

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

IN RE: OIL SPILL BY THE OIL RIG	*	Docket 10-MD-2179
<i>DEEPWATER HORIZON</i> IN THE	*	
GULF OF MEXICO ON APRIL 20, 2010	*	Section J
	*	
Applies to:	*	New Orleans, Louisiana
	*	
Docket 10-CV-02771,	*	October 7, 2013
<i>IN RE: THE COMPLAINT AND</i>	*	
<i>PETITION OF TRITON ASSET</i>	*	
<i>LEASING GmbH, et al.</i>	*	
	*	
Docket 10-CV-4536,	*	
<i>UNITED STATES OF AMERICA v.</i>	*	
<i>BP EXPLORATION & PRODUCTION,</i>	*	
<i>INC., et al.</i>	*	
	*	
* * * * *		

DAY 5, AFTERNOON SESSION
TRANSCRIPT OF NONJURY TRIAL BEFORE
THE HONORABLE CARL J. BARBIER
UNITED STATES DISTRICT JUDGE

Appearances:

For the Plaintiffs:	Herman Herman & Katz, LLC BY: STEPHEN J. HERMAN, ESQ. 820 O'Keefe Avenue New Orleans, Louisiana 70113
---------------------	--

For the Plaintiffs:	Domengeaux Wright Roy & Edwards, LLC BY: JAMES P. ROY, ESQ. 556 Jefferson Street, Suite 500 Post Office Box 3668 Lafayette, Louisiana 70502
---------------------	--

1 Appearances:

2 For the Plaintiffs: Levin Papantonio Thomas Mitchell
3 Rafferty & Proctor, PA
4 BY: BRIAN H. BARR, ESQ.
5 316 South Baylen Street, Suite 600
6 Post Office Box 12308
7 Pensacola, Florida 32591

8 For the Plaintiffs: Irpino Law Firm
9 BY: ANTHONY IRPINO, ESQ.
10 2216 Magazine Street
11 New Orleans, Louisiana 70130

12 For the Plaintiffs: Weitz & Luxenberg, PC
13 BY: ROBIN L. GREENWALD, ESQ.
14 700 Broadway
15 New York, New York 10003

16 For the Plaintiffs: Lundy Lundy Soileau & South, LLP
17 BY: MATTHEW E. LUNDY, ESQ.
18 501 Broad Street
19 Lake Charles, Louisiana 70601

20 For the Plaintiffs: Morgan & Morgan
21 BY: FRANK M. PETOSA, ESQ.
22 188 East Capital Street, Suite 777
23 Jackson, Mississippi 39201

24 For the States'
25 Interests: Attorney General's Office
BY: COREY L. MAZE, ESQ.
WINFIELD J. SINCLAIR, ESQ.
500 Dexter Avenue
Montgomery, Alabama 36130

For the State of
Louisiana: Attorney General's Office
BY: JAMES D. CALDWELL, ESQ.
1885 North Third Street
Post Office Box 94005
Baton Rouge, Louisiana 70804

1 Appearances:

2
3 For the State of Louisiana: Kanner & Whiteley, LLC
4 BY: ALLAN KANNER, ESQ.
5 DOUGLAS R. KRAUS, ESQ.
6 701 Camp Street
7 New Orleans, Louisiana 70130

8
9 For the United States of America: U.S. Department of Justice
10 Torts Branch, Civil Division
11 BY: STEPHEN G. FLYNN, ESQ.
12 Post Office Box 14271
13 Washington, D.C. 20044

14
15 For the United States of America: U.S. Department of Justice
16 Environment & Natural Resources
17 Environmental Enforcement Section
18 BY: THOMAS BENSON, ESQ.
19 STEVEN O'ROURKE, ESQ.
20 SCOTT CERNICH, ESQ.
21 A. NATHANIEL CHAKERES, ESQ.
22 ANNA CROSS, ESQ.
23 BETHANY ENGEL, ESQ.
24 RICHARD GLADSTEIN, ESQ.
25 JUDY HARVEY, ESQ.
SARAH HIMMELHOCH, ESQ.
Post Office Box 7611
Washington, D.C. 20044

17 For BP Exploration & Production Inc.,
18 BP America Production Company, BP PLC: Liskow & Lewis, APLC
19 BY: DON K. HAYCRAFT, ESQ.
20 701 Poydras Street, Suite 5000
21 New Orleans, Louisiana 70139

22 For BP Exploration & Production Inc.,
23 BP America Production Company, BP PLC: Kirkland & Ellis, LLP
24 BY: J. ANDREW LANGAN, ESQ.
25 HARIKLIA "CARRIE" KARIS, ESQ.
MATTHEW T. REGAN, ESQ.
PAUL D. COLLIER, ESQ.
BARRY E. FIELDS, ESQ.
300 N. LaSalle
Chicago, Illinois 60654

1 Appearances:

2
3 For BP Exploration & Kirkland & Ellis, LLP
4 Production Inc., BY: MARTIN BOLES, ESQ.
BP America Production 333 South Hope Street
Company, BP PLC: Los Angeles, California 90071

5
6 For BP Exploration & Kirkland & Ellis, LLP
7 Production Inc., BY: ROBERT R. GASAWAY, ESQ.
BP America Production JOSEPH A. EISERT, ESQ.
Company, BP PLC: 655 Fifteenth Street, N.W.
Washington, D.C. 20005

8
9 For BP Exploration & Covington & Burling, LLP
10 Production Inc., BY: ROBERT C. "MIKE" BROCK, ESQ.
BP America Production BRIDGET K. O'CONNOR, ESQ.
Company, BP PLC: 1201 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

11
12 For Transocean Holdings Frilot, LLC
13 LLC, Transocean Offshore BY: KERRY J. MILLER, ESQ.
14 Deepwater Drilling Inc., 1100 Poydras Street, Suite 3700
Transocean Deepwater Inc.: New Orleans, Louisiana 70163

15
16 For Transocean Holdings Sutherland Asbill & Brennan, LLP
17 LLC, Transocean Offshore BY: STEVEN L. ROBERTS, ESQ.
Deepwater Drilling Inc., 1001 Fannin Street, Suite 3700
Transocean Deepwater Inc.: Houston, Texas 77002

18
19 For Transocean Holdings Munger Tolles & Olson, LLP
20 LLC, Transocean Offshore BY: MICHAEL R. DOYEN, ESQ.
Deepwater Drilling Inc., BRAD D. BRIAN, ESQ.
Transocean Deepwater Inc.: LUIS LI, ESQ.
21 GRANT A. DAVIS-DENNY, ESQ.
22 ALLEN M. KATZ, ESQ.
355 S. Grand Avenue, 35th Floor
Los Angeles, California 90071

23

24

25

1 Appearances:2
3 For Halliburton Energy
Services, Inc.:Godwin Lewis, PC
BY: DONALD E. GODWIN, ESQ.
JENNY L. MARTINEZ, ESQ.
BRUCE W. BOWMAN JR., ESQ.
PRESCOTT W. SMITH, ESQ.
SEAN W. FLEMING, ESQ.
1201 Elm Street, Suite 1700
Dallas, Texas 752707
8 For Halliburton Energy:
Services, Inc.:Godwin Lewis, PC
BY: R. ALAN YORK, ESQ.
GWENDOLYN E. RICHARD, ESQ.
1331 Lamar, Suite 1665
Houston, Texas 7701011 For Anadarko Petroleum
Corporation, Anadarko
E&P Company LP:Kuchler Polk Schell Weiner
& Richeson, LLC
BY: DEBORAH D. KUCHLER, ESQ.
1615 Poydras Street, Suite 1300
New Orleans, Louisiana 7011214 For Anadarko Petroleum
Corporation, Anadarko
E&P Company LP:Bingham McCutchen, LLP
BY: WARREN A. FITCH, ESQ.
KY E. KIRBY, ESQ.
2020 K Street, N.W.
Washington, D.C. 20006

18 Official Court Reporter:

Jodi Simcox, RMR, FCRR
500 Poydras Street, Room HB-406
New Orleans, Louisiana 70130
(504) 589-7780
Jodi_Simcox@laed.uscourts.gov23
24 Proceedings recorded by mechanical stenography using
computer-aided transcription software.

25

I N D E X

	<u>Page</u>
1	
2	
3	
4	Thomas Hunter, Ph.D. Cross-Examination By Mr. Regan: 1315
5	Mike Mason Videotaped deposition 1354
6	
7	Ronald Dykhuizen, Ph.D. Voir Dire Examination By Mr. Cernich: 1355
8	Direct Examination By Mr. Cernich: 1364
9	Cross-Examination Mr. Regan 1433
10	Redirect Examination The Witness 1494
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

AFTERNOON SESSION

(October 7, 2013)

* * * * *

THE DEPUTY CLERK: All rise.

THE COURT: All right. Please be seated.

(WHEREUPON, **THOMAS HUNTER, PH.D.**, having been previously duly sworn, testified as follows:)

THE DEPUTY CLERK: Please state your full name and correct spelling for the record.

THE WITNESS: Thomas Hunter, T-H-O-M-A-S, H-U-N-T-E-R.

MR. REGAN: May I proceed, Your Honor?

THE COURT: Yes.

CROSS-EXAMINATION

BY MR. REGAN:

Q. I'm Matt Regan on behalf of BP and, Doctor, I have you on cross-examination. Good afternoon, Dr. Hunter.

A. Good afternoon.

Q. I want to pick up with something you said on your direct examination that the best way to determine flow was having a known geometry and pressure readings on both sides of it; do you recall that?

A. That's correct.

Q. And so what you really need is two reliable pressures and a known geometry in between. Is that another way of saying the

THOMAS HUNTER, PH.D. - CROSS

1:22 PM 1 same thing?

1:22 PM 2 A. I should have clarified that it's not better than

1:22 PM 3 collecting it in the shift.

1:22 PM 4 Q. Fair enough. So two of the things that you were looking

1:22 PM 5 at in your independent assessment of flow at Macondo was

1:22 PM 6 related to the geometry of the situation and then the pressure

1:22 PM 7 information that you had available; correct?

1:22 PM 8 A. That's correct.

1:22 PM 9 Q. With respect to the geometry, it was not just learning the

1:22 PM 10 geometry as it was as of the time of the accident but also any

1:22 PM 11 changes or restrictions that might have happened during the

1:22 PM 12 course of the flow period; correct?

1:22 PM 13 A. I can't really answer that because it depends on whether

1:22 PM 14 you're referring to the estimate that was made on day 87 or the

1:22 PM 15 day -- or the estimates that were made at earlier times.

1:22 PM 16 Q. Let's talk about the estimates prior to the capping stack.

