was 6 microsips,  
09:46:27 14 didn't you?

09:46:28 15 A. No, I did not say that.

09:46:30 16 Q. Well, let's look at TREX 8628.7.1. This is an excerpt from  
09:46:40 17 some notes that we looked at yesterday from someone from -- if you  
09:46:44 18 look at the upper right-hand corner, let's blow that up  
09:46:49 19 temporarily.

09:46:52 20 MS. HARVEY: Counsel has not identified who these notes  
09:46:54 21 are from, and I think it lacks foundation.

09:46:57 22 MR. BOLES: These were used yesterday in response to the  
09:46:59 23 same objection. It was noted that there's no dispute you were at a  
09:47:03 24 meeting on July 30 with the government scientists.

09:47:05 25 MS. HARVEY: In response to that objection, Dr. Hunter

09:47:08 1 was a 30(b)(6) witness, Dr. Hsieh is not.

09:47:12 2 MR. BOLES: Dr. Hsieh was a 30(b)(6) witness as well.

09:47:16 3 MS. HARVEY: But not for the July 30th meeting.

09:47:18 4 MR. BOLES: Actually, they've been admitted, I guess.

09:47:21 5 THE COURT: Whose notes were these? Are these the ones  
09:47:25 6 we never established who wrote them?

09:47:27 7 MR. REGAN: They were produced by PNNL, which is one of  
09:47:30 8 the --

09:47:30 9 MR. BOLES: Pacific Northwest National Laboratories.

09:47:33 10 MR. REGAN: And they were admitted this morning.

09:47:36 11 MS. HARVEY: But they still lack foundation, and  
09:47:38 12 Dr. Hsieh can't identify them.

09:47:40 13 THE COURT: Let's see if he can either -- he can answer  
09:47:47 14 and deny whatever he can comment on. Go ahead.

09:47:50 15 MR. BOLES: Sure, and that's all I'm going to be  
09:47:53 16 exploring.

09:47:54 17 THE COURT: So these are notes from a meeting on  
09:47:55 18 July 30th? You were at that meeting?

09:47:59 19 THE WITNESS: I was at that meeting. These were not my  
09:48:01 20 notes.

09:48:02 21 THE COURT: He is going to ask you about somebody else's  
09:48:05 22 notes from that meeting that apparently references you, and you can  
09:48:08 23 respond to the questions, okay?

09:48:10 24 THE WITNESS: All right.

09:48:11 25 BY MR. BOLES:

09:48:11 1 Q. Did you tell the government scientists gathered on July 30th  
09:48:14 2 when you were discussing your analysis that BP was preferring  
09:48:19 3 6 microsips for rock compressibility?

09:48:20 4 A. No, I did not say that. If you want me to try to explain why  
09:48:27 5 this person wrote it down. I might have said when I was doing the  
09:48:33 6 bracketing calculation that when 6 microsips were used, we get a  
09:48:39 7 spill volume of 2.9 million barrels. And I am not sure, but I  
09:48:46 8 could have made the comment that this would be something that BP  
09:48:51 9 would prefer in the sense that, if you had a spill, you would  
09:48:55 10 prefer a lower volume than a higher volume.

09:48:59 11 But I did not say that BP preferred 6 microsips as the  
09:49:06 12 compressibility, because my understanding was BP felt that 12  
09:49:11 13 microsips was representative of reservoirs in the Gulf of Mexico  
09:49:17 14 region.

09:49:17 15 Q. And you clearly communicated, and we saw it on the summary  
09:49:24 16 slide a couple of slides ago, that the amount of cumulative flow  
09:49:28 17 that you were estimating depended on the number you put in for rock  
09:49:32 18 compressibility?

09:49:34 19 A. That's correct.

09:49:34 20 Q. And there was concern at the highest levels of the government's  
09:49:42 21 science team and the United States government, about whether or not  
09:49:45 22 your use of 12 microsips was correct?

09:49:51 23 A. I don't know of those concerns.

09:49:52 24 Q. Well, let's look at TREX 141784.1.1. And this is a National  
09:50:03 25 Oceanic and Aeronautics Administration person named Bill Lehr

09:50:09 1 writing to Marcia McNutt. She's the director of the United States  
09:50:12 2 Geological Survey, right?

09:50:14 3 A. Yes.

09:50:14 4 Q. So she is your boss's boss or up the chain of command?

09:50:19 5 A. Yes.

09:50:19 6 Q. And she is writing just a day after, or two days after these  
09:50:22 7 presentations. I am referring to the second highlighted part. "I  
09:50:28 8 would like to see," skipping a bit here, "justification for the use  
09:50:32 9 of a different compressibility than the reported value of 6."

09:50:40 10 Correct?

09:50:42 11 A. That's what the memo says, yes.

09:50:44 12 Q. So he is not believing that they're relying on BP and just  
09:50:50 13 accepting 12 microsips, right?

09:50:52 14 MS. HARVEY: Objection, this is speculation. Somebody  
09:50:54 15 else's e-mail. He is not on it.

09:50:58 16 MR. BOLES: If I may respond, your Honor.

09:50:59 17 THE COURT: I'll sustain the objection to the form of the  
09:51:02 18 question.

09:51:02 19 BY MR. BOLES:

09:51:03 20 Q. All right. Let me ask you this: Were you aware that the  
09:51:08 21 director of your organization, Marcia McNutt, was receiving  
09:51:15 22 expressions of concern within the United States science team about  
09:51:21 23 your use of 12 microsips?

09:51:23 24 A. No, I was not aware of this e-mail or -- nor of her concern.

09:51:29 25 Q. Let's take a look at another one, TREX 8662.1.1. Now, Director



09:51:39 1 McNutt is hearing from someone from another national laboratory or  
09:51:43 2 the Lawrence Livermore National Laboratory who e-mails, "As I  
09:51:47 3 recall, the reservoir rock compressibility of 6 microsips was the  
09:51:51 4 original estimate from BP. Paul Hsieh of USGS used this value, and  
09:51:56 5 also 12 and 18 in his reservoir studies. Higher values resulted in  
09:52:01 6 higher flow rates all else equal." Skipping a bit. "I recall Paul  
09:52:06 7 liked 12 the best."

09:52:07 8 Did director McNutt pass along this concern to you?

09:52:11 9 A. No. Director McNutt did not pass on this concern to me.  
09:52:16 10 However, we had explored this in my deposition, and I said to you  
09:52:23 11 that this is not an accurate description of what I presented. And,  
09:52:30 12 in fact, I don't like any number in particular. I use 12 because  
09:52:36 13 12 was the number that was indicated to me as the most  
09:52:41 14 representative number.

09:52:44 15 And also, the person who wrote this e-mail, Mr. Miller,  
09:52:50 16 was not present when Kelly McAughan told me that 12 was the  
09:52:56 17 representative number. I don't know if he was present when Bob  
09:53:02 18 Merrill presented information using 12 in his analysis. And if I  
09:53:12 19 were somebody who only knew that there was a measurement of  
09:53:16 20 6 microsips from a sidewall core and I looked at some presentation  
09:53:22 21 that had 12 and 18, I would be confused, too.

09:53:26 22 So I would imagine, I would explain this e-mail as from  
09:53:33 23 somebody who didn't have full range of information, and so it's  
09:53:41 24 reasonable that he would raise these questions.

09:53:43 25 Q. Well, the part of the information he didn't have, apparently,

09:53:45 1 is that you and Mike Levitan of BP, the well test analysis person,  
09:53:52 2 and that he was using 6 microsips and that you had written that  
09:53:54 3 down in your notes. Did you tell him that or any other government  
09:53:58 4 scientist that?

09:53:59 5 A. Well, I don't know Mr. Miller, and, no, I did not tell -- I did  
09:54:04 6 not report it, what Mr. Levitan used; because, as I said, the main  
09:54:10 7 purpose of the meeting was to establish the size of the reservoir.  
09:54:16 8 I wrote down all of the numbers. For example, Mike Levitan used a  
09:54:21 9 permeability of 500 millidarcies. I did not report that either.

09:54:25 10 The main thing that had to be reported was the shape of  
09:54:30 11 the reservoir and having that shape explain why the pressure  
09:54:35 12 followed a straight line trend for two days and then deviated from  
09:54:41 13 the straight line trend.

09:54:43 14 Q. The bottom line, Dr. Hsieh, is that at this time, at the end of  
09:54:47 15 July 2010 and early August 2010, the United States government  
09:54:53 16 wasn't relying on a BP number for rock compressibility as being the  
09:55:01 17 final word or as a definite thing that they didn't have to look at  
09:55:06 18 further; isn't that correct?

09:55:11 19 A. Well, I used 12 microsips because that was indicated to me that  
09:55:15 20 12 was the most representative value for reservoirs in the Gulf of  
09:55:21 21 Mexico region. That was what I relied on.

09:55:23 22 Q. Right. And you also presented alternative cases of 6 and 18 on  
09:55:29 23 July 30?

09:55:29 24 A. Yes. Those were bracketing calculations, yes.

09:55:32 25 Q. And we've seen that people were writing to the director of

09:55:36 1 United States Geological Survey questioning your use -- your going  
09:55:40 2 from the measured value of 6 up to 12 after you did that July 30  
09:55:45 3 presentation, correct?

09:55:46 4 A. Well, you showed me those concerns. I was not aware of those  
09:55:49 5 concerns. And again, I would say that those concerns came from  
09:55:54 6 lack of information of what values were being used in reservoir  
09:56:02 7 modeling by BP.

09:56:03 8 Q. Those concerns also came from Secretary of Energy Chu, didn't  
09:56:08 9 they?

09:56:08 10 A. Secretary of Energy Chu did ask me about rock  
09:56:13 11 compressibilities, yes.

09:56:14 12 Q. Let's look at his e-mail to you from August 2. Let's look at  
09:56:18 13 TREX 8644.4.1. You got this e-mail from Dr. Chu on August 2nd,  
09:56:32 14 2010?

09:56:32 15 A. Yes, I did.

09:56:33 16 Q. And he wrote to you, "Are the uncertainties in the rock  
09:56:39 17 compressibility being narrowed as we continue forward in Horner  
09:56:45 18 time?"

09:56:45 19 A. Yes, that's what he asked.

09:56:47 20 Q. And you responded to this e-mail, didn't you?

09:56:49 21 A. Yes, I did.

09:56:50 22 Q. Let's take a look at TREX 8645.1.2. It's a long e-mail back,  
09:56:59 23 but I want to focus on what you said bottom line to him was, to  
09:57:05 24 Secretary Chu, "I will continue to research on ways to better  
09:57:09 25 define the rock compressibility and report my findings to the

09:57:13 1 science team. Please e-mail me if you have additional questions."

09:57:18 2 Did you send that response to Secretary Chu?

09:57:20 3 A. Yes, I had sent this e-mail back to Secretary Chu, yes.

09:57:25 4 Q. And did you ever, in fact, continue your research on ways to  
09:57:28 5 better define rock compressibility?

09:57:30 6 A. No. There was no additional information on rock  
09:57:34 7 compressibilities.

09:57:35 8 Q. Actually, you did have some additional information, didn't you,  
09:57:45 9 sir? You had -- just before the Macondo incident you had read the  
09:57:50 10 leading treatise on the field that includes rock compressibility,  
09:57:56 11 which is geomechanics, right?

09:57:57 12 A. Could you be more specific?

09:58:03 13 Q. Yes. Is rock compressibility part of a field known as rock  
09:58:09 14 mechanics or geomechanics?

09:58:12 15 A. Well, yes, rock compressibility is something that is part of  
09:58:20 16 geomechanics, but it's also part of oil reservoir engineering.  
09:58:27 17 It's part of ground water hydrology. I am just not sure what  
09:58:32 18 question you're trying to ask in terms of the leading treatise.