1:23 PM 17 The capping stack was the first time that you felt that you had

1:23 PM 18 a known geometry for purposes of pressure; correct?

1:23 PM 19 A. That's correct. And accurate pressure measurements.

1:23 PM 20 **MR. REGAN:** So if we pull up TREC-9692.3.2.

1:23 PM 21 **BY MR. REGAN:**

1:23 PM 22 Q. Just on the topic of looking at restrictions for the

1:23 PM 23 Court's benefit, the types of restrictions that could exist --

1:23 PM 24 this is from a presentation that Dr. Dykhuizen and Dr. Morrow

1:23 PM 25 had put together in mid-May of 2010. And there's a chart here

THOMAS HUNTER, PH.D. - CROSS

1 : 2 3 PM 1 talking about restrictions here on the right side. Do you see
1 : 2 3 PM 2 that?

1 : 2 3 PM 3 A. I do. And I believe this is actually a BP chart that was
1 : 2 3 PM 4 borrowed by them.

1 : 2 3 PM 5 Q. Okay. It was borrowed by them and put into their
1 : 2 3 PM 6 presentation?

1 : 2 3 PM 7 A. I think that's right. And they may have added some of the
1 : 2 3 PM 8 wording on the sides.

1 : 2 3 PM 9 Q. If you're looking at the question of what are the
1 : 2 3 PM 10 restrictions to take into account at Macondo during the flow
1 : 2 4 PM 11 period, they would include mechanical restrictions such as in
1 : 2 4 PM 12 the riser when it was kinked over; correct?

1 : 2 4 PM 13 A. That's correct.

1 : 2 4 PM 14 Q. It would include restrictions in the BOP such as the
1 : 2 4 PM 15 restrictions caused by rams or the annulars or other mechanical
1 : 2 4 PM 16 restrictions; correct?

1 : 2 4 PM 17 A. That's correct.

1 : 2 4 PM 18 Q. And then within the wellbore itself -- that is, below the
1 : 2 4 PM 19 mud line, which is represented right here -- you could have
1 : 2 4 PM 20 restrictions that could include cement, skin, mechanical
1 : 2 4 PM 21 restrictions, friction restrictions, and also sanding; correct?

1 : 2 4 PM 22 A. That's correct.

1 : 2 4 PM 23 Q. And if you wanted to do a flow rate estimate using
1 : 2 4 PM 24 hydraulics -- that is, two pressures and a known geometry in
1 : 2 4 PM 25 between -- you'd have to come to some assessment or assumption

THOMAS HUNTER, PH.D. - CROSS

1 about what those restrictions were doing in that flow area;
2 correct?

3 A. It depends on which calculation we're doing. If you're
4 trying to do what I call a complete nodal analysis from top to
5 bottom, you would do that. If you had some way to measure
6 solely at the top and understood the impact, you could do that
7 as well.

8 Q. But the uncertainty about these restrictions was one of
9 the challenges that you appreciated in May and in June of 2010
10 in looking at the problem; correct?

11 A. Sure. If one were doing a complete system assessment,
12 that's correct.

13 Q. Now we'll talk a little bit about pressures. With respect
14 to the capping stack, you said one of the real benefits of it
15 is that you had known pressure instrumentation; correct?

16 A. That's correct.

17 Q. So those gauges were put on the capping stack before it
18 was installed and you had great confidence in them; correct?

19 A. That's correct.

20 Q. Prior to that time period, there was much more limited
21 pressure information available?

22 A. That's also correct.

23 Q. And again, just -- just to get us oriented here as we walk
24 through these pressure information over the next several weeks,
25 really.

THOMAS HUNTER, PH.D. - CROSS

1 **MR. REGAN:** Can we put up D-24368.

2 **BY MR. REGAN:**

3 **Q.** And, Dr. Hunter, this is just a schematic, very generic,
4 of the well. I have listed here ambient pressure, the PT-B
5 pressure gauge, and then reservoir pressure. Do you see that?

6 **A.** I do.

7 **Q.** Okay. Reservoir pressure was something that was measured
8 before the blowout, basically initial reservoir pressure;
9 correct?

10 **A.** Before the blowout, that's correct, at the -- what I would
11 call day zero, yes.

12 **Q.** Right. Ambient pressure is the pressure of the sea right
13 around the point of the BOP or the point of exit of flow;
14 correct?

15 **A.** That's correct.

16 **Q.** And the PT-B pressure gauge was at the bottom of the BOP;
17 correct?

18 **A.** That is correct.

19 **Q.** All right. The PT-B pressure gauge means a pressure that
20 is a combination of things that are happening below it -- that
21 is, upstream -- and things that are happening above it,
22 downstream level; correct? It reflects the combination of
23 those two areas; right?

24 **A.** The pressure that it reads is influenced by what is below
25 and what's above. It reads whatever the pressure is at that

THOMAS HUNTER, PH.D. - CROSS

1 point or what it thinks the pressure is, yes.

2 Q. And that was really one of the challenges of the PT-B
3 pressure gauge is trying to understand you had one gauge, one
4 pressure, and two unknown geometries on either side; correct?

5 A. As far as a complete well, that would be correct.

6 Q. Okay. You personally did not rely, in making judgments
7 about flow rate, on the pressure readings from the PT-B gauge;
8 correct?

9 A. That's not entirely correct. And by the way, there is a
10 missing -- the mud boost line also had a pressure gauge for a
11 period of time at the top.

12 Now, when one looked at the differential from such
13 things as the riser cut, one did look at the PT-B and I did
14 that myself, actually, but that was about differential flow,
15 not about total flow.

16 Q. Right. For purpose -- for purposes of arriving at a
17 calculation of flow, it was your view, and you told your team
18 that it was your view, that you did not think the PT-B gauge
19 was something that should be viewed as accurate or precise for
20 a flow rate determination; right?

21 A. I believe my statement to the team was that the pressure
22 gauge didn't read totally true pressure, but it -- it was used
23 for differential pressures, meaning from one time to another.

24 Q. You didn't -- you testified there was two flow rate
25 estimates that you and your team put together, one in mid-June,

THOMAS HUNTER, PH.D. - CROSS

1:28 PM 1 probably the 15th of June, and then one being based on the
1:28 PM 2 capping stack; correct?

1:28 PM 3 A. That -- that's correct.

1:28 PM 4 Q. You did not calculate a flow rate during the time period
1:28 PM 5 of May; correct?

1:28 PM 6 A. That's correct.

1:28 PM 7 Q. And from your perspective, there was not enough data
1:28 PM 8 available from the well to calculate a defensible flow rate in
1:28 PM 9 May of 2010; correct?

1:28 PM 10 A. I would not say it that way. I would say there was a team
1:28 PM 11 of people looking at the techniques to do visualization of
1:28 PM 12 other methods to determine flow. We -- I was perfectly happy
1:28 PM 13 to let them proceed. I didn't spend any resources of our team
1:28 PM 14 looking at that during that period.

1:28 PM 15 Q. Well, it was your view that there was not sufficient data
1:28 PM 16 from the well to make a flow rate estimate in May of 2010;
1:28 PM 17 correct?

1:28 PM 18 A. There was not sufficient data from -- that we had compared
1:28 PM 19 to, for example, the capping stack pressure data that we chose
1:28 PM 20 not to make a pressure estimate during that time.

1:28 PM 21 Q. Okay. All right. You did not make any flow rate estimate
1:28 PM 22 coming out of the Top Kill events; correct?

1:29 PM 23 A. That's correct. And if I could clarify it, "you" means
1:29 PM 24 both myself, personally, and the team?

1:29 PM 25 Q. Yes.

THOMAS HUNTER, PH.D. - CROSS

1 A. And the answer is neither made an estimate.

2 Q. So I'll talk briefly about the Top Hat measurement that
3 you testified about on direct.

4 MR. REGAN: If we could put up 21006.1.

5 BY MR. REGAN:

6 Q. This was the demonstrative that you were shown and you
7 explained the device to the Court and you explained basically
8 the three things about it: It had a -- in essence, a riser for
9 collection, you had ports on the top of it, and you had what
10 was called the skirt; correct?

11 A. Not exactly. This one's not leaking oil.

12 Q. Okay.

13 A. The other one portrayed where the oil was coming from.

14 Q. Right. But in terms of the -- understanding the piece --
15 the pieces of the device --

16 A. That's correct. There were three areas where oil was
17 exiting into the gulf and you pointed them out and I agree with
18 what you said.

19 Q. The other thing that's not accurate about this is that
20 actually when it was installed, it was -- it ended up being on
21 an angle; correct?

22 A. Many times it was on an angle.

23 MR. REGAN: So if we can pull up D-24388-2.

24 BY MR. REGAN:

25 Q. This is from -- actually from Dr. Dykhuizen's expert

THOMAS HUNTER, PH.D. - CROSS

1 report, but this is a representation of the Top Hat being on an
2 angle in June of 2010. And you saw that?

3 A. Yes. Yes. It is accurate to say it did tilt when it was
4 on there at various times and various cants.

5 Q. And because of it, this skirt area that is at the bottom
6 of the Top Hat, that had great uncertainty when it came to
7 trying to get a flow rate estimate using the Top Hat; correct?

8 A. It had great uncertainty because of the tilt, but also
9 because of the -- the differences in diameter and the skirt
10 material which was actually present.

11 Q. And so in terms of the flow rate estimate that was -- that
12 were done by your team, the DOE teams, they had three
13 components; that is, flow from the bottom of the Top Hat, the
14 skirt, flow from the ports there on the top, and flow -- and
15 collection; correct?

16 A. That's correct. In this case the ports aren't shown --
17 only one port is shown.

18 Q. It's sliced in half so you can see the inside; right?

19 A. Right.

20 Q. Okay. And as to the flow from the skirt, it's your view
21 that that flow is largely unquantifiable; correct?

22 A. I don't know if I said unquantifiable. Anything is
23 quantifiable. It was certainly greater than zero. It was
24 significantly -- you could visually observe it was significant.
25 To get a completely accurate estimate was much more difficult.

THOMAS HUNTER, PH.D. - CROSS

1:31 PM 1 Q. Right. Because using visual observation made it difficult

1:31 PM 2 to quantitatively assess the flow from the Top Hat; correct?

1:31 PM 3 A. To precisely estimate the flow. You could quantify it,
1:31 PM 4 but it would have a significant --

1:31 PM 5 Q. The most imprecise part of this estimate was the flow
1:31 PM 6 coming out of the skirt; correct?

1:31 PM 7 A. That's correct.

1:31 PM 8 Q. And it was the largest part of this estimate; correct?

1:31 PM 9 A. I believe in our calculations, it was bigger than the
1:32 PM 10 other two components. I don't recall exactly the numbers, but
1:32 PM 11 I believe that is correct.

1:32 PM 12 Q. So the least quantifiable part also was the largest
1:32 PM 13 component of the flow rate estimate?

1:32 PM 14 A. I think that's right.

1:32 PM 15 Q. If we then go to talking about the capping stack period
1:32 PM 16 you testified about on your direct examination, on Monday, the
1:32 PM 17 26th of July, your team, the DOE team or Tri-Lab team, you had
1:32 PM 18 a presentation that was given to you; correct?

1:32 PM 19 A. Yes. I believe that's the date, the 26th.

1:32 PM 20 MR. REGAN: If we pull up TREX-9706.1.

1:32 PM 21 BY MR. REGAN:

1:32 PM 22 Q. There was a PowerPoint presentation that we'll show here
1:32 PM 23 in a second, Dr. Hunter. This was what was presented to you on
1:32 PM 24 that Monday; correct?

1:32 PM 25 A. That's correct.

THOMAS HUNTER, PH.D. - CROSS

1 : 3 2 P M 1 Q. All right.

1 : 3 2 P M 2 A. It appears to be.

1 : 3 2 P M 3 Q. And if we go to 9706.4, the DOE team or the Tri-Lab team,
1 : 3 3 P M 4 which for reference purposes is the three national labs, walked
1 : 3 3 P M 5 through what they called a history of flow-based estimates from
1 : 3 3 P M 6 well flow rate prior to shutting with the capping stack. Do
1 : 3 3 P M 7 you see that?

1 : 3 3 P M 8 A. I do now, yes.

1 : 3 3 P M 9 Q. Okay. And it has the attempts that were made prior to it
1 : 3 3 P M 10 and it includes the Top Hat there on July -- on June 15th,
1 : 3 3 P M 11 correct?

1 : 3 3 P M 12 A. June 15 would include the Top Hat, yeah.

1 : 3 3 P M 13 Q. Right. And it includes the range of estimates, 72,000 to
1 : 3 3 P M 14 83,000, with a range of 51,000 to 104,000. Is that right?

1 : 3 3 P M 15 A. That's correct. And that would be as of the date
1 : 3 3 P M 16 June 15th, whenever the observation was made.

1 : 3 3 P M 17 Q. Right. And it notes there was great uncertainty in the
1 : 3 3 P M 18 skirt flow resistance; correct?

1 : 3 3 P M 19 A. That's correct.

1 : 3 3 P M 20 Q. And if we turn to the next page, which is 9706.5, the team
1 : 3 3 P M 21 provides some additional notes about the efforts to calculate
1 : 3 3 P M 22 flow prior to capping stack and provides them on this page to
1 : 3 3 P M 23 you; correct?

1 : 3 3 P M 24 A. That's correct.

1 : 3 3 P M 25 Q. And with respect again to the Top Hat flow, the Tri-Lab

THOMAS HUNTER, PH.D. - CROSS

1 effort to calculate total flow based on Top Hat 4 leak paths
2 and known surface collection, they told you there was great
3 uncertainty in the leak -- skirt leak path and some uncertainty
4 in pressure measurement inside the Top Hat; correct?

5 A. They told me, but I had my own view and I agreed with that
6 view, that there was more uncertainty with the skirt because it
7 had this, as you -- as you pointed out, different geometry.

8 Q. And in terms of the uncertainty from the pressure
9 measurements of the Top Hat, you could have a pressure
10 difference of just 1 psi, just 1 psi, and it could have major,
11 major differences in terms of the flow rate calculations for
12 Top Hat because of the nature of that device; correct?

13 A. The Top Hat flow, we had -- I had guessed at the pressure.
14 I said it was between 1 and 3 psi and that was used as the
15 parameter range. I thought that's about what it was. Because
16 if it gets too high, it will blow the Top Hat off of the top of
17 the well. So the -- and within that range, there was quite a
18 variation between 1 and 3, that's correct. So the pressure
19 made a difference.

20 Q. So you've had some additional uncertainty because you were
21 reading such small pressure gauges with instrumentation that
22 was 5,000 feet deep?

23 A. You would -- you would have uncertainty in the skirt.
24 You'd have virtually no uncertainty in what was collected at
25 the ship.

THOMAS HUNTER, PH.D. - CROSS

1:35 PM 1 Q. Okay. But in terms of the pressure readings in the Top
1:35 PM 2 Hat, you had uncertainty there, too?

1:35 PM 3 A. There would be uncertainty in the pressure readings,
1:35 PM 4 that's correct.

1:35 PM 5 Q. As reflected in the presentation?

1:35 PM 6 A. That's correct.

1:35 PM 7 Q. And the conclusion of the Tri-Labs, the three national
1:35 PM 8 labs, was that none of the methods listed above provide
1:35 PM 9 believable mass flow results. That was the conclusion they
1:35 PM 10 expressed to you on July 26th; correct?

1:35 PM 11 A. That's what they said, yes.

1:35 PM 12 Q. With respect, then, to the capping stack calculations,
1:35 PM 13 once the capping stack was installed with its instrumentation
1:35 PM 14 and with its geometry, you now finally had the data you were
1:35 PM 15 looking for, two known pressures and a known geometry in
1:36 PM 16 between; correct?

1:36 PM 17 A. That's correct.

1:36 PM 18 Q. And you did a variety -- your team, you and your team did
1:36 PM 19 a variety of estimates of flow from looking into the kill line
1:36 PM 20 or looking at the kill line and collection periods or looking
1:36 PM 21 at the choke line; right?

1:36 PM 22 A. That's correct, as we pointed out in direct.

1:36 PM 23 Q. Okay. Well, if we look at that same Monday presentation,
1:36 PM 24 9706, if we look at the page 26, 9706.26.1, as of Monday of --
1:36 PM 25 the 26th of July, the actual flow rates were still to be

THOMAS HUNTER, PH.D. - CROSS

1 determined; right?

2 A. What day did you have for that?

3 Q. July 26th, Dr. Hunter.

4 A. I don't know if the flow rates had been calculated. They
5 had not been assembled and put into the common viewgraph format
6 that we had. I can't say what the status of the calculation
7 was.

8 Q. Fair enough. Two days later on the Wednesday of that
9 week, you were informed that Secretary Chu wanted to have a new
10 flow rate by Friday; correct?

11 A. That's correct. I believe there's an e-mail to that
12 effect as well.

13 Q. And so that Wednesday would have been the first that you
14 had heard for you, yourself and your team that Secretary Chu
15 and others in the administration wanted to have a flow rate and
16 they wanted to have it done in the next 48 hours; correct?

17 A. No, I can't say that I -- I can't say that's the first I
18 heard. Because I had conversations with Steve Chu virtually
19 every day in that period and we could have discussed it, you
20 know, a week earlier and we certainly didn't do a calculation
21 in the 48-hour period.

22 **MR. REGAN:** Go to Exhibit 9718.1.1.

23 **BY MR. REGAN:**

24 Q. This is an e-mail that you received, and we've blacked out
25 some of the e-mail information there. But just -- that's your

THOMAS HUNTER, PH.D. - CROSS

1 personal e-mail address, at least part of it. Do you see that?

2 A. Yes.

3 Q. Okay. We tried to cover that as much as we could.

4 Because at this point in time, you were no longer at Sandia
5 National Labs; right?

6 A. That is certainly correct.

7 Q. Okay. So as of Wednesday, the 28th of July, 4:00 p.m.,
8 Marcia McNutt told you that she had just gotten off the phone,
9 "What we really need, hopefully by Friday, is the total amount
10 that had leaked out since the beginning of the accident";
11 correct?

12 A. That's correct.

13 Q. You did not have that number calculated by Wednesday,
14 July 28th; correct?

15 A. I don't know when we had that number calculated. I had
16 begun the calculations, you know, way back on the 11th of July
17 telling people to get ready, and I discussed the methodology
18 with the team about how to do both the last day and -- and the
19 interval over time had been discussed as a matter of doing the
20 work and those discussions -- this e-mail did not initiate
21 those discussions.

22 Q. Okay. Well, you responded to this e-mail, if we look at
23 9718.1.2. This is your response to that e-mail on the same
24 date. Do you recognize it?

25 A. I do.

THOMAS HUNTER, PH.D. - CROSS

1:38 PM 1 Q. And you responded saying: "This is the track we are on,
1:38 PM 2 but it is unlikely we can get the full time frame analyzed from
1:39 PM 3 the beginning of the incident by Friday."

1:39 PM 4 Correct?

1:39 PM 5 A. That's correct.

1:39 PM 6 Q. And you said: "We need to be sure the logic and all the
1:39 PM 7 events have been carefully reviewed. We can probably get the
1:39 PM 8 recent cap flow and the correction for cap installation. We
1:39 PM 9 will then need an event by event description to look at
1:39 PM 10 adjustments and overlay of that by a depletion assumption."

1:39 PM 11 You wrote that; correct?

1:39 PM 12 A. That's correct.

1:39 PM 13 Q. And then your last sentence says: "We need to assure that
1:39 PM 14 the pace for getting these results is consistent with the
1:39 PM 15 subsequent need for accuracy."

1:39 PM 16 Correct?

1:39 PM 17 A. That's also correct.

1:39 PM 18 Q. And that's something you believed as a scientist?

1:39 PM 19 A. I absolutely thank you for protecting my e-mail. Other
1:39 PM 20 people haven't.

1:39 PM 21 Q. I hope to be uniform in that, but if we see one up there,
1:39 PM 22 we can try to fix it.

1:39 PM 23 Now, with respect to the pace, the pace for getting
1:39 PM 24 these results, you didn't set that pace; correct?

1:39 PM 25 A. Well, sir, I'd say I'm probably the principal setter of

THOMAS HUNTER, PH.D. - CROSS

1 the pace, because I initiated the work. I asked people to get
2 prepared and to do it. And I knew that we should start as soon
3 as the data came in from the capping stack, and people were
4 geared up to do it. I recall numerous conversations with the
5 analysts about, Let's get it as soon as we can. And as you
6 pointed out, Steve Chu then added to that, "It would be nice if
7 we could get it by Friday of that week."

8 Q. So you believe that you were already working on the
9 information as of the time that you wrote this e-mail and said:
10 "This is the track we are on, but it is unlikely we can get it
11 analyzed by Friday"?

12 A. As of July 28th, I know we were working on it. And I
13 didn't know how much we would get done by the 30th, but it was
14 clear we were able to.