09:58:36 19 Q. Sure. Let's put up TREF 144580.1. This is *Fundamentals Of*  
09:58:47 20 *Rock Mechanics, Fourth Edition* by Jaeger, Cook and Zimmerman. And  
09:58:53 21 you've seen this book before?

09:58:55 22 A. Yes, definitely. I mean, this is a well-known book.

09:58:57 23 Q. And, in fact, you've read the book?

09:58:59 24 A. Yes, I've read the book.

09:59:00 25 Q. And you read the book before the Macondo incident?

09:59:03 1 A. Yes, I read the book when I was in grad school. I mean an  
09:59:07 2 early edition.

09:59:08 3 Q. This is a classic text in the field of rock mechanics?

09:59:11 4 A. That's correct.

09:59:11 5 Q. And the fourth edition had come out a year before the Macondo  
09:59:15 6 incident revised and expanded by the new coauthor Professor Robert  
09:59:21 7 Zimmerman?

09:59:21 8 A. That's correct.

09:59:22 9 Q. He is going to be testifying as an expert in this case about  
09:59:26 10 rock compressibility.

09:59:32 11 A. Is there a question there?

09:59:34 12 Q. No.

09:59:35 13 A. Oh, I'm sorry.

09:59:36 14 Q. I can't get away with anything with you, Dr. Hsieh.

09:59:45 15 But you told the world in a book review you wrote about  
09:59:48 16 this book that because of Dr. Zimmerman's labor of love, as you put  
09:59:53 17 it, this classic text will, again, take its place as the premium  
09:59:58 18 text in rock mechanics?

09:59:59 19 A. That's correct. I mean, this text was out of print for a  
10:00:03 20 number of years, and Dr. Zimmerman, through his labor of love, and  
10:00:09 21 I believe it is, indeed, a labor of love, brought this book back,  
10:00:13 22 updated it, and it was published again, yes.

10:00:16 23 Q. Well, you would be glad to hear that I am about to leave the  
10:00:20 24 subject of rock compressibility and microsips to go into the macro  
10:00:25 25 results of your calculations of cumulative flow that you talked

10:00:29 1 about --

10:00:29 2 A. All right.

10:00:29 3 Q. -- on your direct examination.

10:00:31 4 Let's look at the demonstrative that we put together,  
10:00:33 5 D24389. So the left-hand side of this timeline takes us back to  
10:00:41 6 where we left off. This was your -- the time of your presentation  
10:00:45 7 to the other government scientists -- I'm sorry.

10:00:50 8 On the far left in red, in the meeting of the assembled  
10:00:56 9 government scientists they came up with a consensus cumulative flow  
10:01:00 10 estimate that they would tell the world of 4.9 million barrels from  
10:01:06 11 the Macondo incident, correct?

10:01:09 12 A. Yes.

10:01:09 13 Q. And so that was on -- and it was also with a plus or minus ten  
10:01:15 14 percent uncertainty?

10:01:16 15 A. That's correct.

10:01:16 16 Q. Now, we just saw that at this point in time your cumulative  
10:01:22 17 estimate was 4.6 million barrels cumulative spill?

10:01:26 18 A. Yes. That was based on data from July 15th to July 28th.

10:01:32 19 Q. And then you got a little bit of additional data until the well  
10:01:36 20 was killed on August 3rd?

10:01:38 21 A. Well, not a little bit. I mean, from July 15th to July 28th is  
10:01:46 22 13 days. The well was killed on August 3rd, so there was six more  
10:01:50 23 days bringing it to 19 days, so I would not call that a little bit  
10:01:55 24 more data.

10:01:55 25 Q. And then on August 3rd, that was the cut off of data from the

10:01:59 1 capping stack because the well was killed, right?

10:02:01 2 A. That's correct.

10:02:02 3 Q. And so as you testified on direct, a couple of months later you  
10:02:06 4 started working on the publication of your analysis of the Macondo  
10:02:11 5 spill?

10:02:12 6 A. Yes. I wrote a report in August -- in October of 2010.

10:02:19 7 Q. And at that point your estimated cumulative flow was still  
10:02:27 8 4.6 million barrels, correct?

10:02:31 9 A. If you're referring to the first draft, yes, the first draft  
10:02:37 10 had the number that I presented on July 30th.

10:02:42 11 Q. And then the second draft, which is -- you're anticipating me  
10:02:45 12 here -- on October 13th the number had gone up from 4.6 to 4.76?

10:02:52 13 A. That's correct. So the sequence of event was that in early  
10:02:58 14 October Mark Sogge asked me to write a report, he wanted a draft  
10:03:04 15 within a week. And in order to get that draft to him, I put the  
10:03:10 16 value of 4.6 that was estimated on July 30th that I reported into  
10:03:17 17 that draft. And that was an estimate based on data from July 15th  
10:03:26 18 to July 28th.

10:03:28 19           The second draft, which is October 13th, I used data from  
10:03:33 20 July 15th all the way through August 3rd, so that's 19 days of  
10:03:38 21 data. And using those extra six days, the estimate went from 4.6  
10:03:45 22 to 4.76.

10:03:47 23 Q. Now, you didn't have anymore data between that estimate and  
10:03:51 24 your final estimate of 4.9 million stock-tank barrels that you came  
10:03:56 25 to on October 22nd, did you?

10:03:59 1 A. No. The change from 4.76 to 4.92 was not based on additional  
10:04:06 2 data. That change was based on refining the time steps used in the  
10:04:15 3 simulation. Refining a time step is a way to check that the time  
10:04:19 4 step has appropriate resolution, so it would be like a higher  
10:04:24 5 resolution picture versus a lower resolution picture.

10:04:28 6 And when the time steps were refined, the estimated flow  
10:04:32 7 rate went from 4.76 to 4.92, which is about a three percent  
10:04:40 8 difference. And in practical applications, if you refine the time  
10:04:45 9 steps, you get a few percent change that indicates to you that the  
10:04:51 10 resolution is appropriate and that refinement of time steps  
10:04:57 11 explains the difference between 4.76 and 4.92.

10:05:05 12 So effectively, those two numbers are very close  
10:05:07 13 together. I used 4.92 because it was the result from the more  
10:05:11 14 refined time step simulation.

10:05:13 15 Q. And the time step, as I understand it, you were using a  
10:05:18 16 simulator to stimulate flow through the reservoir?

10:05:22 17 A. Yes.

10:05:23 18 Q. And it does the simulation in steps of time?

10:05:26 19 A. That's correct.

10:05:27 20 Q. And they're measured in fractions of a day?

10:05:30 21 A. Whatever units you want to use.

10:05:32 22 Q. Let's take a look at that. Let's look at the time steps that  
10:05:37 23 you used for your October 11 estimate, which is 4.6 million  
10:05:43 24 barrels. That's TREX 8647.10.1, time step there was 0.2 days,  
10:05:54 25 correct?



10:05:59 1 A. That is a -- the time step actually is finer in the beginning  
10:06:03 2 and then coarser towards the end and then when shutdown happens is  
10:06:12 3 finer again. But this was most of the time step that most -- most  
10:06:18 4 of the time step was .2 days, that's correct.

10:06:22 5 Q. And it was the same time steps for the higher number that you  
10:06:25 6 had in October 13th. Let's look at 8648.11.1. Same time steps  
10:06:36 7 reported in the reports that you provided to us in the litigation,  
10:06:39 8 correct?

10:06:39 9 A. Again, in order to keep the report short, this was just a  
10:06:46 10 general characterization. As I said, the actual time steps were  
10:06:50 11 not always .2 days. The way you determine time step is when the  
10:06:57 12 pressure is changing rapidly through time, you make smaller time  
10:07:02 13 steps; and when the pressure is not changing as much, you can use  
10:07:07 14 larger time steps.

10:07:10 15 So after -- let's say, after the initial explosion, the  
10:07:16 16 time steps would be finer, and then gradually it would become  
10:07:21 17 .2 days. When the shut-in occurs, there's a big change in time --  
10:07:25 18 in pressure, and the time steps would be much finer. And then, as  
10:07:33 19 the equilibration occurs, the time steps would be coarser again.

10:07:37 20 But to describe all of that would involve several more  
10:07:40 21 paragraphs. Dr. Sogge wanted a report, a ten-page report. So I  
10:07:49 22 just eliminated all of those details and described the general time  
10:07:55 23 step that was applied in most of the simulation. But the  
10:07:59 24 refinement was really in periods when the pressure changes the  
10:08:05 25 most, and that is during the initial blowout and the shut-in

10:08:10 1 period. So those changes were not reflected in various drafts of  
10:08:15 2 the report.

10:08:16 3 Q. And I think that's right. In the October 22nd draft where you  
10:08:20 4 finally reached the 4.9 million barrel cumulative flow number, the  
10:08:25 5 time step as 8615.11.1. It's still showing as --

10:08:32 6 A. That's correct. Because for most of the time the flow -- the  
10:08:38 7 pressure was changing gradually. So for most of the simulation,  
10:08:42 8 the time step is .2 days. But the accuracy that is achieved is --  
10:08:49 9 better accuracy is achieved is by refining time steps only during  
10:08:53 10 those periods when the pressure is changing rapidly. And those  
10:08:58 11 changes occur only in the beginning of the blowout and during  
10:09:03 12 shut-in, and those were the places where time steps were refined.

10:09:07 13 Q. Thank you, Dr. Hsieh. Now, I would like to switch to a  
10:09:12 14 different rock property called permeability.

10:09:15 15 A. Okay.

10:09:16 16 Q. And permeability is an important property in terms of  
10:09:22 17 determining flow rate through a porous rock like the Macondo  
10:09:27 18 reservoir; is that right?

10:09:28 19 A. Yes, that is right.

10:09:30 20 Q. In fact, under the defining equation, Darcy's Law, the flow  
10:09:36 21 rate, all other things being equal, is directly proportional to  
10:09:39 22 permeability?

10:09:40 23 A. Everything -- well, Darcy's Law says, yes, everything being  
10:09:45 24 equal, the flow rate is proportional to permeability. Could you  
10:09:49 25 excuse me for a second?

10:09:51 1 Q. Of course, I'll do the same. In fact, I am going to replenish  
10:09:55 2 my bottle. Are you ready?

10:10:01 3 A. Yes.

10:10:02 4 Q. All right. So you doubled the permeability, all other things  
10:10:06 5 being equal, you'll double the flow rate?

10:10:08 6 A. In Darcy's Law, that's correct. Darcy's Law saying that the  
10:10:14 7 flow rate is equal to -- is proportional to the pressure gradient  
10:10:20 8 actually multiplied by the permeability, yes.

10:10:22 9 Q. But Darcy's Law, that's the fundamental law or equation of flow  
10:10:28 10 of fluids through porous media like a sandstone reservoir, isn't  
10:10:32 11 it?

10:10:33 12 A. That is one of the fundamental equations. There's also an  
10:10:40 13 equation of mass conservation, and the flow equation that we use is  
10:10:46 14 a combination of Darcy's Law and an equation that we call the mass  
10:10:54 15 conservative equation.

10:10:55 16 Q. Is that called the material balance equation, the equation of  
10:10:58 17 conservation of mass that you just referred to?

10:11:01 18 MS. HARVEY: Objection. This is really going into expert  
10:11:04 19 testimony here.

10:11:04 20 THE COURT: It does seem like we're getting way beyond  
10:11:08 21 what this witness was here to testify about, and he has not been  
10:11:12 22 qualified as an expert. I know he has some expertise, obviously.  
10:11:16 23 But he is not here as an expert, so we seem to be going far afield  
10:11:21 24 here.

10:11:22 25 MR. BOLES: I will get back on track, your Honor.

10:11:24 1 THE COURT: Okay.