15 Q. The request for having the thing -- the estimate done by
16 Friday, though, was one that came from Secretary Chu and other
17 members of the cabinet?

18 A. Yes, and I had to tell the secretary that we might not get
19 there and we're going to do it accurately.

20 Q. Consistent with what you testified in your direct exam;
21 correct?

22 A. Uh-huh. Correct.

23 Q. Now, with respect to the work that was done, though, it
24 was primarily done over a critical weekend; correct?

25 A. Oh, no, I don't think that's correct at all. The Flow

THOMAS HUNTER, PH.D. - CROSS

1 Rate Technical Group had begun back at the end of May doing
2 their calculations and their observations. I initiated the
3 work on the 11th of July and it was reported out on the 30th of
4 July. So I don't think it was critically done over -- are we
5 speaking of the weekend of the 28th?

6 Q. Let me show you a document and see if it might refresh
7 your recollection.

8 A. Okay.

9 MR. REGAN: If we can pull up TREX-9908.

10 BY MR. REGAN:

11 Q. This is an e-mail that was sent to --

12 MR. REGAN: Just go down. Take off the top. That
13 one's not redacted.

14 BY MR. REGAN:

15 Q. This is an e-mail to you in response to the oil spill
16 commission. Do you recall responding to them in December of
17 2010 about their presentation about the flow rate estimate?

18 A. I recall talking to the commission and -- because I
19 thought they didn't accurately reflect the flow rate
20 calculation and I had a conversation with them. But I may have
21 written them something, but I don't recall.

22 Q. Let's go to the second page, 9908.2.2, and the middle
23 paragraph there. This is from your e-mail. Do you recall
24 telling them with respect to this calculation of the
25 government's official estimate, starting there in the middle of

THOMAS HUNTER, PH.D. - CROSS

1 the page: "The pressure measurements taken in the capping
2 stack allowed a fairly straightforward engineering calculation
3 to be done and the flow to the sea was only out of the new kill
4 valve, and part of the flow was still going to the surface from
5 the lower lines. This changed everything and the understanding
6 of the flow will be the basis for all future deliberations on
7 the flow, including interaction between the U.S. Government and
8 parties held liable for the accident. These critical
9 measurements allowed a quantitative basis to evaluate the flow
10 which was done by DOE scientists over a critical weekend and
11 culminated in bringing together all the flow rate teams that
12 ultimately agreed that the DOE estimate was the one to claim as
13 the official government estimate."

14 Does that refresh your recollection, Dr. Hunter?

15 A. Yeah. In fact, I think it reinforces what I said. The
16 calculations had been ongoing for some time. They were asked
17 to be put into a standard format for that weekend. The
18 standard format required summarizing -- getting final results,
19 putting them together, and then ultimately looking at them with
20 other scientists over that weekend. So the "critical weekend"
21 was referring to the fact that we had all the information put
22 together in a standard format and we worked the best we could
23 to bring everybody together, including this other team of --
24 other five teams' information over the weekend.

25 Q. So you presided over a meeting then on Friday, July 30th,

THOMAS HUNTER, PH.D. - CROSS

1 : 4 3 P M 1 with a variety of teams estimating flow; correct?

1 : 4 3 P M 2 A. That's correct.

1 : 4 3 P M 3 Q. And you had a Flow Visualization Team; correct --

1 : 4 3 P M 4 A. At the meeting, there was a Flow Visualization Team, yes.

1 : 4 3 P M 5 Q. You had multiple Reservoir Teams; correct?

1 : 4 4 P M 6 A. Two, I believe.

1 : 4 4 P M 7 Q. You had a Nodal Analysis Team?

1 : 4 4 P M 8 A. That's correct.

1 : 4 4 P M 9 Q. You had a team from Woods Hole doing Doppler velocity

1 : 4 4 P M 10 issues?

1 : 4 4 P M 11 A. Yes.

1 : 4 4 P M 12 Q. And then you had your DOE Team or the Tri-Lab Team as is

1 : 4 4 P M 13 reflected in these documents?

1 : 4 4 P M 14 A. It should be a total of six.

1 : 4 4 P M 15 Q. And you have some notes that you took as the moderator of

1 : 4 4 P M 16 that meeting. I'd like to put those up.

1 : 4 4 P M 17 **MR. REGAN:** Exhibit 9929.95.

1 : 4 4 P M 18 **BY MR. REGAN:**

1 : 4 4 P M 19 Q. And you recognize Exhibit 9929 as your handwriting,

1 : 4 4 P M 20 Dr. Hunter?

1 : 4 4 P M 21 A. I do. My handwriting is not the best, and I think in my

1 : 4 4 P M 22 deposition, I said, yes, I can tell by the sloppiness of the

1 : 4 4 P M 23 numbers that it's mine.

1 : 4 4 P M 24 Q. You might have some competition there.

1 : 4 4 P M 25 With respect to then what you've listed here on this

THOMAS HUNTER, PH.D. - CROSS

1 : 4 4 P M 1 page, these are the six flow rate estimates that were presented
1 : 4 4 P M 2 by the multiple teams to you in that meeting; correct?

1 : 4 5 P M 3 A. That's correct. That is my note from them. They actually
1 : 4 5 P M 4 had on their viewgraph materials more specific information.

1 : 4 5 P M 5 Q. And you wrote down numbers that you were hearing from
1 : 4 5 P M 6 these different teams on July 30th, 2010, as to their flow rate
1 : 4 5 P M 7 estimates; correct?

1 : 4 5 P M 8 A. I did, yes.

1 : 4 5 P M 9 Q. And those numbers range from 24 to 40, 42 to 49. We see
1 : 4 5 P M 10 33 to 63. We see a range here from 52 to 115. We see one at
1 : 4 5 P M 11 59,200, and we see 53-64, 51-60.

1 : 4 5 P M 12 And then No. 6, is that the DOE Team?

1 : 4 5 P M 13 A. That's the DOE Team. That's correct.

1 : 4 5 P M 14 Q. 53 and you wrote "plus or minus 5"; correct?

1 : 4 5 P M 15 A. I did, yes.

1 : 4 5 P M 16 Q. So at this meeting, you were presented with this range of
1 : 4 5 P M 17 flow rate estimates from the various teams who had been looking
1 : 4 5 P M 18 at the question of flow; correct?

1 : 4 5 P M 19 A. Correct. And I believe the individual presentations are
1 : 4 5 P M 20 basically consistent with this. I would point out they're not
1 : 4 5 P M 21 at the same times, but they're at different times in the flow.

1 : 4 6 P M 22 Q. So some of these teams were looking at flow at different
1 : 4 6 P M 23 periods of time, and some of them were looking at the capping
1 : 4 6 P M 24 stack?

1 : 4 6 P M 25 A. That's correct.

THOMAS HUNTER, PH.D. - CROSS

1 I think it's clear, when the capping stack was shut,
2 there was no flow to observe.

3 Q. With respect to choosing the DOE number, that was really a
4 recommendation that you made; correct?

5 A. After discussion, I think I said earlier, it was my job to
6 synthesize what I thought was the best representation of all of
7 the information and I recommended that number go forward.
8 That's correct.

9 MR. REGAN: If I could pull up some notes that were
10 taken then at the meeting, 9906.3.3.

11 BY MR. REGAN:

12 Q. As these are coming up, Dr. Hunter, there was a
13 Dr. Ratzell who was a member of the Tri-Lab Team; correct?

14 A. That's correct.

15 Q. And he worked with Dr. Dykhuizen?

16 A. Yes. He was the assigned team lead during much of the
17 period there.

18 Q. There was also a Dr. Charlie Morrow; is that correct?

19 A. That's correct.

20 Q. And he also worked with Dr. Dykhuizen; correct?

21 A. That's correct.

22 Q. Dr. Ratzell made the presentation on July 30th; correct?

23 A. Yes, he did.

24 Q. And with respect to the capping stack that he said to you
25 and others, including Secretary Chu, "it is 3-ram capping

THOMAS HUNTER, PH.D. - CROSS

1 : 47 PM 1 stack; all above the BOP so don't have to deal with its
1 : 47 PM 2 complexity"; correct?

1 : 47 PM 3 A. Yes. Which I think should be read as "don't have to deal
1 : 47 PM 4 with the complexity of the BOP."

1 : 47 PM 5 Q. With respect to uncertainties, he presented that some of
1 : 47 PM 6 the uncertainties, though, in the DOE's numbers were
1 : 47 PM 7 "multiphase flow models and EOS; K-factors are uncertain."
1 : 47 PM 8 Correct?

1 : 47 PM 9 A. That's correct. EOS means equations of state.

1 : 47 PM 10 Q. So Dr. Ratzell represented that the DOE numbers that he
1 : 47 PM 11 gave to you and others at that meeting had uncertainties
1 : 47 PM 12 because of the multiphase flow model. You had differences in
1 : 47 PM 13 the equations of state, or EOS, and K-factor uncertainties;
1 : 47 PM 14 correct?

1 : 47 PM 15 A. That's what he -- that's what -- I'm not sure who took
1 : 47 PM 16 these notes, but whoever took the notes said that.

1 : 48 PM 17 Q. Do you recall Dr. Ratzell saying those things?

1 : 48 PM 18 A. Oh, sure, sure.

1 : 48 PM 19 Q. K-factors refers to resistance in a given area that you're
1 : 48 PM 20 trying to examine or flow. It's a resistance coefficient?

1 : 48 PM 21 A. It's sort of the same, but it's a relationship between
1 : 48 PM 22 pressure drop and whatever geometric feature is there.

1 : 48 PM 23 Q. "Equation of state" is talking about the fluid that you're
1 : 48 PM 24 analyzing and it's a way that you can then try to figure out
1 : 48 PM 25 its density?

THOMAS HUNTER, PH.D. - CROSS

1 : 48 PM 1 A. Equation of state generally talks about all the properties
1 : 48 PM 2 and the relationship between them of any substance. For
1 : 48 PM 3 example, for fluid, it would be temperature, pressure, density,
1 : 48 PM 4 all the different variables that describe it.

1 : 48 PM 5 Q. If we turn then to one of Dr. Ratzell's slides, 8635.97.1.
1 : 48 PM 6 This slide summarizes again the DOE Tri-Labs calculations from
1 : 48 PM 7 capping stack; correct?

1 : 49 PM 8 A. That's correct.

1 : 49 PM 9 Q. It said: "There was good to excellent comparison of their
1 : 49 PM 10 results."

1 : 49 PM 11 Correct?

1 : 49 PM 12 A. That's correct.

1 : 49 PM 13 Q. And they told you 53,000 barrels per day, plus or minus
1 : 49 PM 14 5,000 barrels per day; right?