10:11:24 2 BY MR. BOLES:

10:11:25 3 Q. What I want to talk to you about, Dr. Hsieh, is what you used,  
10:11:31 4 because the United States has said that they relied on certain  
10:11:36 5 numbers from BP in doing their assessment of the Macondo well, so I  
10:11:41 6 want to talk about the numbers you used for permeability that you  
10:11:45 7 based on BP's data.

10:11:48 8 Now --

10:11:52 9 A. Could I make a correction? I did not use a number for  
10:11:55 10 permeability. The permeability numbers from my report are results  
10:12:01 11 from history matching. So whatever history matching results  
10:12:06 12 provided me with the permeability, that was the permeability that  
10:12:12 13 were used in determining the flow rate.

10:12:14 14 Q. Okay. And I apologize for making my timeline unclear, but I am  
10:12:19 15 now on this new property permeability. I am going back now to the  
10:12:23 16 beginning of your work prior to shut-in. And you -- let's look at  
10:12:28 17 TREX 8627.2. This is the technical note that you got from BP that  
10:12:40 18 provided some numbers used in modeling, correct?

10:12:46 19 A. Yes.

10:12:46 20 Q. And there was a chart there, and I want to zoom in on that,  
10:12:54 21 it's D-24495. And there were numbers in that technical note for  
10:13:06 22 permeability, correct?

10:13:08 23 A. Yes, that's correct.

10:13:09 24 Q. And you looked at those numbers?

10:13:11 25 A. Yes, I did look at those numbers.

10:13:13 1 Q. And after that, you came up with a permeability number of 220  
10:13:20 2 millidarcies?

10:13:22 3 A. Yes. In the first -- in my overnight model that I developed,  
10:13:29 4 why based my numbers on these numbers and I used something like 220  
10:13:35 5 millidarcies in that calculation, yes.

10:13:37 6 Q. And not the 500 millidarcies that you later used for your  
10:13:43 7 calculation of total flow in the Macondo well?

10:13:46 8 A. That's correct. The overnight calculation, I didn't have any  
10:13:51 9 pressure data, or I only had a few hours of pressure data. Those  
10:13:56 10 numbers were not sufficient to estimate permeability, so I used  
10:14:01 11 whatever number was available, which was from this report.

10:14:06 12 In my final model, there was a -- there were 19 days of  
10:14:13 13 pressure data, and the permeability was based on analyzing those  
10:14:18 14 19 days of pressure data.

10:14:19 15 Q. But going back to this early period before the shut-in, and I  
10:14:24 16 want to focus on these numbers. Because the United States told the  
10:14:29 17 Court yesterday that the numbers in the first two columns -- let's  
10:14:35 18 take it from the left, the left-hand side in the blown-up chart is  
10:14:40 19 the name of the different layers in and above the Macondo  
10:14:46 20 reservoir, correct?

10:14:48 21 A. Yes.

10:14:48 22 Q. So the last three rows. M56D, M56E, M56F, that's the Macondo  
10:14:56 23 reservoir?

10:14:56 24 A. That's right.

10:14:57 25 Q. And then the first column says "arithmetic air perm," do you

10:14:57 1 see that?

10:14:57 2 A. Yes.

10:15:04 3 Q. That's air permeability?

10:15:05 4 A. Well, that's permeability measured by injecting air through the  
10:15:12 5 samples is my interpretation.

10:15:13 6 Q. That's right. And that was done at the Weatherford laboratory  
10:15:16 7 from rock samples, correct?

10:15:18 8 A. I don't know.

10:15:19 9 Q. But in any event, you got those numbers?

10:15:22 10 A. I did get those numbers, yes.

10:15:23 11 Q. And those numbers we will see again and again in this case, so  
10:15:26 12 I want to focus on them.

10:15:29 13 In the second column is geometric air perm. Do you see  
10:15:33 14 that?

10:15:33 15 A. Yes.

10:15:33 16 Q. That's also measurement of permeability by putting air through  
10:15:37 17 the cores and then averaging it using a geometric average rather  
10:15:42 18 than an arithmetic average, correct?

10:15:46 19 A. I'm not sure if that's the definition.

10:15:48 20 Q. The next column converts those air permeabilities to oil  
10:15:53 21 permeabilities, doesn't it?

10:15:56 22 A. My understanding is permeability is permeability. However,  
10:16:07 23 when you use air, you have -- you don't exactly -- you don't  
10:16:19 24 exactly proximate oil so, yes, there is a conversion to the  
10:16:23 25 permeability that would be used when you're simulating oil, yes.

10:16:29 1 THE COURT: Mr. Boles, I am trying to understand where  
10:16:32 2 you're headed with all of this, because it seems like Dr. Hsieh has  
10:16:36 3 said that he didn't do any calculations on permeability, he got the  
10:16:40 4 numbers where he got the numbers. Whether that was valid or not, I  
10:16:47 5 assume other people are going to talk about it, so I am not sure  
10:16:51 6 why we're going through all of this exercise.

10:16:54 7 MR. O'ROURKE: Where I am going with it, your Honor, is  
10:16:57 8 that Dr. Hsieh took a number from this, this data, and came up with  
10:17:00 9 220 millidarcies. Yesterday you were presented with a  
10:17:04 10 demonstrative that said that the same two left-hand columns of air  
10:17:10 11 permeability showed that BP was telling the world or telling the  
10:17:13 12 government that permeability was 400 millidarcies or higher. So  
10:17:16 13 Dr. Hsieh is someone who, in fact, used those two columns of air  
10:17:20 14 permeability and came out of it with a much lower number.

10:17:24 15 THE COURT: Well, I think he said he came up with 220.

10:17:28 16 MR. O'ROURKE: All right, then I will move on, your  
10:17:29 17 Honor, that's clear.

10:17:29 18 BY MR. O'ROURKE:

10:17:34 19 Q. Okay. Now let's fast forward again in time, Dr. Hsieh, to the  
10:17:40 20 time in August or late July where you're starting to -- you're  
10:17:46 21 coming up with a second model you did, which is your flow rate  
10:17:50 22 model.

10:17:50 23 A. Yes.

10:17:51 24 Q. And you mentioned on direct examination that you added a new  
10:17:58 25 feature to your leak detection model so you could now model flow

10:18:01 1 rate.

10:18:01 2 A. Yes.

10:18:02 3 Q. And that was an equation -- let me start over. In your leak  
10:18:05 4 detection model, you're focusing on the reservoir and its behavior,  
10:18:08 5 correct?

10:18:10 6 A. Well, in all models, you have the reservoir, so, yes.

10:18:16 7 Q. In the flow rate model, you added a new equation to  
10:18:22 8 characterize flow from the reservoir up through the wellbore and up  
10:18:25 9 to the ocean?

10:18:26 10 A. That's correct.

10:18:27 11 Q. And you had a coefficient in there that you called C to  
10:18:32 12 represent all of the pressure losses from obstacles and  
10:18:36 13 restrictions up the wellbore, whatever they might be?

10:18:40 14 A. That's correct.

10:18:40 15 Q. Whether it was the cement, the BOP or anything?

10:18:46 16 A. It was meant to characterize pressure loss from flowing up the  
10:18:53 17 reservoir -- from the -- flowing up the oil well itself.

10:18:58 18 Q. But if there were pressure losses caused by eroding cement,  
10:19:03 19 that would have been taken into account in your coefficient C?

10:19:07 20 A. That was not how I envisioned it, but -- so I don't know the  
10:19:13 21 answer to that question. That equation is used in describing  
10:19:22 22 pressure loss in pipes.

10:19:24 23 Q. But you didn't have anything else in your model, your flow rate  
10:19:29 24 model to account for the pressure losses from the oil having to get  
10:19:34 25 through any eroding obstacles between the reservoir and the ocean,



10:19:39 1 other than C, that coefficient?

10:19:44 2 A. I am not sure what you mean by "eroding obstacles." In my  
10:19:51 3 model, nothing was eroding.

10:19:52 4 Q. In your model, everything was kept constant in the outflow  
10:19:56 5 path, correct?

10:19:58 6 A. That's right.

10:19:58 7 Q. Your C was constant throughout the incident?

10:20:01 8 A. That's correct.

10:20:03 9 Q. And in real life, what C is representing would vary or would  
10:20:12 10 have varied if restrictions to flow in the well had changed over  
10:20:16 11 the life of the incident?

10:20:18 12 A. If restrictions had changed, yes, then C would change.

10:20:23 13 Q. Now, we talked earlier about Dr. -- or Professor Flemings from  
10:20:30 14 the University of Texas, the one that you sent that BP data to that  
10:20:33 15 included the 6 microsips. Do you remember that discussion we had a  
10:20:37 16 half hour ago?

10:20:38 17 A. No, I did not send him the 6 microsips as BP data. I sent him  
10:20:43 18 the volume of the oil reservoir, and the 6 microsips happened to be  
10:20:50 19 a leftover feature in a spreadsheet that I was using. So I did not  
10:20:56 20 send him the 6 microsips as data from BP.

10:21:00 21 Q. Now, Professor Flemings was brought on board as a consultant  
10:21:04 22 for the United States science team, or your group, to give you  
10:21:08 23 expertise about the geology of the Macondo reservoir?

10:21:13 24 A. That's correct.

10:21:14 25 Q. And he talked to you about how it's not just one monolithic

10:21:19 1 sandstone; it's actually made up of lots of individual prehistoric  
10:21:24 2 channels of sand?

10:21:26 3 A. I don't know what "lots" means, but, yes, I mean, he did -- and  
10:21:32 4 it was understood that the reservoir was made up of channels of  
10:21:37 5 sand.

10:21:38 6 Q. And he specifically advised your team that some of those  
10:21:43 7 channels might not be connected to the Macondo well?

10:21:47 8 A. No, he was brought -- the primary discussion was whether the  
10:21:58 9 reservoir was connected to an aquifer. An aquifer is a body of  
10:22:05 10 water, and his assessment was that the reservoir was not connected  
10:22:11 11 to an aquifer, but it was not his assessment that within the oil  
10:22:18 12 reserve, the reserve was disconnected.

10:22:22 13 Q. So he was, in your view, talking about connectivity of the  
10:22:26 14 channels in their longitudinal direction where they would  
10:22:29 15 eventually get to a possible aquifer?

10:22:31 16 A. That's right. That was the main concern of the science team of  
10:22:39 17 the -- yes, the government science team and of the leaders of the  
10:22:44 18 science team, whether there was aquifer support.

10:22:49 19 And, you know, Professor Flemings was right there, I was  
10:22:53 20 in the room with him, and that was the main thing that we  
10:22:56 21 discussed. We also consulted other sediment scientists to discuss  
10:23:02 22 whether the oil reservoir was connected to a water aquifer. And  
10:23:09 23 the topic of whether the reservoir within itself was connected or  
10:23:14 24 disconnected was never a topic of discussion.

10:23:17 25 Q. In any event, he indicated there is a significant possibility

10:23:21 1 of pore connectivity of those sand channels longitudinally as they  
10:23:28 2 might connect to a possible reservoir?

10:23:29 3 A. Yes. He said there is a significant possibility that the  
10:23:35 4 reservoir -- the oil reservoir was not connected to a water  
10:23:41 5 aquifer.

10:23:42 6 Q. And the reason you were looking at water aquifers is because if  
10:23:48 7 there is an aquifer and if it's connected to the Macondo reservoir,  
10:23:53 8 it could provide more pressure support for more oil production, is  
10:23:57 9 that right?

10:23:58 10 A. Yes -- well, the assumption made for the initial red, yellow,  
10:24:07 11 green zones was that there was an aquifer, and so if there was an  
10:24:14 12 aquifer, we would expect a higher pressure. So when we saw a lower  
10:24:20 13 pressure, we wanted to determine whether that indicated that there  
10:24:26 14 was an aquifer support or not.

10:24:28 15 Q. And in addition to -- and those are two different issues,  
10:24:32 16 aren't they? Whether there was an aquifer is one issue -- I guess  
10:24:35 17 there is three issues -- whether it's connected, which is what  
10:24:38 18 Professor Flemings said is a significant pore probability; and then  
10:24:43 19 the third issue is whether the aquifer actually -- if it exists and  
10:24:48 20 is connected, can provide pressure support in the short time period  
10:24:52 21 like in the Macondo incident, correct?

10:24:54 22 A. Well, if the aquifer was not connected, then it's a moot issue  
10:25:00 23 anyway.

10:25:00 24 Q. Right.

10:25:01 25 A. If the aquifer was connected, then it would provide aquifer

10:25:11 1 support. And the time of the aquifer support would be from the  
10:25:15 2 moment the well was shut in.

10:25:17 3 Q. And in your analysis that you've talked about today, you came  
10:25:21 4 to the conclusion that there is no aquifer support or flow at the  
10:25:25 5 Macondo well, correct?

10:25:27 6 A. Yes.

10:25:27 7 Q. Now, we've been talking about the flow from the reservoir.  
10:25:36 8 That is reported by you and others in what's called stock-tank  
10:25:39 9 barrels?

10:25:40 10 A. That's correct.

10:25:41 11 Q. So that's a conversion from the volume in the reservoir to the  
10:25:47 12 volume at the surface?

10:25:48 13 A. That's correct.

10:25:49 14 Q. And that's because in the reservoir, there's lots of -- oil is  
10:25:53 15 under pressure, there's lots of dissolved gases. As the oil goes  
10:25:57 16 up, a lot of that gas dissolves and the volume shrinks.

10:26:01 17 MS. HARVEY: Objection. This is getting into expert  
10:26:03 18 testimony again.

10:26:04 19 MR. BOLES: This is just by background, I'll go straight  
10:26:07 20 to --

10:26:08 21 THE COURT: Yes, we are. Mr. Boles, you've been going on  
10:26:11 22 an hour and 40 minutes. This witness is a fact witness. We took  
10:26:15 23 37 minutes on direct, I'm wondering how long you plan to go on  
10:26:18 24 here.

10:26:19 25 MR. BOLES: I'm almost done, your Honor, and I'll

10:26:22 1 restrict myself to what he was told by BP. I'll cut the  
10:26:25 2 background.

10:26:25 3 THE COURT: All right. Good.

10:26:26 4 BY MR. BOLES:

10:26:27 5 Q. The conversion from -- the number used for conversion from  
10:26:30 6 reservoir barrels to stock-tank barrels is called a formation  
10:26:34 7 volume factor?

10:26:34 8 A. Yes.

10:26:35 9 Q. And you got a formation volume factor from BP of 2.35?

10:26:41 10 A. Yes. That was the -- as best as I can recollect, that was the  
10:26:47 11 formation volume factor that I used, that I got from BP.

10:26:51 12 Q. So if someone else comes into this courtroom and testifies that  
10:26:54 13 BP's formation volume factor was 2.1, that's not what you think you  
10:26:58 14 got from BP in any event, correct?

10:27:01 15 A. Yes -- I mean, I would agree with that statement.

10:27:07 16 MR. BOLES: Your Honor, I think that's all I have. Thank  
10:27:09 17 you, Dr. Hsieh.

10:27:10 18 THE WITNESS: You're welcome.

10:27:11 19 THE COURT: Do you have any redirect?

10:27:22 20 REDIRECT EXAMINATION

10:27:22 21 BY MS. HARVEY:

10:27:49 22 Q. Hello, Dr. Hsieh. Can you please pull up Exhibit 8645, please.  
10:28:11 23 And, Dr. Hsieh, this is the exhibit that counsel for BP showed you  
10:28:15 24 on cross-examination, your exchange with Secretary Chu; is that  
10:28:19 25 right?

10:28:19 1 A. Yes.

10:28:20 2 Q. And can you -- counsel went over the last paragraph, but can  
10:28:25 3 you please blow up the three paragraphs before that. And what  
10:28:37 4 was the first exchange that you had with Secretary Chu, what was he  
10:28:43 5 asking you?

10:28:44 6 A. He was asking me in the e-mail that was shown was there any  
10:28:52 7 additional update to rock compressibility values.

10:28:56 8 Q. And what was your response?

10:28:58 9 A. This e-mail was my response, I pointed it out to him that the  
10:29:07 10 rock compressibility of 12 microsips was based on BP's estimate. I  
10:29:14 11 don't know if you want me to read the whole thing or --

10:29:17 12 Q. No, just specifically the second paragraph, what was your  
10:29:21 13 response and why you were -- what BP had told you about the use of  
10:29:26 14 6 versus 12 microsips?

10:29:28 15 A. So BP told me that 6 microsips was from a sidewall core. They  
10:29:38 16 considered that this value was too low and that 12 microsips was  
10:29:45 17 more representative of reservoirs in the Gulf of Mexico region and  
10:29:51 18 that was what I conveyed to Secretary Chu.

10:29:54 19 And also that -- in the presentation given by Bob Merrill  
10:29:59 20 on July 9th, that 12 microsips was used to calculate the reservoir  
10:30:06 21 pressures. Those were the reservoir pressures that we used to  
10:30:11 22 calculate the red, yellow, and green zones for the shut-in  
10:30:18 23 criteria, and that Dr. Merrill also used 6 as a low value and 18 as  
10:30:23 24 a high value to bracket the rock compressibilities.

10:30:30 25 Q. And turning back to that presentation with Dr. Merrill, you had

10:30:34 1 talked before about the assumptions that were listed on the chart  
10:30:40 2 for Dr. Merrill's modeling. Did he indicate at that meeting what  
10:30:44 3 number he was using for permeability?

10:30:46 4 A. No. He did not indicate a permeability value. Not that I  
10:30:52 5 recall.

10:30:54 6 MS. HARVEY: Thank you. No further questions.

10:30:56 7 THE COURT: All right. Thank you, Dr. Hsieh. You're  
10:30:58 8 done.

10:30:59 9 THE WITNESS: Thank you, your Honor.

10:31:00 10 THE COURT: We are going to take a 15-minute recess.

10:31:02 11 THE DEPUTY CLERK: All rise.

10:31:03 12 (WHEREUPON, A RECESS WAS TAKEN.)

10:32:40 13 (OPEN COURT.)

10:55:48 14 THE COURT: All right. Please be seated, everyone.

10:55:54 15 MR. REGAN: Your Honor, Matt Regan on behalf of BP. One  
10:55:57 16 preliminary matter with respect to the Hunter exhibits that were  
10:56:00 17 admitted this morning. There are additional Hunter exhibits from  
10:56:04 18 last week's trial from his video deposition that also need to be  
10:56:07 19 offered, so I'll offer those now.

10:56:10 20 THE COURT: Okay. Any objection?

10:56:15 21 MR. DOYEN: What was being offered? I missed it. I  
10:56:17 22 couldn't hear.

10:56:18 23 MR. REGAN: Dr. Hunter's video that was played, I believe  
10:56:21 24 on Thursday of last week, these are the exhibits from that video.

10:56:25 25 THE COURT: All right. Without objection, those are

10:56:27 1 admitted.

10:56:28 2 MR. REGAN: And then with respect to the upcoming  
10:56:30 3 witness, we have a *Daubert* motion that's also pending as to  
10:56:35 4 Dr. Griffiths. Do you want to address that later?

10:56:38 5 MR. O'ROURKE: We are going to play a short video  
10:56:41 6 deposition before Dr. Griffiths, your Honor.

10:56:42 7 THE COURT: Okay. Let's go ahead and play the video.

10:56:44 8 MR. REGAN: My apologies.

10:56:47 9 MR. O'ROURKE: And it will be Mr. Benson doing the  
10:56:50 10 examination of Griffiths, so he will handle that motion.

10:56:51 11 THE COURT: Who is the video of?

10:56:53 12 MR. O'ROURKE: The video is David Barnett, he is the  
10:56:56 13 Chief Operating Officer of Wild Well Control, a contractor to BP.  
10:57:01 14 This video runs a little under ten minutes. It's the second of our  
10:57:05 15 three video depositions. And we will bring the transcripts and  
10:57:08 16 submit them.

10:57:09 17 THE COURT: Okay.

10:57:09 18 (WHEREUPON, THE VIDEO DEPOSITION CLIP OF DAVID BARNETT WAS  
11:07:10 19 PLAYED.)

11:07:10 20 THE COURT: All right. Next witness is?

11:07:12 21 MR. BENSON: Good morning, your Honor. Tom Benson for  
11:07:15 22 the United States. Our next witness is Stewart Griffiths.

11:07:18 23 THE COURT: All right. And I've looked at the *Daubert*  
11:07:24 24 motion. It's very similar to the issue with Dr. Dykhuizen, and I  
11:07:30 25 am going to deny the motion to exclude Dr. Griffiths. He obviously



11:07:40 1 has sufficient expertise as a -- long-standing expertise,  
11:07:48 2 education, and experience in this field.

11:07:51 3 And, as I understand, part of the objection was based on  
11:07:55 4 the fact that he used custom modeling analysis, and my  
11:08:07 5 understanding is that's been published. And again, to the extent  
11:08:12 6 BP raises criticisms of his approach, that can be raised by  
11:08:19 7 cross-examination. Okay?

11:08:20 8 MR. REGAN: Very well, your Honor. Thank you.

11:08:22 9 MR. BENSON: Thank you, your Honor. Dr. Griffiths, can  
11:08:25 10 you approach, please.

11:08:41 11 THE DEPUTY CLERK: If you'll raise your right hand.

11:08:41 12 (WHEREUPON, STEWART GRIFFITHS, WAS SWORN IN AND TESTIFIED AS  
11:08:51 13 FOLLOWS:)

11:08:51 14 THE DEPUTY CLERK: If you would take a seat. If you'll  
11:08:53 15 state and spell your name for the record, please.

11:08:56 16 THE WITNESS: My name is Stewart Griffiths, S-T-E-W-A-R-T  
11:09:01 17 G-R-I-F-F-I-T-H-S.

11:09:06 18 VOIR DIRE EXAMINATION

11:09:06 19 BY MR. BENSON:

11:09:06 20 Q. Good morning, Dr. Griffiths.

11:09:09 21 A. Good morning.

11:09:09 22 Q. Can you introduce yourself to the Court?

11:09:11 23 A. Yes. Good morning, your Honor, my name is Stewart Griffiths.

11:09:14 24 Q. And are you retired, Dr. Griffiths?

11:09:17 25 A. I am.

11:09:17 1 Q. Where did you work before your retirement?

11:09:19 2 A. Sandia National Laboratories.

11:09:21 3 Q. Are you prepared to offer an expert opinion today?

11:09:25 4 A. Yes, I am. I'm getting a great deal of feedback.

11:09:37 5 THE COURT: Pull that microphone toward you.

11:09:39 6 THE WITNESS: Okay.

11:09:39 7 BY MR. BENSON:

11:09:40 8 Q. Dr. Griffiths, are you prepared to offer an expert opinion  
11:09:43 9 today?

11:09:43 10 A. Yes, I am.

11:09:43 11 Q. In real broad terms, what topics are you providing an opinion  
11:09:48 12 about?

11:09:48 13 A. Flow rates and cumulative discharge from the Macondo well.

11:09:51 14 Q. And have you prepared demonstratives to help explain your  
11:09:55 15 testimony today?

11:09:55 16 A. Yes, I have.

11:09:56 17 Q. If we could have Demonstrative 21205. Dr. Griffiths, can you  
11:10:04 18 just give us an overview of what you did in this case and what  
11:10:09 19 you'll be testifying about today?

11:10:10 20 A. Yes. I developed a model based on measured pressures and flow  
11:10:15 21 rates of collected oil, and as well as some principles of fluid  
11:10:20 22 dynamics. That model was also used to calculate flow rates over  
11:10:24 23 the 86 days using pressures measured periodically during that  
11:10:28 24 period.