1 : 49 PM 15 A. That's correct.

1 : 49 PM 16 Q. So that's plus or minus 10 to 20 percent error; right?

1 : 49 PM 17 A. I believe it would be interpreted that way. Five would
1 : 49 PM 18 be -- if it's plus or minus 5, it's 10 percent; plus or minus
1 : 49 PM 19 10 would be 20 percent.

1 : 49 PM 20 Q. Dr. Ratzell told you the Analysis Team -- that is,
1 : 49 PM 21 Dr. Dykhuizen, Dr. Morrow, and the other scientists -- had
1 : 49 PM 22 significant concerns that the uncertainty remained large;
1 : 49 PM 23 correct?

1 : 49 PM 24 A. That's correct.

1 : 49 PM 25 Q. And they told you that their greater uncertainty was

THOMAS HUNTER, PH.D. - CROSS

1 : 49 PM 1 multiphase correlation; correct?

1 : 49 PM 2 A. Yes, that's what they say.

1 : 49 PM 3 Q. And they say: Especially for choke line flow analyses --

1 : 49 PM 4 because when they modeled the choke closure, the models that

1 : 49 PM 5 these scientists put together predicted that the flow was going

1 : 49 PM 6 up as the valve was being closed; correct?

1 : 50 PM 7 A. That's because -- right. There was what they call an

1 : 50 PM 8 anomaly; because as you closed the choke, in fact, it does get

1 : 50 PM 9 smaller; it should restrict the flow. The transition happens,

1 : 50 PM 10 but in general, that's right.

1 : 50 PM 11 Q. Turn to the next, 8635.96.1. The scientists also told you

1 : 50 PM 12 on June -- July 30th, 2010, that they had insufficient

1 : 50 PM 13 information to perform an uncertainty analysis on a flow rate

1 : 50 PM 14 and total flow at the time of the meeting; correct?

1 : 50 PM 15 A. That's correct. You got two images up there. I think

1 : 50 PM 16 they are -- are they both the same?

1 : 50 PM 17 Q. They are. One is just probably unnecessary.

1 : 50 PM 18 A. Yes. I believe this is an exact copy of the viewgraphs

1 : 50 PM 19 that I was presented. And I can't recall if I was presented

1 : 50 PM 20 these also on the 26th, four days prior. But certainly on the

1 : 50 PM 21 30th, they were presented.

1 : 50 PM 22 Q. Now, at the conclusion of Dr. Ratzell's presentation on

1 : 50 PM 23 the 30th, there then was a discussion amongst you and Secretary

1 : 50 PM 24 Chu and Director McNutt and others; correct?

1 : 51 PM 25 A. To be honest with you, I don't recall Marcia -- excuse me,

THOMAS HUNTER, PH.D. - CROSS

1 : 5 1 PM 1 Dr. McNutt's role, but certainly Secretary Chu and myself and
1 : 5 1 PM 2 the rest of the team.

1 : 5 1 PM 3 Q. And it's true that, at that point in time, what you
1 : 5 1 PM 4 discussed was the purpose of arriving at this flow rate number
1 : 5 1 PM 5 on that day, and one of the purposes was the oil budget;
1 : 5 1 PM 6 correct?

1 : 5 1 PM 7 A. That's correct.

1 : 5 1 PM 8 Q. A second purpose that you discussed as the reason for
1 : 5 1 PM 9 arriving at a flow rate number that day was damages charged to
1 : 5 1 PM 10 BP; correct?

1 : 5 1 PM 11 A. See, I don't know how to refer to you, but the
1 : 5 1 PM 12 conversation people brought -- Steve Chu, for example, brought
1 : 5 1 PM 13 that into the conversation. That's correct.

1 : 5 1 PM 14 Q. And Secretary Chu's perspective was with respect to
1 : 5 1 PM 15 arriving at a number for damages charged to BP, high accuracy
1 : 5 1 PM 16 was not needed there; correct?

1 : 5 1 PM 17 A. That was the gist of what he said. I don't recall what he
1 : 5 1 PM 18 actually said, but that's correct.

1 : 5 1 PM 19 Q. He also made it clear that there was not time to wait,
1 : 5 1 PM 20 that the number needed to be done by -- in the next day, rather
1 : 5 2 PM 21 than waiting for the next week; correct?

1 : 5 2 PM 22 A. If you're speaking of the 30th, he stated -- you are
1 : 5 2 PM 23 speaking of the 30th?

1 : 5 2 PM 24 Q. Yes.

1 : 5 2 PM 25 A. His statement was we need to get a number as quick as we

THOMAS HUNTER, PH.D. - CROSS

1 can. His hope was that it could be done that weekend. It
2 wasn't done that weekend, but that was his hope.

3 Q. Well, the press release that went out with the 53,000
4 estimate for July 15th was issued on Monday, August 2nd;
5 correct?

6 A. That's correct.

7 Q. And the meetings about -- where the teams said they had
8 insufficient information to perform an uncertainty analysis on
9 flow rate was on Friday, July 30th; correct?

10 A. That's correct.

11 Q. And then you had another meeting on Saturday, July 31st;
12 correct?

13 A. That is correct.

14 Q. Okay. And if we could turn to TREG-9725.2.1, which are
15 additional notes that were taken at this meeting on July 30th.

16 You heard, Dr. Hunter, Secretary Chu also say, as you
17 just testified to: "With respect to damages, 10 to 20 percent
18 uncertainty is all that was needed because they'll settle, so
19 it doesn't matter."

20 Correct?

21 A. Did I hear that? I don't recall. It's certainly written
22 here. I don't know whose notes these are. But I thought the
23 statement was 10 percent, but I don't have a recollection of
24 that. It wasn't a strong factor in my mind.

25 Q. Right. Let me turn now then to the meeting on Saturday,

THOMAS HUNTER, PH.D. - CROSS

1 the 31st. If we could go to 8628.58.1, your notes from that
2 meeting. And you attended that meeting; correct?

3 A. I actually conducted both meetings.

4 Q. Understood.

5 Secretary Chu was at a meeting on Saturday, the 31st;
6 correct?

7 A. I believe that's correct. Certainly on the 30th; I
8 believe also on the 31st.

9 Q. And these notes indicate: "Tom Hunter still pushing for
10 10 percent integral or daily."

11 Do you see that?

12 A. I see that now. I may have seen this in depositions, too.

13 Q. I think you did.

14 With respect to the word "integral," what does that
15 mean?

16 A. Well, "integral" in this case, I believe, refers to the
17 flow from Day Zero to Day 87, adding it all up.

18 **MR. CHAKERES:** Your Honor, I'm going to object,
19 Dr. Hunter just testified that he does not know the provenance
20 of these notes and, you know, he's just using them to flash
21 notes on the screen without establishing a foundation.

22 **MR. REGAN:** Dr. Hunter was not only at these
23 meetings, but he was designated as the United States' witness
24 about these discussions, as a 30(b)(6) witness. And he's
25 testified about them at his deposition already as that

THOMAS HUNTER, PH.D. - CROSS

1 representative.

2 **THE COURT:** All right. I'll overrule that objection.

3 **BY MR. REGAN:**

4 **Q.** So you -- on the 31st of July, you were pushing for
5 10 percent for both the cumulative flow -- that's what's
6 referred to as "integral" -- and also for the last day of flow;
7 is that right?

8 **A.** It was my belief that that was an accurate assessment of
9 the uncertainty, given the data and the fact that I performed
10 some of the calculations myself. And if this person said I was
11 "pushing for them," I probably stated that that was my view.

12 **Q.** And were you told in that meeting that the cabinet wants a
13 nice, clean number, as reflected here in the --

14 **A.** I really don't recall that at all. I was more concerned
15 about what -- what we could do to get an accurate number than
16 what the cabinet wanted.

17 **Q.** Dr. Dykhuizen, you recall him expressing a different view
18 at the meeting about what the appropriate percentage for
19 uncertainty was on the --

20 **THE COURT:** Just -- are these actually your notes?

21 **THE WITNESS:** No.

22 **THE COURT:** Who took these notes, do you know?

23 **THE WITNESS:** I don't know. I don't know, sir.

24 **THE COURT:** Do we know who took these notes?

25 **MR. REGAN:** I think these are notes taken by a

THOMAS HUNTER, PH.D. - CROSS

1 gentleman named Curt Ammerman.

2 **THE WITNESS:** Curt Ammerman?

3 **MR. REGAN:** Curt Oldenburg; he was one of the FRTG
4 members.

5 **THE COURT:** Do you know who that is?

6 **THE WITNESS:** I probably saw the name, but I do not
7 know the individual.

8 **MR. REGAN:** I can get that in a second.

9 **THE COURT:** Okay.

10 **BY MR. REGAN:**

11 **Q.** So with respect to the press release that went out, it
12 went out with a 53,000 July 15th final number; correct?

13 **A.** For the Day 87 flow, it said 53,000, yes.

14 **Q.** And it had an integral, that is an extrapolation from that
15 number back to April 20th, to calculate a 4.9 million-barrel
16 cumulative flow number; correct?

17 **A.** I wouldn't call it an extrapolation back from that number.
18 It had another day upon it, Day Zero, which was derived from
19 understanding something about well depletion and starting at 53
20 at Day 87.

21 **Q.** The understanding about well depletion was just that you
22 could have a linear relationship between flow and depletion;
23 correct?

24 **A.** And reservoir pressure; correct. That is correct.

25 **Q.** But the way that the line was developed, the integral was

THOMAS HUNTER, PH.D. - CROSS

1 : 5 6 P M 1 to start at 53 and work backwards; correct?

1 : 5 7 P M 2 A. That's probably a nuance of the arithmetic. But,

1 : 5 7 P M 3 basically, if you knew there was a 10 percent change in

1 : 5 7 P M 4 reservoir pressure -- that is, the pressure at the bottom of

1 : 5 7 P M 5 the well -- you would increase the Day Zero amount by

1 : 5 7 P M 6 10 percent and draw that point, then draw a line between them.

1 : 5 7 P M 7 Q. The 4.9 million number in the August 2nd press release did

1 : 5 7 P M 8 not account for any changes in restrictions in the well during

1 : 5 7 P M 9 that time period other than putting the capping stack on and

1 : 5 7 P M 10 cutting the riser; correct?

1 : 5 7 P M 11 A. And that is correct, yes.

1 : 5 7 P M 12 Q. The 4.9 million cumulative flow, 10 percent uncertainty

1 : 5 7 P M 13 figure did not account for any geometry changes either;

1 : 5 7 P M 14 correct?