11:10:30 25 I validated that model a number of different ways. I

11:10:33 1 calculated uncertainties associated with that model and documented  
11:10:38 2 all of that in my expert report. I, then, read numerous defense  
11:10:44 3 expert reports and wrote a rebuttal to those.

11:10:48 4 Q. And, Dr. Griffiths, what did you conclude was the total  
11:10:51 5 discharge for the Macondo well?

11:10:53 6 A. Five million barrels, 5.0 million barrels.

11:10:57 7 Q. And we'll talk about that in detail later on. First, let's  
11:11:01 8 turn to your educational background. What university degrees have  
11:11:05 9 you earned?

11:11:06 10 A. I have bachelor, masters, and Ph.D. in mechanical engineering,  
11:11:10 11 all from the University of Illinois.

11:11:12 12 Q. What was your area of specialization in your studies?

11:11:16 13 A. Fluid dynamics, thermal sciences, so fluid dynamics, heat  
11:11:21 14 transfer, thermal dynamics.

11:11:23 15 Q. And just in broad terms, what is fluid dynamics?

11:11:27 16 A. The study of the motion of fluids.

11:11:29 17 Q. Where did you go to work after earning your Ph.D.?

11:11:33 18 A. I went directly to work for Sandia.

11:11:35 19 Q. Sandia National Laboratories?

11:11:36 20 A. Yes, correct.

11:11:37 21 Q. And why did you choose to work at Sandia?

11:11:41 22 A. Well, I felt at the time, I think I still feel today, it's the  
11:11:45 23 premier multi-disciplinary engineering laboratory in the world. It  
11:11:53 24 has roughly 5,000 technical people, very, very smart people to  
11:11:58 25 learn from. And then, because of the nature of the work, there's

11:12:02 1 also an almost unlimited supply of interesting technical  
11:12:08 2 challenges. And that's something I really enjoy.

11:12:11 3 Q. And how long did you work at Sandia?

11:12:14 4 A. Thirty-one years.

11:12:16 5 Q. If we could have Demonstrative 21207, please. And,  
11:12:22 6 Dr. Griffiths, can you give us a few examples of work that you did  
11:12:26 7 at Sandia that you believe are relevant to your Macondo work?

11:12:29 8 A. Sure. I mean, I did a great number of things relative to --  
11:12:35 9 relevant to this. I think there are three that sort of stand out  
11:12:38 10 as most relevant. I worked for quite a number of years in  
11:12:43 11 containment of underground nuclear tests. These are tests of  
11:12:48 12 nuclear explosive devices. I worked on nuclear weapons components  
11:12:52 13 for a number of years, and I think the one area most relevant to  
11:12:58 14 this is gas transfer systems.

11:13:00 15 And then I also was a response team member of a counter  
11:13:05 16 terrorist organization, this is U.S. government counter terrorist  
11:13:11 17 organization known at that time as NEST responsible for countering  
11:13:15 18 terrorist threats involving nuclear weapons.

11:13:19 19 And so through those three things, I guess, I learned --  
11:13:24 20 well, I learned in school most of this, but I certainly gained  
11:13:28 21 experience in flow in pipes, flow in porous media, both man-made  
11:13:34 22 materials, geological materials, multiphase flows, erosion, and I  
11:13:41 23 think especially in my work in containment of underground nuclear  
11:13:45 24 tests that I learned field tests, instrumentation systems, and how  
11:13:52 25 to examine and interpret data in order to learn things from it.

01:13:57 1 Q. What are some of the particular skills that you employed in  
01:14:04 2 your work in the Macondo case?

01:14:07 3 A. Well, I think the ones most relevant are, of course, fluid  
01:14:11 4 dynamics, parameter estimation, which is closely related to  
01:14:16 5 optimization, writing specialized software and using that to sort  
01:14:22 6 of learn from data about your system, and I think those are maybe  
01:14:31 7 the biggest ones.

01:14:34 8 Q. In your time at Sandia, have you ever been involved in  
01:14:37 9 investigations after a system fails like you did here?

01:14:40 10 A. Multiple times.

01:14:41 11 Q. And have you ever done work relating to erosion at your time at  
01:14:47 12 Sandia?

01:14:47 13 A. Yes, in fact -- well, I've worked on erosion a couple of  
01:14:52 14 different times. The one most relevant here I think is actually a  
01:14:56 15 response to sort of an urgent problem that involved flow of a gas  
01:15:02 16 in a tube. There were particles in the gas stream that should not  
01:15:07 17 have been there. There was a valve downstream in this flow that at  
01:15:13 18 a certain point in time would have to close and seal that tube.  
01:15:18 19 And so I worked on understanding how much erosion would occur in  
01:15:23 20 the body of that valve. And then, as a result of that erosion,  
01:15:28 21 what sort of leak rate the valve might exhibit.

01:15:31 22 Q. Dr. Griffiths, when you retired from Sandia, what position did  
01:15:37 23 you hold?

01:15:37 24 A. I was a Senior Scientist.

01:15:38 25 Q. And what did you do as a Senior Scientist at Sandia?

11:15:43 1 A. Well, let's see. I continued my own research activities. I  
11:15:49 2 led Sandia's Laboratory Directed Research and Development Program  
11:15:54 3 in nuclear weapons. I was on the Science Advisory Board's  
11:15:59 4 collection of about a dozen people that sort of collectively were  
11:16:03 5 responsible for all sort of science research at Sandia. And again,  
11:16:10 6 I got pulled off all of that every once in awhile to do something  
11:16:14 7 that Sandia felt was urgent and important.

11:16:17 8 Q. We'll be talking today about a model that you built to measure  
11:16:22 9 the flow rate from the Macondo well after the blowout. Have you  
11:16:27 10 ever built special purpose models like that in your time at Sandia?

11:16:30 11 A. I would say models of that sort were my stock and trade at  
11:16:34 12 Sandia. I did that over and over again where you had data, you put  
11:16:38 13 together a model to interpret and understand the data. So, yes.

11:16:43 14 Q. And have you ever developed your own model related to  
11:16:47 15 multiphase flow in your prior career?

11:16:49 16 A. Yes, I have.

11:16:50 17 Q. Of the models you've developed at Sandia, have you sold any of  
11:16:54 18 those to the public?

11:16:55 19 A. I hold two software copyrights and have licensed software to  
11:17:00 20 the public for both of those.

11:17:01 21 Q. Let's turn to publications for a moment. We'll talk later  
11:17:09 22 about a peer-reviewed paper that you published with your cumulative  
11:17:09 23 flow rate numbers from Macondo. Other than that paper, have you  
11:17:12 24 ever published any peer-reviewed papers before?

11:17:14 25 A. Yes. I -- over the course of my career, I've published on the

11:17:19 1 order of 50, I think it's actually over 50, but roughly 50 journal  
11:17:27 2 papers, dozens more conference papers, and then hundred -- more  
11:17:32 3 than 100 internal corporate-titled reports.

11:17:37 4 Q. Have you ever published papers in the field of fluid dynamics?

11:17:40 5 A. Virtually all of my publications in some way involve fluid  
11:17:47 6 dynamics, not every one, but the vast majority of them do.

11:17:50 7 Q. And have you ever served as a peer reviewer for journals  
11:17:55 8 reviewing other people's papers?

11:17:56 9 A. Yes, I have.

11:17:57 10 Q. And would that include reviewing in the field of fluid  
11:18:01 11 dynamics?

11:18:02 12 A. Again, almost exclusively.

11:18:04 13 Q. If we could have Demonstrative 21255, please. And,  
11:18:12 14 Dr. Griffiths, are these the cover pages of your expert report and  
11:18:16 15 expert rebuttal report in this case? And its' TREX 11485R and  
11:18:22 16 11486R.

11:18:24 17 A. They are.

11:18:25 18 Q. And do you adopt those two expert reports as part of your  
11:18:30 19 testimony in this case?

11:18:30 20 A. Yes, I do.

11:18:33 21 MR. BENSON: Your Honor, at this time, the United States  
11:18:35 22 offers Stewart Griffiths as an expert in fluid dynamics, applied  
11:18:39 23 mathematics and data analysis and computer modeling. We would also  
11:18:44 24 offer into evidence his expert report and rebuttal report,  
11:18:48 25 TREX 11485R and 11486R.

11:18:51 1 THE COURT: All right. Other than what was in your  
11:18:53 2 *Daubert* motion, do you have anything else?

11:18:56 3 MR. REGAN: Not other than the *Daubert* motion.

11:18:57 4 THE COURT: Okay. So I will accept him as an expert as  
11:19:00 5 tendered, and admit those reports.

11:19:03 6 MR. BENSON: Thank you, your Honor.

11:19:05 7 DIRECT EXAMINATION

11:19:05 8 BY MR. BENSON:

11:19:06 9 Q. Dr. Griffiths, let's turn for a moment to the work you did  
11:19:08 10 during the response. Were you part of the federal Tri-Lab Team?

11:19:12 11 A. Well, in a small way. I was never in Houston. I did  
11:19:18 12 participate in calls late in the thing, you know, over several  
11:19:23 13 weeks before it was shut in.

11:19:25 14 Q. And at a high level, what type of analysis were you working on  
11:19:30 15 or what subject area were you working on during the response?

11:19:33 16 A. During the response, I was working almost entirely on issues  
11:19:38 17 associated with well integrity. That was the big concern at that  
11:19:46 18 time, and most of what I was doing was associated with that.

11:19:49 19 Q. Did you start looking at flow rate during your time during the  
11:19:54 20 response?

11:19:54 21 A. I think because of well integrity, I looked at flow rates a  
11:19:58 22 little bit, and it was certainly in July timeframe that I started  
11:20:04 23 thinking about how I would construct a model to use available data  
11:20:09 24 for flow rates.

11:20:10 25 Q. Is that something you continued to work on after the well was



11:20:14 1 shut in?

11:20:15 2 A. I did.

11:20:15 3 Q. And why is that? Why did you keep working on it?

11:20:19 4 A. It was just a very interesting problem, I thought.

11:20:22 5 Q. So it was something that you wanted to pursue?

11:20:25 6 A. It was.

11:20:25 7 Q. Did anyone ask you to come up with a flow rate estimate after  
11:20:28 8 the well was shut in?

11:20:30 9 A. No.

11:20:30 10 Q. And we'll get to the mechanics of what you did in a minute, but  
11:20:36 11 did you end up publishing your work anywhere?

11:20:38 12 A. I did.

11:20:39 13 Q. And if we could have TREX 10031, please. Is this the  
11:20:47 14 publication of your results, Dr. Griffiths?

11:20:49 15 A. Yes, it is.

11:20:51 16 Q. And was this article peer-reviewed?

11:20:54 17 A. Yes, it was.

11:20:55 18 Q. And when did you submit this article for publication?

11:20:57 19 A. I believe it was in December of 2011. It was just before I  
11:21:04 20 retired.

11:21:05 21 Q. And was that before or after you were hired by the United  
11:21:09 22 States to work in this litigation?

11:21:11 23 A. That was several months before that time.

11:21:15 24 Q. And in putting this paper together, did you use the same method  
11:21:20 25 that you used in your expert reports in this litigation?

11:21:23 1 A. Method -- basic methodology is exactly the same. Since I  
11:21:28 2 started work with the Department of Justice, I got additional data  
11:21:36 3 both over the 86 days and then also additional data associated with  
11:21:41 4 the period following shut-in. And so those have been incorporated  
11:21:47 5 into my methodology. But the basic methodology is exactly the  
11:21:51 6 same.

11:21:51 7 Q. And let's turn now to what that methodology is and how it  
11:21:57 8 works. If we could have Demonstrative 21210, please. And at a  
11:22:05 9 high level, Dr. Griffiths, can you describe your methodology for  
11:22:08 10 us?