1 : 5 7 P M 15 A. Well, there was certainly a sense there could be geometry

1 : 5 7 P M 16 changes and everyone had a view of uncertainty. So it was what

1 : 5 7 P M 17 I call "engineering judgment" about the uncertainty. And I

1 : 5 8 P M 18 know, in people's mind, it had to be some context of geometry

1 : 5 8 P M 19 changes, unquantifiable. But, basically, the judgment was

1 : 5 8 P M 20 10 percent with people being aware that, yes, there might have

1 : 5 8 P M 21 been geometry changes.

1 : 5 8 P M 22 Q. Your judgment was 10 percent uncertainty on the 53,000

1 : 5 8 P M 23 single-day estimate; correct?

1 : 5 8 P M 24 A. My judgment or the team's judgment?

1 : 5 8 P M 25 Q. Well, you, as the leader of the team.

THOMAS HUNTER, PH.D. - CROSS

1 : 5 8 P M 1 A. My judgment was it was an estimate that was good for the
1 : 5 8 P M 2 Day 87, 53, and it was also good for the integral amount.
1 : 5 8 P M 3 Q. So you had the same uncertainty for both the single-day
1 : 5 8 P M 4 and for the entire time period; correct?
1 : 5 8 P M 5 A. I actually had less uncertainty on the 53. I thought it
1 : 5 8 P M 6 was tighter than that. I think you could find somewhere that I
1 : 5 8 P M 7 actually expressed that I thought Day 87 was better than
1 : 5 8 P M 8 10 percent. And, of course, that would allow more leeway at
1 : 5 8 P M 9 the other end, which it could be greater than 10 percent and
1 : 5 9 P M 10 still average out to 10 percent.
1 : 5 9 P M 11 Q. Let me ask you this, Dr. Hunter: The final day is a
1 : 5 9 P M 12 component of the cumulative estimate; correct?
1 : 5 9 P M 13 A. The final day is one of the numbers -- one of 87 numbers
1 : 5 9 P M 14 that went into it.
1 : 5 9 P M 15 Q. And when you use that final day number to calculate a
1 : 5 9 P M 16 cumulative number, you bring with it its uncertainty; correct?
1 : 5 9 P M 17 A. That's correct.
1 : 5 9 P M 18 Q. And you had the same uncertainty for 53,000 as you did for
1 : 5 9 P M 19 cumulative flow, as you recommended on July 31st to the
1 : 5 9 P M 20 administration; correct? 10 percent for each?
1 : 5 9 P M 21 A. Yes. The statement is that 10 percent uncertainty covered
1 : 5 9 P M 22 it all. What I just said was I thought the 53 number was
1 : 5 9 P M 23 tighter, and there was probably more uncertainty as one moved
1 : 5 9 P M 24 to the left. Hence, 10 percent would cover it all.
1 : 5 9 P M 25 Q. The 10 percent uncertainty for the cumulative flow, for

THOMAS HUNTER, PH.D. - CROSS

1 : 59 PM 1 the 4.9 million number, that does not include the fact that BOP
1 : 59 PM 2 resistances may have been changed over the 86-day time period;
1 : 59 PM 3 correct?

1 : 59 PM 4 A. Correct. No matter which way they changed.

1 : 59 PM 5 Q. The 10 percent uncertainty for cumulative flow does not
2 : 00 PM 6 include any potential multiphase effects that may have occurred
2 : 00 PM 7 over the 86 days that could impact flow; correct?

2 : 00 PM 8 A. No, I don't think that's correct. I think the calculation
2 : 00 PM 9 certainly included multiphase flow; that means oil and gas.
2 : 00 PM 10 What it did not account for was any significant changes in the
2 : 00 PM 11 two-phase flow.

2 : 00 PM 12 Q. So changes in multiphase flow were not included in the
2 : 00 PM 13 10 percent for the cumulative number; correct?

2 : 00 PM 14 A. That's correct.

2 : 00 PM 15 Q. The potential for different flow paths over 86 days, that
2 : 00 PM 16 was not included in the 10 percent uncertainty; correct?

2 : 00 PM 17 A. If you mean by different flow paths down within the well,
2 : 00 PM 18 they were not included.

2 : 00 PM 19 Q. And you never saw any calculation where someone actually
2 : 00 PM 20 tried to determine the uncertainty for that 4.9 million
2 : 00 PM 21 cumulative flow where they did include the effect of potential
2 : 00 PM 22 geometry changes, BOP changes, wellbore changes, or flow path
2 : 00 PM 23 changes, have you?

2 : 00 PM 24 A. I believe that's correct. No one did the composite, in
2 : 00 PM 25 fact, of those effects you just mentioned. They did, however,

THOMAS HUNTER, PH.D. - CROSS

2:01PM 1 have them in their mind as we talked about what overall
2:01PM 2 uncertainty to assign.

2:01PM 3 Q. If we go to TRES-9361.46, at the top of the page, this is
2:01PM 4 the DOE NNSA report that was summarizing the outcome of those
2:01PM 5 meetings in late July. Do you recognize this chart that's
2:01PM 6 found on page 46?

2:01PM 7 A. Is that two questions? Yes, it is that; and I do
2:01PM 8 recognize it, yes.

2:01PM 9 Q. Thank you, Dr. Hunter.

2:01PM 10 This is the line that was drawn from 53,000 on
2:01PM 11 July 15th, extrapolating back to approximately 63,000 as of the
2:01PM 12 third day of the spill?

2:01PM 13 A. I still don't quite -- would not use the language of "line
2:01PM 14 that was drawn."

2:01PM 15 The point at the right was determined from those
2:01PM 16 measurements we described in the capping stack. The point at
2:02PM 17 the left, the far left, was determined by knowing the reservoir
2:02PM 18 pressure was different and making the assumption that it was
2:02PM 19 linearly different. That gives you that point. Then you would
2:02PM 20 have a line between the two, and then you have those two
2:02PM 21 adjustments that have to be made for cutting the riser and
2:02PM 22 placing the capping stack.

2:02PM 23 Q. You agree, Dr. Hunter, that the further you get away from
2:02PM 24 the capping stack, July 15th, the further you move backwards
2:02PM 25 towards April 20th, the less certainty you have in the validity

THOMAS HUNTER, PH.D. - CROSS

2 : 0 2 P M 1 of the daily flow rates that are represented by this line?

2 : 0 2 P M 2 A. I wouldn't doubt the validity of the measure. I think
2 : 0 2 P M 3 there's more uncertainty in specifically what the number is. I
2 : 0 2 P M 4 believe there are other factors which could contribute, but I
2 : 0 2 P M 5 have no way of knowing and don't judge that they were
2 : 0 2 P M 6 significant.

2 : 0 2 P M 7 Q. But factually true: The further you get back away from
2 : 0 2 P M 8 July 15th, the more uncertainty you have?

2 : 0 2 P M 9 A. The more phenomena you would have that could have an
2 : 0 2 P M 10 impact on uncertainty.

2 : 0 3 P M 11 Q. And with respect to factors such as erosion, if there was
2 : 0 3 P M 12 erosion that took place past Day 2, would that have the affect
2 : 0 3 P M 13 of increasing this cumulative estimate or decreasing it?

2 : 0 3 P M 14 A. Well, I think you're taking the case, for example, of
2 : 0 3 P M 15 which there would be something blocking the flow, and that
2 : 0 3 P M 16 eroded away and the flow would go up. So for those days in
2 : 0 3 P M 17 which it was blocking, it would reduce the flow, but it would
2 : 0 3 P M 18 be critical that erosion occurred at a place that was actually
2 : 0 3 P M 19 blocking the flow, and that's not known.

2 : 0 3 P M 20 Q. With respect to the time that the August 2nd press release
2 : 0 3 P M 21 went out, the BOP was still down in the seabed; correct?

2 : 0 3 P M 22 A. That's correct.

2 : 0 3 P M 23 Q. It was not recovered until September of 2010; correct?

2 : 0 3 P M 24 A. I don't remember the date, but I think the month is
2 : 0 3 P M 25 definitely September.

THOMAS HUNTER, PH.D. - CROSS

2 : 0 3 P M 1 Q. And after it was recovered, your work with respect to this
2 : 0 3 P M 2 team was largely done?

2 : 0 3 P M 3 A. That's -- my work with this team was basically done on
2 : 0 4 P M 4 September 20th, and I believe it was recovered prior to that.

2 : 0 4 P M 5 MR. REGAN: If you could pull up TRES-9671.2.1.

2 : 0 4 P M 6 BY MR. REGAN:

2 : 0 4 P M 7 Q. Do you recall receiving an e-mail from Marcia McNutt in
2 : 0 4 P M 8 early January 2011, titled with respect to issue of BOP
2 : 0 4 P M 9 forensics?

2 : 0 4 P M 10 A. Yes. Do I recall getting the e-mail? No, but this is an
2 : 0 4 P M 11 e-mail that I got and it makes sense that I would get it. And
2 : 0 4 P M 12 I may have seen it in deposition, too.

2 : 0 4 P M 13 Q. And Director McNutt is referring to new information that
2 : 0 4 P M 14 had been recovered from DNV analyses of the BOP in December of
2 : 0 4 P M 15 2010 that she had been alerted to; correct?

2 : 0 4 P M 16 A. Yes.

2 : 0 4 P M 17 Q. And she's giving you the heads-up on that.

2 : 0 4 P M 18 If we could go to 9710.3.1.

2 : 0 5 P M 19 In the body of the e-mail, just focusing, we can just
2 : 0 5 P M 20 focus on the top and then what she has on Number 4. She says:
2 : 0 5 P M 21 "DNV is conducting an exact laser scan to get the
2 : 0 5 P M 22 cross-sectional area of the region through which flow could
2 : 0 5 P M 23 have occurred. It seems to me on first blush that this new
2 : 0 5 P M 24 evidence affects our work in the following manner."

2 : 0 5 P M 25 Do you see that?

THOMAS HUNTER, PH.D. - CROSS

2 : 0 5 P M 1 A. I do.

2 : 0 5 P M 2 Q. She asks: "Does anyone have any ideas for how to model
2 : 0 5 P M 3 the erosion from the opening with time?"
2 : 0 5 P M 4 Correct?

2 : 0 5 P M 5 A. Yes.

2 : 0 5 P M 6 Q. And then she says: "In looking at our final curve for
2 : 0 5 P M 7 flow rate as a function of time, we do need to consider
2 : 0 5 P M 8 carefully the competing processes of depletion of the
2 : 0 5 P M 9 reservoir, which causes the flow rate to decrease, and possible
2 : 0 5 P M 10 widening of the flow path, which causes the flow to increase.
2 : 0 5 P M 11 The final curve may be peaked in the middle, for all I know."
2 : 0 5 P M 12 That's what she wrote to you in January 2011?