11:22:08 11 A. I will try. It really consists of just three pieces. One is  
11:22:15 12 the mathematical model based on a couple of principles of fluid  
11:22:21 13 dynamics. One is conservation of mass. Conservation mass has  
11:22:26 14 nothing other than anything that goes in one end of a pipe has to  
11:22:29 15 come out the other end. And some very well-established  
11:22:34 16 relationships that describe the relationship between flow rate and  
11:22:39 17 pressure differences.

11:22:40 18           So that's step one. That is not really a model of  
11:22:47 19 anything at that point, because it contains a number of constants  
11:22:50 20 that relate flow rate to pressure drop. Those constants in my  
11:22:56 21 report, which is described as parameter estimation, those constants  
11:22:59 22 are determined empirically, so I think in my report I refer to this  
11:23:04 23 as a physically based empirical model. So the physically based is  
11:23:09 24 the principles of fluid dynamics. That's the first bullet.

11:23:13 25           The empirical is the second part where I determine those

11:23:18 1 constants from measured pressures and measured flow rates of  
11:23:21 2 collected oil.

11:23:23 3           At that point I had a model that described the flow as a  
11:23:28 4 function of pressure difference for every point in the Macondo  
11:23:32 5 well, so from the reservoir to the bottom of the well, up the  
11:23:37 6 wellbore, through the BOP, up the capping stack, including the  
11:23:41 7 split for the choke and kill lines, and then I used a portion of  
11:23:45 8 that model along with the pressure difference between reservoir  
11:23:50 9 pressure and pressures measured at the bottom of the BOP  
11:23:55 10 periodically over the 86 days.

11:23:57 11           And so with part of that model relating flow rate to  
11:24:02 12 pressure drop and the measured BOP pressures, I was able to  
11:24:06 13 calculate then flow rates when there are measured pressures over  
11:24:12 14 the 86 days.

11:24:14 15 Q. Let's go to Demonstrative 21211 and talk about that  
11:24:19 16 relationship between flow rate and pressure that you mentioned a  
11:24:23 17 moment ago. Now, Dr. Griffiths, can you describe the relationship  
11:24:28 18 between pressure drop and flow rate?

11:24:30 19 A. Well, there are two basic categories of flow, laminar flow,  
11:24:35 20 turbulent flow. In laminar flow, flow rates are proportional,  
11:24:40 21 linearly proportional to a pressure drop. In turbulent flows,  
11:24:47 22 which have a different character, flow rates are proportional to  
11:24:51 23 the square root of a pressure difference. If I have a pipe, that  
11:24:56 24 pressure difference is the difference in pressures between the two  
11:24:59 25 ends of the pipe.

11:25:00 1 Q. And so those are the two equations that we see here on this  
11:25:03 2 demonstrative?

11:25:04 3 A. Yes, those are the two equations.

11:25:06 4 Q. And so  $Q$  equals flow rate; is that right?

11:25:09 5 A. Well, in my model  $Q$  is specifically flow rate of that portion  
11:25:15 6 of the mixture that is stock-tank oil.  $Kappa$  in my model -- so the  
11:25:23 7 only place there is laminar flow is in the reservoir. So  $kappa$  in  
11:25:28 8 this describes laminar flow.  $Kappa$  is the same as productivity  
11:25:32 9 index. That's actually an industry standard term for what I am  
11:25:38 10 doing here. Relates flow rate of stock-tank oil to pressure  
11:25:42 11 difference between far field reservoir and the bottom of the well.

11:25:48 12 Q. And after the  $kappa$  term, you have a  $\Delta P$  term in those  
11:25:52 13 equations.

11:25:53 14 A.  $\Delta$  meaning difference or change in mathematics.

11:25:56 15 Q. So that's just the change in pressure from one place in a  
11:25:59 16 system to another?

11:26:00 17 A. Correct.

11:26:01 18 Q. Are there any real-world examples of using differential  
11:26:05 19 pressure to calculate or measure flow rate?

11:26:08 20 A. Sure. There's a device you can buy, a number of people make  
11:26:13 21 them, it's called to a differential pressure flow meter. It's a  
11:26:17 22 little box, it will have an orifice or nozzle in it. You measure  
11:26:23 23 the pressure across that nozzle or orifice, and when you have the  
11:26:29 24 thing calibrated, that difference in pressure is used to determine  
11:26:34 25 flow rate.

11:26:36 1 Q. And so to figure out a flow rate, you need -- with this method,  
11:26:39 2 you need your constant term and your delta pressure, is that how it  
11:26:42 3 works?

11:26:43 4 A. That's correct.

11:26:43 5 Q. And so let's turn to figuring out how you found your constants.

11:26:48 6 And you used the term "discharge coefficient" in your report.

11:26:51 7 What's a discharge coefficient?

11:26:52 8 A. Well, discharge coefficient is just the turbulent analog of a  
11:27:01 9 productivity index. So discharge coefficient just describes  
11:27:04 10 turbulent flow, it relates, in my case, flow rate of stock-tank oil  
11:27:10 11 to square root of a pressure difference.

11:27:12 12 Q. And so for a given change in pressure, your discharge  
11:27:17 13 coefficient will tell you what the flow rate is for that part of  
11:27:20 14 the system?

11:27:20 15 A. Yes, that part. Yes.

11:27:24 16 Q. Let's turn to Demonstrative 21212. Dr. Griffiths, can you  
11:27:29 17 describe for us what the diagram you see on the right is?

11:27:32 18 A. The diagram is a diagram of the well. Obviously, it's not to  
11:27:38 19 scale. The lower pinkish sort of section down there represents the  
11:27:45 20 production casing. The dark blue is the BOP. The lighter blue  
11:27:52 21 above that, the LMRP. In my analysis, I treat those as combined.  
11:27:57 22 And then on top of that is the capping stack with a kill line off  
11:28:01 23 to the left, the yellow line; and off to the right, the choke line  
11:28:07 24 and variable choke that was actually used to shut in the well.

11:28:10 25 Q. And then you have another diagram next to that. Can you

11:28:13 1 describe what that is?

11:28:14 2 A. Yes. So that's a diagram just showing flow paths. So those  
11:28:20 3 aren't pipes or anything, it was just flow paths. And this is the  
11:28:26 4 sort of description of geometry that my model needs. I need to  
11:28:30 5 know when the flow goes from here to here and then here to here,  
11:28:33 6 that those are connected. So this is just starting in the bottom  
11:28:39 7 right of that diagram, you see the reservoir pressure,  $P_{res}$ .  
11:28:44 8 Kappa relates -- this is productivity index, relates flow rate from  
11:28:50 9 the reservoir to the bottom of the well.

11:28:53 10 Based on that pressure difference, then going up, you see  
11:28:57 11 a K well, that's discharge coefficient for the wellbore, that  
11:29:02 12 describes flow rate between the pressure at the bottom of the well  
11:29:07 13 and the BOP and so on up through the thing. And then you get to  
11:29:11 14 the split in the capping stack where you have, you know, both the  
11:29:15 15 kill and choke lines.

11:29:16 16 Q. For your model, how did you figure out what values to use for  
11:29:21 17 your discharge coefficients and your productivity index?

11:29:24 18 A. Those were all determined through a sort of formal process  
11:29:29 19 known as parameter estimation. What I did was I used measured flow  
11:29:35 20 rates of collected oil, along with the pressure differences through  
11:29:39 21 the system that accompanied that flow rate. I used two conditions  
11:29:45 22 there, one which oil was being collected, and the same condition  
11:29:50 23 except without oil collection.

11:29:53 24 And in addition, I used the measured pressures at the  
11:29:58 25 bottom of the BOP, and there on the diagram there you see PT-B with

11:30:04 1 a green circle. That green dot sort of represents the pressure  
11:30:08 2 gauge. So I used pressures measured at the PT-B location, the  
11:30:13 3 bottom of the BOP, and pressures measured at the capping stack,  
11:30:20 4 that's PT-3K-2, at each of 15 steps as the variable choke was  
11:30:26 5 closed. So I was using these pressures during the shut-in process  
11:30:29 6 as well. So that collection of information along with formal  
11:30:35 7 parameter estimation is how I obtained those discharge  
11:30:39 8 coefficients.

11:30:39 9 Q. And the details of all of that are in your expert report. Let  
11:30:43 10 me just ask you now, has any BP expert challenged how you did your  
11:30:47 11 parameter estimation?

11:30:48 12 A. Not that I am aware of.

11:30:50 13 Q. Can you describe the information -- maybe just looking at this  
11:30:54 14 diagram will help -- the information that you used in your best  
11:30:58 15 estimate calculation that gets you your 5.0 million total?

11:31:02 16 A. Sure. As I said earlier, I only used part of the model. The  
11:31:06 17 stick figure on the left is kind of the full model. For my best  
11:31:10 18 estimate, I used simply the productivity index and the discharge  
11:31:15 19 coefficient for the wellbore, K well, and then used the difference  
11:31:20 20 in pressure between reservoir and BOP to calculate flow rates.

11:31:25 21 Q. And let's turn to Demonstrative 21213. The Court has heard a  
11:31:33 22 little bit about PT-B already in this case, but can you just  
11:31:37 23 describe where PT-B was located and see if these diagrams will  
11:31:41 24 help?

11:31:42 25 A. So the drawing at the left is just sort of the subsea

11:31:47 1 environment. The long vertical thing is the wellbore. You can see  
11:31:52 2 a small image of the BOP sitting atop the casing. At the right is  
11:31:59 3 a photograph of the recovered BOP, and the arrow there is pointing  
11:32:04 4 at the PT-B gauge, which sets in a port just below the test rams.

11:32:13 5 Q. Why did you choose to use PT-B data as part of your best  
11:32:18 6 estimate in this case?

11:32:18 7 A. Well, if you use -- well, two reasons. One, PT-B pressure data  
11:32:24 8 is the only historical record of what was going on in the well over  
11:32:29 9 this 86 days. So that's important.

11:32:32 10 The other important thing is that when you use this  
11:32:35 11 difference between the pressure at the bottom of the BOP and the  
11:32:40 12 reservoir to calculate those flow rates, that any changes that had  
11:32:45 13 occurred or might have occurred in the BOP are automatically  
11:32:50 14 accounted for through their influence on the BOP pressures.

11:32:58 15 Q. You say they're automatically accounted for, why is that?

11:33:01 16 A. Well, I mean, essentially I have a flow meter with no leaks in  
11:33:05 17 it, upstream of a valve. You know, if you close that valve, the  
11:33:11 18 variable choke, or if anything else happens, when the riser was  
11:33:15 19 removed and other things like that, anything that changes the  
11:33:18 20 resistance downstream of PT-B, then flow rate changes because PT-B  
11:33:24 21 has to -- this is conservation mass, PT-B has to go up so that the  
11:33:31 22 pressure difference between the reservoir and BOP goes down so that  
11:33:37 23 any changes, erosion, anything that happened downstream of PT-B  
11:33:44 24 shows up in the pressures of PT-B and, therefore, they are  
11:33:48 25 automatically accounted for.



11:33:50 1 Q. Let's turn to Demonstrative 21214, please. And what does this  
11:33:58 2 reflect, Dr. Griffiths?

11:33:59 3 A. These are the reservoir and BOP pressures that I use in my best  
11:34:03 4 estimate calculation.

11:34:04 5 Q. And so the reservoir pressures are the red line --

11:34:07 6 A. Yes.

11:34:08 7 Q. -- at the top of the graph?

11:34:09 8 A. Yes.

11:34:09 9 Q. And the BOP pressures are those individual data points in black  
11:34:14 10 below?

11:34:14 11 A. Yeah. You'd never tell from this plot, but there are actually  
11:34:20 12 on the order of 90,000 measured pressures shown by those black  
11:34:25 13 dots. They all overlap a lot, so you can't see them all, but there  
11:34:29 14 are, in fact, a huge number of values represented there.