2 : 0 5 P M 13 A. That's correct.

2 : 0 5 P M 14 Q. And you responded to this e-mail; correct?

2 : 0 5 P M 15 A. I probably did. I wasn't working on this problem at all,
2 : 0 5 P M 16 but I probably responded to the e-mail.

2 : 0 6 P M 17 Q. Go to TRES-9671.1.1. You responded to Director McNutt
2 : 0 6 P M 18 that this is indeed interesting. You said you wanted to inject
2 : 0 6 P M 19 a word of caution and you referred to "Ron D."
2 : 0 6 P M 20 Is that Ron Dykhuizen?

2 : 0 6 P M 21 A. That would be Ron Dykhuizen?

2 : 0 6 P M 22 Q. And "Art" is Art Ratzell?

2 : 0 6 P M 23 A. Yes.

2 : 0 6 P M 24 Q. You said: "Your comment about the trend had merit, but I
2 : 0 6 P M 25 don't know what should be discussed via e-mail" and continue;

THOMAS HUNTER, PH.D. - CROSS

2:06 PM 1 correct?

2:06 PM 2 A. Right. Because my assumption was none of this should be

2:06 PM 3 discussed in e-mail, but I didn't know that at all, wasn't

2:06 PM 4 something I was engaged in, the legal process. I just

2:06 PM 5 cautioned what we shouldn't use that mechanism.

2:06 PM 6 Q. You wrote to Director McNutt: "I would be cautious with

2:06 PM 7 another prediction, especially one with such great

2:07 PM 8 uncertainty."

2:07 PM 9 Correct?

2:07 PM 10 A. Yes.

2:07 PM 11 Q. And at the very bottom, you say: "This whole effort needs

2:07 PM 12 a systemic correlation of data and forensics."

2:07 PM 13 Correct?

2:07 PM 14 A. Yes. I believe that's one of my statements.

2:07 PM 15 Q. And that was your view as of January of 2011; correct?

2:07 PM 16 A. That's correct.

2:07 PM 17 Q. With respect to the impact of the BOP on the August 2nd,

2:07 PM 18 2010 4.9 million flow rate estimate, there was no -- nothing in

2:07 PM 19 that estimate that accounted for any changes in the BOP;

2:07 PM 20 correct?

2:07 PM 21 A. That's correct.

2:07 PM 22 By the way, can I point out that 4.9 was an estimate

2:07 PM 23 of what came out of the well, not an estimate of what went into

2:07 PM 24 the ocean. We -- in our estimate, it says that 800,000 barrels

2:07 PM 25 went into -- immediately into the collection system.

THOMAS HUNTER, PH.D. - CROSS

2 : 0 7 P M 1 Q. So you would -- the 4.9 would be a gross number and you
2 : 0 7 P M 2 would subtract the 810,000?

2 : 0 7 P M 3 A. We -- and we did. Whenever this topic comes up, I always
2 : 0 7 P M 4 point out that the estimate into the ocean was 4.1.

2 : 0 8 P M 5 MR. REGAN: Okay. Thank you, Dr. Hunter.

2 : 0 8 P M 6 THE COURT: Redirect?

2 : 0 8 P M 7 MR. CHAKERES: Your Honor, we have no redirect.

2 : 0 8 P M 8 THE COURT: Okay. Thank you very much, Dr. Hunter.

2 : 0 8 P M 9 THE WITNESS: Thank you, sir. Does that mean I'm
2 : 0 8 P M 10 done?

2 : 0 8 P M 11 THE COURT: You're done.

2 : 0 8 P M 12 Okay. The government can call its next witness.

2 : 0 8 P M 13 MR. O'ROURKE: Your Honor, Steve O'Rourke for the
2 : 0 8 P M 14 United States.

2 : 0 8 P M 15 We are going to call the next witness by video
2 : 0 8 P M 16 deposition. It's Mike Mason, former vice president of BP. It
2 : 0 8 P M 17 runs for less than six minutes. Just for planning purposes,
2 : 0 8 P M 18 we're going to have a total of three videos during our case in
2 : 0 8 P M 19 chief, just one right now.

2 : 0 8 P M 20 THE COURT: Okay.

2 : 0 8 P M 21 MR. O'ROURKE: We've also provided courtesy copies of
2 : 0 8 P M 22 the transcripts, too.

2 : 0 8 P M 23 (WHEREUPON, the videotaped deposition of Mike
2 : 0 8 P M 24 Mason was played.)
25

THOMAS HUNTER, PH.D. - CROSS

12:27 PM 1 (WHEREUPON, **RONALD DYKHUIZEN, PH.D.**, having been duly
12:27 PM 2 sworn, testified as follows:)

2:14 PM 3 **THE DEPUTY CLERK:** Please state your full name and
2:14 PM 4 correct spelling for the record.

2:15 PM 5 **THE WITNESS:** My name is Dr. Ronald Dykhuizen.
2:15 PM 6 That's spelled D-Y-K-H-U-I-Z-E-N.

2:15 PM 7 **THE COURT:** You've got to -- you can pull the whole
2:15 PM 8 thing a little closer to you.

2:15 PM 9 **THE WITNESS:** Is this better?

2:15 PM 10 **THE COURT:** Yes, that's better.

2:15 PM 11 **THE WITNESS:** Thank you.

2:15 PM 12 **MR. REGAN:** Your Honor, Matt Regan on behalf of BP.
2:15 PM 13 We have a *Daubert* motion that's pending with respect to
2:15 PM 14 Dr. Dykhuizen. It's in combination with a motion that's --

2:16 PM 15 **THE COURT:** Yes. I've read the motion and the
2:16 PM 16 opposition. I'm going to overrule the motion and let him
2:16 PM 17 testify. Again, if there are -- if there's any particular
2:16 PM 18 question that you have a problem with, you can object, and I'll
2:16 PM 19 rule on it at the time. Okay?

2:16 PM 20 **MR. REGAN:** Very well. Thank you.

2:16 PM 21 **THE COURT:** All right.

2:16 PM 22 Go ahead. I'm sorry.

2:16 PM 23 **MR. CERNICH:** May it please the Court, Scott Cernich
2:16 PM 24 on behalf of the United States.

2:16 PM 25 Could I please have demonstrative D-21145,

THOMAS HUNTER, PH.D. - CROSS

2 : 16 PM 1 please.

2 : 16 PM 2 Your Honor, this is just a road map of what
2 : 16 PM 3 we'll be covering today with Dr. Dykhuizen.

2 : 16 PM 4 **THE COURT:** Okay.

2 : 16 PM 5 **VOIR DIRE EXAMINATION**

2 : 16 PM 6 **BY MR. CERNICH:**

2 : 16 PM 7 **Q.** Dr. Dykhuizen, what is your expertise as it relates to
2 : 16 PM 8 this case?

2 : 17 PM 9 **A.** I have a Ph.D. in mechanical engineering. I have done
2 : 17 PM 10 lots of work in multiphase flow, analyzing flow systems. I've
2 : 17 PM 11 also been on a number of accident investigation teams.

2 : 17 PM 12 **Q.** How long have you done that work for?

2 : 17 PM 13 **A.** I've worked in this field for about 35 years.

2 : 17 PM 14 **Q.** And you mentioned multiphase flow. Can you tell
2 : 17 PM 15 Judge Barbier what multiphase flow is.

2 : 17 PM 16 **A.** Multiphase flow is a flow typically through a piping
2 : 17 PM 17 system -- but it doesn't have to be -- where we have a mixture
2 : 17 PM 18 of phases. It could be a mixture of gas and liquid or liquids
2 : 17 PM 19 and solid or a gas, liquid, and solids. So a boiling flow is a
2 : 17 PM 20 condition of multiphase flow, where you'd have liquid and steam
2 : 17 PM 21 traveling in a pipe.

2 : 17 PM 22 **Q.** Is multiphase flow something you've worked in throughout
2 : 17 PM 23 your career?

2 : 17 PM 24 **A.** Yes, it is.

2 : 17 PM 25 **MR. CERNICH:** Could I have demonstrative D-21140,

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 17 PM 1 please.

2 : 17 PM 2 **BY MR. CERNICH:**

2 : 17 PM 3 **Q.** Is this a summary of your educational background,

2 : 17 PM 4 Dr. Dykhuizen?

2 : 17 PM 5 **A.** Yes, it is.

2 : 17 PM 6 **Q.** How does your educational background relate to your work

2 : 17 PM 7 in this case?

2 : 18 PM 8 **A.** I have a B.S. and an M.S. degree in nuclear engineering,

2 : 18 PM 9 specializing in flow systems. I have a Ph.D. in mechanical

2 : 18 PM 10 engineering. I did my thesis topic on the stability of

2 : 18 PM 11 multiphase flows.

2 : 18 PM 12 **Q.** And how does a background in nuclear engineering relate to

2 : 18 PM 13 your work in this case?

2 : 18 PM 14 **A.** My specialty in nuclear engineering was analyzing flow

2 : 18 PM 15 and, therefore, I've done a lot of calculations of flow in

2 : 18 PM 16 nuclear engineering.

2 : 18 PM 17 **Q.** Where are you currently employed?

2 : 18 PM 18 **A.** Sandia Laboratories.

2 : 18 PM 19 **Q.** What do you do there?

2 : 18 PM 20 **A.** I'm an engineer. Principal member of the technical staff

2 : 18 PM 21 is my title.

2 : 18 PM 22 **Q.** How long have you been employed at Sandia?

2 : 18 PM 23 **A.** For approximately 30 years.

2 : 18 PM 24 **Q.** What position do you hold there?

2 : 18 PM 25 **A.** Principal member of the technical staff. I direct other

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 18 PM 1 engineers and programs. I have no line responsibility as a
2 : 18 PM 2 staff member, as you might expect.

2 : 18 PM 3 Q. But do you supervise other engineers?

2 : 19 PM 4 A. On programs, yes. On their raises and salaries, no.

2 : 19 PM 5 MR. CERNICH: Could I have D-21141, please.

2 : 19 PM 6 BY MR. CERNICH:

2 : 19 PM 7 Q. Is this a summary of your relevant work experience?

2 : 19 PM 8 A. Yes, it is.

2 : 19 PM 9 Q. Does your professional experience in mechanical
2 : 19 PM 10 engineering and fluid mechanics experience relate to your work
2 : 19 PM 11 on this case?

2 : 19 PM 12 A. Yes, it does.