11:34:32 15 Q. Now, is everything in the black line measured BOP data?

11:34:37 16 A. No. All of the points, all of the BOP pressures there were  
11:34:41 17 measured; these are also corrected pressures, but they were all  
11:34:46 18 measured values except the one at time zero. So this is a plot of  
11:34:52 19 pressure as a function of time over the 86 days, so there's one dot  
11:34:57 20 at zero time that's a little over 4000 psi, that is not a measured  
11:35:03 21 pressure.

11:35:04 22 Q. And how did you decide what value to use for the time zero?

11:35:09 23 A. If you look carefully at that plot you'll see a line -- so what  
11:35:14 24 I did was just fit a line to the later data and then -- so over  
11:35:21 25 60 days or so, and then extrapolate that backwards to time zero,

11:35:28 1 this 17-day gap, and so just extrapolated that back to time zero,  
11:35:35 2 and that's sort of what's depicted with the gray line.

11:35:38 3 Q. Because there's no PT-B data before May 8th, right?

11:35:42 4 A. There were no pressures reported for PT-B before May 8th.

11:35:47 5 Q. And so for the period before May 8th, you drew the line that  
11:35:52 6 you just talked about extrapolating that data after May 8th?

11:35:55 7 A. That's correct.

11:35:55 8 Q. Why isn't there data before May 8th from PT-B?

11:36:01 9 A. Because somewhere in the explosion and the rig sinking,  
11:36:07 10 communications were lost with PT-B; so there was no longer a  
11:36:10 11 connection to the PT-B, and it took 17 days before that was  
11:36:15 12 restored.

11:36:16 13 Q. Who was responsible for the pressure measurement system at  
11:36:20 14 Macondo?

11:36:21 15 A. I believe BP was.

11:36:22 16 Q. And you talked about fitting the trend of the later data. Why  
11:36:29 17 would there be a trend in the BOP pressure data?

11:36:31 18 A. Because the reservoir pressure is decaying and as the reservoir  
11:36:36 19 pressure decays, the pressures at the BOP also have to decay.

11:36:41 20 Q. So we've talked about how you calculated your discharge  
11:36:46 21 coefficients. We've talked about the pressure data that you used.  
11:36:50 22 Once you had that information, were you able to calculate flow  
11:36:53 23 rates?

11:36:53 24 A. Yes, I was.

11:36:54 25 Q. If we could have Demonstrative 21215, please. And,

11:37:03 1 Dr. Griffiths, can you describe for us what this is?

11:37:05 2 A. This is a plot of flow rate in stock-tank barrels per day --  
11:37:15 3 well, actually, it's thousands of stock-tank barrels per day as a  
11:37:20 4 function of the elapsed time from roughly the time of the  
11:37:24 5 explosion. So over the 86 days.

11:37:26 6 And so what this is is a plot showing every point on this  
11:37:33 7 plot, so there's again the 90-something thousand points on here.  
11:37:37 8 Every point where I have a measured BOP pressure, I can calculate a  
11:37:42 9 flow rate; so I just go through all of those times, for each PT-B  
11:37:47 10 pressure, calculate a flow rate. So this is a plot of those flow  
11:37:51 11 rates.

11:37:51 12 Q. And what's the total that you came up with?

11:37:53 13 A. Well, so these are just flow rates. You integrate or sum these  
11:37:58 14 flow rates in time to get the total discharge, and that is  
11:38:04 15 5.0 million stock-tank barrels.

11:38:06 16 Q. And you've noted on this plot a few of the source control  
11:38:11 17 events that the Court has already heard about. We won't go through  
11:38:16 18 all of those. I just want to ask you, Dr. Griffiths, there's a  
11:38:16 19 note that says "Top Kill omitted," what's that mean?

11:38:19 20 A. Well, during the Top Kill period because there was pumping, the  
11:38:22 21 test rams were opened, there were a lot of different things  
11:38:27 22 influencing those pressures, and I just didn't think they would be  
11:38:32 23 necessary or useful in trying to estimate flow rates.

11:38:37 24 So that four-day period or so, there was a little gap,  
11:38:40 25 and I just neglect all of those pressures; and you see that nothing

11:38:46 1 really changes across that time, but because of the other  
11:38:49 2 activities I didn't want to include them in flow rate calculations.

11:38:53 3 Q. How would it affect your results if you had included the Top  
11:38:57 4 Kill data?

11:38:57 5 A. Well, I've actually done those calculations. If you include  
11:39:01 6 that period, the cumulative discharge goes up very slightly.

11:39:05 7 Q. Now if we could have Demonstrative 21216, please. And,  
11:39:14 8 Dr. Griffiths, can you explain for us what you believe are the  
11:39:16 9 strengths of your methodology?

11:39:17 10 A. Well, certainly that it's built on data from the ground up. I  
11:39:22 11 mean, if you believe that a picture is worth a thousand words, as a  
11:39:27 12 modeler, I believe that one measurement is worth 1,000  
11:39:31 13 calculations. So it's tied to reality because it's tied to the  
11:39:35 14 measured flow rates of collected oil. So that's the biggest one,  
11:39:40 15 in my mind.

11:39:41 16 Beyond that, because I use data, it greatly simplifies  
11:39:48 17 what I have to have in the form of a model. So I don't need  
11:39:52 18 detailed description of the geometry, I don't need equation of  
11:39:56 19 state temperatures, I don't need two-phase factors and all of the  
11:40:00 20 other things that when you use sort of general purpose codes are  
11:40:04 21 required. And those are all sources of uncertainties, so I feel  
11:40:08 22 that by use of data instead of all of those things, I can reduce  
11:40:12 23 uncertainties.

11:40:13 24 I've already mentioned that the methodology automatically  
11:40:16 25 accounts for any erosion in the BOP or riser. That was sort of one

11:40:22 1 of the main reasons I selected this methodology. And collectively,  
11:40:27 2 I think that makes it a more accurate methodology than purely  
11:40:32 3 computational approach.

11:40:33 4 Q. You mentioned a minute ago, Dr. Griffiths, that your  
11:40:37 5 methodology doesn't require certain parameters such as temperature,  
11:40:41 6 two-phase factors, stuff like that. Why is that? How does that  
11:40:45 7 work?

11:40:45 8 A. Well, the best way to try to describe that is by an example.  
11:40:50 9 So suppose you come to me and you say, I have got a pipe and I want  
11:40:53 10 to know what the flow rate is through my pipe over some range of  
11:40:57 11 conditions. And so my general purpose -- if I had a general  
11:41:05 12 purpose tool, first thing I would be asking is how long is your  
11:41:08 13 pipe, what's the diameter of the pipe, are there any elbows. I  
11:41:12 14 need a description of the geometry.

11:41:14 15 And then I need to know what the fluid is. So I ask you  
11:41:18 16 for an equation of state. That sort of goes on and on through a  
11:41:21 17 series of questions, and then I can go calculate what the flow  
11:41:25 18 rates are over your range of conditions.

11:41:29 19 What I did is very different. You come to me, same  
11:41:31 20 problem, I have a pipe. I don't need to know any of that. Go take  
11:41:37 21 your pipe, measure the flow rate through your pipe, tell me that  
11:41:43 22 flow rate. And I might ask you two conditions. Measure either in  
11:41:48 23 your range of interest or close to your range of interest, tell me  
11:41:52 24 the flow rate you got and tell me the delta P, the pressure  
11:41:57 25 difference that accompanied that.

11:41:59 1           From that information, I construct a model just like this  
11:42:03 2 sort of model I did here, and I can use that then to calculate flow  
11:42:09 3 rates over your whole range of condition. And I can do it, I  
11:42:14 4 believe, more accurately than I could do with a purely  
11:42:18 5 computational approach.

11:42:21 6           Equation of state, temperatures, all of that sort of  
11:42:23 7 stuff that you're using in general purpose models, I mean, all  
11:42:27 8 you're really doing there -- it doesn't really do this, but  
11:42:30 9 effectively what's going on is you have to calculate what the  
11:42:34 10 discharge coefficient is. In my methodology, I get it from the  
11:42:39 11 measured flow rates and pressure that you provide.

11:42:45 12 Q. Now, Dr. Griffiths, once you built your model, did you do  
11:42:48 13 anything to validate it?

11:42:52 14 A. Yes.

11:42:52 15 Q. Why do you think it's important to do validation in a situation  
11:42:55 16 like this?

11:42:56 17 A. Well, I think modeling as an activity should never be viewed as  
11:43:04 18 a process where you take numbers, input -- put them in a black box,  
11:43:09 19 you know, your model, you get answers out and say, yes, I'm done.

11:43:14 20           When you get numbers out of a model, you have to ask  
11:43:16 21 yourself do these numbers make sense, is there anything in my model  
11:43:24 22 that gives results that contradict something I know or believe.  
11:43:28 23 You have to ask is there any data that I can compare with, and you  
11:43:33 24 have to ask are there other ways I might calculate the same thing  
11:43:37 25 that would confirm my results.

11:43:40 1           So from my perspective, it's simple. You don't trust the  
11:43:45 2 output of models until you have an affirmative basis for having  
11:43:50 3 confidence in them.

11:43:51 4 Q. Is the type of validation you did here something you would  
11:43:55 5 typically do in your work at Sandia?

11:43:57 6 A. Yes, always.

11:43:58 7 Q. If we could have Demonstrative 21217, please. And your expert  
11:44:07 8 report goes through the validation that you did, so I want to go  
11:44:09 9 through these quickly. If you could sort of walk us through the  
11:44:12 10 first three bullets and then we will look at the others separately.

11:44:15 11 A. The first thing, because of my methodology, I am estimating  
11:44:19 12 parameters. Most of those aren't known, but I get a value of the  
11:44:25 13 productivity index. My value is about 44. The first thing I want  
11:44:29 14 to know is, is that consistent with what other people think it  
11:44:33 15 ought to be. And if it's not, then I have to go back and rethink  
11:44:38 16 things.

11:44:39 17           But I have a value of 44, roughly. I think BP during the  
11:44:44 18 response had values between 37 and 50, something like that. So  
11:44:51 19 this is a sanity check, okay. You know, I didn't get 400 for a PI.

11:44:57 20           I also then looked at flow rates of collected oil. So  
11:45:01 21 there are four periods prior to the shut-in when oil was collected  
11:45:05 22 that I feel were suitable for comparison. I used only one of those  
11:45:12 23 in my methodology, so I have three others, and so I then used the  
11:45:17 24 model to calculate what -- from a calculational point of view, what  
11:45:22 25 I thought those others should be. And all three of those agreed

11:45:27 1 with the measured values within better than 2 percent. So very  
11:45:31 2 good agreement on that.

11:45:32 3 The third bullet here is about this issue of whether  
11:45:37 4 changes in BOP pressure can properly represent changes in flow  
11:45:46 5 rate. I used those pressure differences and I've claimed that  
11:45:50 6 anything downstream of that would be automatically accounted for.

11:45:53 7 So here what I did was calculate using reservoir and BOP  
11:45:57 8 pressures during the shut-in process, one method. Then also  
11:46:02 9 calculated using the reservoir pressure and the ambient pressure;  
11:46:06 10 and in that case, the only thing the model knows about is that I'm  
11:46:10 11 closing the choke.

11:46:12 12 So the BOP pressure is not involved in that at all. And  
11:46:15 13 in that case, I got agreement within again a couple of percent, and  
11:46:20 14 that shows conclusively that -- that flow rates are properly --  
11:46:29 15 changes in resistance downstream of PT-B are properly accounted for  
11:46:35 16 in my best estimate methodology.

11:46:38 17 Q. Once you started doing this validation process and getting some  
11:46:41 18 of the results, what did you do next?

11:46:43 19 A. Oh, well, let's see. So one of the things -- a lot of that was  
11:46:50 20 going on very early. I mean, even while I was still at Sandia, I  
11:46:54 21 became aware of that. And there was a little bit -- I was a little  
11:46:57 22 bit concerned that these have very small numbers, you know,  
11:47:01 23 1.7 percent, 3 percent, very good agreement. And I was a little  
11:47:05 24 bit concerned about that in light of my assumptions. I mean, I  
11:47:10 25 knew what assumptions I had made to put the model together, and I



11:47:13 1 thought that this was maybe a little bit too good to be true.

11:47:18 2           So what I did then -- and this appears at Appendix C in  
11:47:21 3 my report -- rather than take assumptions and work my way towards  
11:47:26 4 this model based on discharge coefficients, I started with  
11:47:31 5 classical two-phase flow correlations, and using those classical  
11:47:37 6 correlations, derived what a discharge coefficient would be. And  
11:47:42 7 then I examined how those discharge coefficients would vary as  
11:47:47 8 pressures and temperatures varied.

11:47:49 9           And what I found was that, in fact, they varied much less  
11:47:53 10 than what I had thought they would. And so this was just another  
11:47:58 11 part of validation, looking at the problem from another  
11:48:01 12 perspective.

11:48:02 13 Q. Let's turn to another couple of acts of validation that you  
11:48:07 14 did. And if we could have Demonstrative 21218, please.

11:48:26 15 Dr. Griffiths, can you describe what we have here?

11:48:30 16 A. Yes. This is a plot of pressures, measured and calculated  
11:48:38 17 pressures at the BOP and at the capping stack, so this is PT-B and  
11:48:45 18 PT-3K-2 pressures. The measured pressures are symbols here and the  
11:48:50 19 curves are my calculated values, and so these are pressures as a  
11:48:55 20 function of choke position as the well is being shut in. And what  
11:49:00 21 you see is that the calculations reproduced the measured values  
11:49:05 22 within, you know, roughly 100 psi over that entire range, and  
11:49:10 23 that's just extremely good agreement, from my perspective.

11:49:14 24 Q. Now, we'll talk a little bit later that one of the criticisms  
11:49:19 25 that BP has raised is that you should have used a commercial code

11:49:22 1 for your work rather than sort of your specially built model. Did  
11:49:27 2 you do anything to compare your model to the commercial codes that  
11:49:32 3 BP has talked about?

11:49:32 4 A. Yes, I did.

11:49:33 5 Q. Can we have demonstrative 21219, please. And what does this  
11:49:39 6 show, Dr. Griffiths?

11:49:40 7 A. So this is a figure from my original report. It's calculations  
11:49:48 8 done by Tony Liao of BP during the response and it's flow rate --  
11:49:54 9 this is, again, thousands of stock-tank barrels per day -- as a  
11:49:59 10 function of frictional pressure drop along the wellbore. So the  
11:50:03 11 calculation Tony did was for the wellbore. So those are the red  
11:50:10 12 symbols.

11:50:11 13 They were all done using, I think, a code favored by BP  
11:50:16 14 called PROSPER, so it's a one-dimensional multiphase flow code that  
11:50:21 15 he was using. And that's the red symbols.

11:50:24 16 The black curve is a replication of those results using a  
11:50:31 17 constant discharge coefficient. And that is the flow rate is going  
11:50:36 18 to be proportional to the square root of the delta P, so the black  
11:50:40 19 line is that. And you see that a constant discharge coefficient  
11:50:43 20 reproduces Tony Liao's results within, you know, a percent,  
11:50:48 21 percent-and-a-half over all flow rates between 0 and 50,000 barrels  
11:50:54 22 a day.

11:50:58 23 MR. BENSON: At this time, your Honor, I would like to  
11:50:59 24 turn to some modeling by Dr. Bushnell that Dr. Griffiths used as  
11:51:03 25 part of his validation process. This issue was raised yesterday.

11:51:07 1 I don't know if BP still has an objection, if you want to take that  
11:51:10 2 up first.

11:51:12 3 MR. REGAN: Matt Regan, your Honor. We do have a  
11:51:15 4 objection to this on numerous bases. The first of which is that  
11:51:16 5 Dr. Griffiths testified in his deposition that he did not rely on  
11:51:19 6 any other experts to reach his opinions, so that would be Objection  
11:51:21 7 No. 1.

11:51:22 8 Objection No. 2 is that the order for this litigation is  
11:51:27 9 limited to number of experts that can testify, and that was the  
11:51:31 10 subject of Judge Shushan's order that was brought up yesterday.  
11:51:34 11 The continual reference to Dr. Bushnell is just an attempt to try  
11:51:40 12 to add another expert to this case. The choices had to be made  
11:51:43 13 about which experts were going to be brought to this case, and  
11:51:47 14 Judge Shushan has ruled that none of the U.S. experts relied on  
11:51:50 15 Dr. Bushnell.

11:51:51 16 Dr. Griffiths testified that he did not rely on any other  
11:51:54 17 experts. So we do object to this continual attempt to bring in  
11:51:57 18 Expert No. 9 or Expert No. 10 through the guise of other experts.

11:52:02 19 MR. BENSON: If I could respond, your Honor. This is the  
11:52:04 20 same issue you dealt with yesterday. Dr. Griffiths can explain  
11:52:07 21 how he used Dr. Bushnell's modeling. The U.S. is -- I mean,  
11:52:13 22 Mr. Regan is right that there was a limit placed on the number of  
11:52:15 23 experts in this case. As part of that limit, there was a process  
11:52:19 24 by which parties could rely on the expert reports of witnesses who  
11:52:23 25 are not going to testify live.

11:52:24 1 THE COURT: Okay. I don't see any difference in this  
11:52:27 2 issue and my ruling yesterday, so to be consistent I will allow it.  
11:52:32 3 Go ahead.

11:52:34 4 MR. BENSON: Okay. Thank you, your Honor.

11:52:36 5 BY MR. BENSON:

11:52:36 6 Q. Now, if we could have Demonstrative 21235, please.

11:52:42 7 Dr. Griffiths, did you rely on the work of Dr. Bushnell in helping  
11:52:45 8 to validate your model in this case?

11:52:48 9 A. Yes, I did.

11:52:49 10 Q. And can you describe what we see here in 21235?

11:52:53 11 A. Well, this is the same sort of plot that we looked at just a  
11:52:58 12 moment ago. This is actually a full out 3D CFD calculation done by  
11:53:05 13 Dr. Bushnell, not for the wellbore but for the kill line. And  
11:53:09 14 again, you see the  $Q$  equals  $K$  root  $\Delta P$ , so this is, again,  
11:53:16 15 demonstrating that a constant discharge coefficient very accurately  
11:53:22 16 captures all of the complexities, all of the issues associated with  
11:53:27 17 multiphase flow in the kill line. And in this case, it spans from  
11:53:34 18 somewhere close to 0 up to 70,000 barrels a day, which is just a  
11:53:40 19 tremendously large range.

11:53:43 20 And then, in this case, the agreement's even better.  
11:53:47 21 These all agree within, I think, better than one percent over that  
11:53:51 22 entire range.

11:53:52 23 Q. When you said, "The span for flow rate is from 0 to  
11:53:56 24 70,000 barrels," does that cover what you call the conditions of  
11:54:00 25 interest?

11:54:00 1 A. Certainly.

11:54:01 2 Q. And what do you mean when you say, "conditions of interest"?

11:54:05 3 A. Well, conditions of interest, when I talk about it usually  
11:54:08 4 means range of pressures. So we know, for example, that the  
11:54:13 5 reservoir pressure is only varied from some value to some value  
11:54:17 6 over the 86 days. PT-B pressure is only varied from some value to  
11:54:22 7 some other value. So that's the range of interest usually when I  
11:54:28 8 talk about it.

11:54:28 9 For flow rates, you know, up to 60, 65,000 barrels a day  
11:54:34 10 all the way down to zero as the well was shut-in are range of  
11:54:39 11 interest.

11:54:39 12 Q. Let's turn to one final source of validation that you did and  
11:54:44 13 that's what you call your alternate calculations.

11:54:46 14 A. Uh-huh.

11:54:46 15 Q. If we could have Demonstrative 21221, please. This reflects  
11:54:53 16 your best estimate calculation which we've been talking about a  
11:54:56 17 little bit already today. Can you walk through your best estimate  
11:54:59 18 and how it relates to your alternate calculations?

11:55:01 19 A. Sure. So as I already described, the best estimate uses just  
11:55:06 20 productivity index and wellbore discharge coefficient, along with  
11:55:10 21 the pressure difference between the reservoir and measured BOP  
11:55:15 22 pressures. So there are attributes associated with this and the  
11:55:21 23 alternate methods, and there's a couple that need to be pointed  
11:55:24 24 out.

11:55:24 25 So clearly, this one relies on the data from PT-B. There

11:55:28 1 is no data before May 8th, so, you know, constrains a little bit  
11:55:32 2 what you can conclude. Does not account for erosion in the  
11:55:37 3 reservoir and wellbore, but does automatically account for any  
11:55:42 4 possible erosion in the BOP and that's the important issue for the  
11:55:47 5 moment.

11:55:47 6 So -- and as I've already said, the result from that best  
11:55:51 7 estimate calculation is 5 million barrels.

11:55:55 8 Q. Let's go to Demonstrative 21222, and talk about your Alternate  
11:56:00 9 1 calculation. What's that?

11:56:02 10 A. Okay. So Alternate 1 is sort of the same calculation, but now  
11:56:08 11 add the BOP to it. So now I have productivity index, wellbore  
11:56:12 12 discharge, and BOP discharge coefficient, and I am using just the  
11:56:17 13 reservoir pressure and ambient sea pressure, so that pressure  
11:56:21 14 difference is the pressure difference on which I base the  
11:56:24 15 calculations.

11:56:25 16 Q. And that's reflected in the diagram on the very right there?

11:56:27 17 A. Exactly. So attributes of this, while it's used in the sea  
11:56:34 18 pressure, so always was the same through this. So that issues  
11:56:39 19 associated with PT-B there's no data before May 8th. Offsets in  
11:56:44 20 PT-B and corrections, those issues go away.

11:56:47 21 And the problem with this one, if it's a problem -- well,  
11:56:51 22 it does not automatically account for possible erosion in the BOP.  
11:56:55 23 So if erosion in the BOP were significant and significantly  
11:57:02 24 affected flow rates over the 86 days, that would not be accounted  
11:57:07 25 for in this Alternate 1 methodology.

11:57:13 1           Nevertheless, you get this discharge of 5.1 which, for  
11:57:20 2 all practical purposes, is identical to 5.0 for my best estimate.

11:57:26 3           The important thing here is my best estimate does account  
11:57:30 4 for potential erosion in the BOP. This alternate does not account  
11:57:35 5 for it, and yet we get nominally the same answer. And from that  
11:57:42 6 you conclude that erosion in the BOP did not significantly affect  
11:57:48 7 the cumulative discharge over the 86 days.

11:57:54 8 Q. Let's turn to your second alternate calculation. We have  
11:57:57 9 demonstrative for that, which is D 2122 --

11:58:01 10           THE COURT: Is this a good point to stop? I'm assuming  
11:58:06 11 you have a ways to go, right?

11:58:07 12           MR. BENSON: We do have a ways to go. We can wrap up the  
11:58:10 13 alternate calculations in about three more minutes I think.

11:58:12 14           THE COURT: All right. Because I do have a meeting,  
11:58:15 15 someone to meet with in a couple of minutes.

11:58:15 16           MR. BENSON: Or we can certainly stop.

11:58:17 17           THE COURT: Why don't we just stop now and come back at  
11:58:19 18 1:15.

11:58:21 19           THE DEPUTY CLERK: All rise.

11:58:22 20           (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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