2 : 19 PM 13 MR. CERNICH: Could I have D-21142.

2 : 19 PM 14 BY MR. CERNICH:

2 : 19 PM 15 Q. Dr. Dykhuizen, does this demonstrative summarize some of
2 : 19 PM 16 your relevant experience in multiphase flow and fluid
2 : 19 PM 17 mechanics?

2 : 19 PM 18 A. Yes, it does. I've worked in geothermal wells. That is a
2 : 19 PM 19 well geometry very similar to the well at Macondo. We have
2 : 19 PM 20 single-phase water at the bottom of a geothermal well,
2 : 19 PM 21 typically. And as the water rises, the pressure changes, the
2 : 19 PM 22 water boils. This is hot water in a geothermal well. So we
2 : 19 PM 23 would have two-phase flow through most of the well.
2 : 19 PM 24 CO2 fire suppression systems.
2 : 20 PM 25 Something also I studied, that would be three-phase

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 0 P M 1 flow. Because CO2 can have a liquid, gas, and solid phase all
2 : 2 0 P M 2 at the same time, and did in my analysis.

2 : 2 0 P M 3 I've been involved in a number of investigative
2 : 2 0 P M 4 teams, most notably the Three Mile Island nuclear reactor
2 : 2 0 P M 5 incident that happened in 1979. In that particular case I was
2 : 2 0 P M 6 involved in calculating the flow that was released from the
2 : 2 0 P M 7 nuclear reactor.

2 : 2 0 P M 8 We were very concerned with maintaining an inventory
2 : 2 0 P M 9 of water. We were pumping water into the reactor at the time
2 : 2 0 P M 10 while water and steam was escaping, and therefore I have to
2 : 2 0 P M 11 perform an interval of that flow to find out how much water is
2 : 2 0 P M 12 left compared to how much water we're putting in.

2 : 2 0 P M 13 Q. Why was it important to keep track of the amount of water
2 : 2 0 P M 14 that was going into the reactor?

2 : 2 0 P M 15 A. Well, on Three Mile Island, the reactor was generating a
2 : 2 1 P M 16 significant amount of heat, and we're trying to keep the
2 : 2 1 P M 17 reactor cool to keep it from melting down. Unfortunately, we
2 : 2 1 P M 18 weren't completely successful with that and we did have a
2 : 2 1 P M 19 certain amount of meltdown.

2 : 2 1 P M 20 Q. Did you apply standard fluid mechanics engineering methods
2 : 2 1 P M 21 and principles to your work there?

2 : 2 1 P M 22 A. Yes, I did.

2 : 2 1 P M 23 Q. Are those the same types of fluid mechanics engineering
2 : 2 1 P M 24 methods and principles you applied in this case?

2 : 2 1 P M 25 A. Yes, it is.

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 1 PM 1 Q. Were your calculations submitted to the Nuclear Regulatory
2 Commission?

2 : 2 1 PM 3 A. Yes. That work was done while the accident was
4 proceeding. We submitted all of our work to the Nuclear
5 Regulatory Commission, and they passed that on to the owners of
6 the reactor.

2 : 2 1 PM 7 Q. The calculations you performed in this case, did you
8 perform those by hand?

2 : 2 1 PM 9 A. Most of those were considered hand calculations. What I
10 tried to do was put most of those into a spreadsheet. I have a
11 couple spreadsheet programs, and that way they could be
12 repeated, whereas the inputs might change or our guesses of the
13 conditions changed.

2 : 2 2 PM 14 So in a sense they were hand calculations but most
15 often performed on a spreadsheet application.

2 : 2 2 PM 16 Q. And are the equations you used the types that can be found
17 in fluid mechanics textbooks?

2 : 2 2 PM 18 A. Yes.

2 : 2 2 PM 19 Q. Do you have experience calculating multiphase flows of
20 hydrocarbons?

2 : 2 2 PM 21 A. Hydrocarbons is also -- often used in geothermal power
22 systems. So we have multiphase flow of hydrocarbons in a
23 geothermal power system. It's also used as a surrogate model
24 for water because it's much cheaper to run experiments used
25 with hydrocarbons than it is with using water. And so I've

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 2 PM 1 done it there in that case also.

2 : 2 2 PM 2 Q. Did you have any experience in the oil field prior to your
2 : 2 2 PM 3 work on this case?

2 : 2 2 PM 4 A. No, none at all.

2 : 2 2 PM 5 Q. Did that pose any challenges for you?

2 : 2 2 PM 6 A. The only real challenge it posed to me was the fact that
2 : 2 2 PM 7 the names of concepts were quite often different, although the
2 : 2 3 PM 8 concepts were identical. And so I quickly helped -- had
2 : 2 3 PM 9 Charles Morrow help me. He was a person at Sandia Laboratories
2 : 2 3 PM 10 I knew that had extensive experience in the petroleum field,
2 : 2 3 PM 11 and he helped translate the terms that the petroleum engineers
2 : 2 3 PM 12 used into terms that I would better understand. But that was
2 : 2 3 PM 13 my only difficulty.

2 : 2 3 PM 14 Q. Is there a significant difference between calculating
2 : 2 3 PM 15 hydrocarbons multiphase flows and multiphase flows of other
2 : 2 3 PM 16 fluids?

2 : 2 3 PM 17 A. No, there isn't. It's just that you use a different
2 : 2 3 PM 18 equation of state to find out what the density of the gas is,
2 : 2 3 PM 19 what the densities of the liquid are, and what the properties
2 : 2 3 PM 20 of viscosity and a number of different properties that you
2 : 2 3 PM 21 would need. But the equations governing the flow were
2 : 2 3 PM 22 identical.

2 : 2 3 PM 23 Q. Did you have an adequate equation of state?

2 : 2 3 PM 24 A. Yes. Charles Morrow generated an equation of state for me
2 : 2 3 PM 25 based on the information that BP gave us. We compared that

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 4 P M 1 equation of state with BP results and found we matched very
2 : 2 4 P M 2 closely. In fact, BP kept modifying their results, and they
2 : 2 4 P M 3 seemed to get closer and closer to the values that Charlie
2 : 2 4 P M 4 calculated originally. So I was very pleased with Charlie's
2 : 2 4 P M 5 work in that area.

2 : 2 4 P M 6 Q. Thank you, Dr. Dykhuizen.

2 : 2 4 P M 7 Now, you were involved in the response to the Macondo
2 : 2 4 P M 8 well?

2 : 2 4 P M 9 A. Yes, I was. I received a call from Dr. Tom Hunter and Tom
2 : 2 4 P M 10 Bickel -- they were both on the line -- and asked me in the
2 : 2 4 P M 11 first week of May to contribute to the government helping BP.

2 : 2 4 P M 12 Q. Did you spend time in Houston during the response?

2 : 2 4 P M 13 A. Yes. Usually Charles Morrow or myself were alternating
2 : 2 4 P M 14 back and forth in Houston. There were some time periods where
2 : 2 4 P M 15 neither of us were there, but, yes, we were there quite often.

2 : 2 4 P M 16 Q. And were you also working on the response when you were
2 : 2 4 P M 17 back at Sandia?

2 : 2 5 P M 18 A. Yes. Typically, it was difficult to get much work done
2 : 2 5 P M 19 while you were at Houston, so the person -- whether it was
2 : 2 5 P M 20 Charles Morrow or myself -- would be doing the calculations
2 : 2 5 P M 21 back at Sandia while the person in Houston was interacting with
2 : 2 5 P M 22 BP engineers and listening to presentations.

2 : 2 5 P M 23 Q. Did Tom Hunter ask you to perform modeling during the
2 : 2 5 P M 24 response?

2 : 2 5 P M 25 A. Yes. He asked me to perform a number of different

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 5 P M 1 modeling tasks.

2 : 2 5 P M 2 Q. Did you work on diagnosing well conditions?

2 : 2 5 P M 3 A. Yes.

2 : 2 5 P M 4 Q. Did you review BP's source control plans?

2 : 2 5 P M 5 A. Yes.

2 : 2 5 P M 6 Q. Did you participate in the well integrity analysis in July

2 : 2 5 P M 7 of 2010?

2 : 2 5 P M 8 A. Yes. I was there for that.

2 : 2 5 P M 9 Q. Did you perform flow rate estimates?

2 : 2 5 P M 10 A. Yes.

2 : 2 5 P M 11 Q. And did you work with BP engineers during the response?

2 : 2 5 P M 12 A. Yes. We worked with BP engineers, trading thoughts of

2 : 2 5 P M 13 what might be going on and trying to interpret data.

2 : 2 5 P M 14 Q. Did you perform some calculations in mid-May of 2010 at

2 : 2 6 P M 15 BP's request?

2 : 2 6 P M 16 A. Yes.

2 : 2 6 P M 17 Q. And did you ever meet a BP engineer named Mike Mason

2 : 2 6 P M 18 during the response?

2 : 2 6 P M 19 A. Yes. I met him a couple of times.

2 : 2 6 P M 20 Q. And who is Mr. Mason?

2 : 2 6 P M 21 A. Mr. Mason was presented to me as a supervisor of a

2 : 2 6 P M 22 calculational group at BP.

2 : 2 6 P M 23 Q. Could you very briefly describe that work that you did in

2 : 2 6 P M 24 mid-May at BP's request.

2 : 2 6 P M 25 A. BP was concerned. They were using one of their standard

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 6 P M 1 codes to calculate the flowing conditions in the well. They
2 : 2 6 P M 2 were concerned that this code may not be used properly in the
2 : 2 6 P M 3 odd geometries that they were proposing.

2 : 2 6 P M 4 The geometry that they were most interested in --
2 : 2 6 P M 5 they had the flow going up one flow path, turning 180 degrees,
2 : 2 6 P M 6 going back down, and then turning 180 degrees going back up
2 : 2 6 P M 7 again.

2 : 2 6 P M 8 And they were concerned that their results may not be
2 : 2 6 P M 9 correct. So they asked myself and other national laboratory
2 : 2 7 P M 10 scientists to reproduce that calculation, given the same
2 : 2 7 P M 11 boundary conditions they were using, and try to calculate a
2 : 2 7 P M 12 pressure at the bottom of the well that you would get with
2 : 2 7 P M 13 these flow paths. I did that for four different geometries and
2 : 2 7 P M 14 presented that to BP blindly, without knowing what their
2 : 2 7 P M 15 results were.

2 : 2 7 P M 16 It turned out that 3 and 4, I agreed very well with
2 : 2 7 P M 17 BP, and the fourth was slightly different. And I was able to
2 : 2 7 P M 18 convince BP that they were indeed using their code incorrectly
2 : 2 7 P M 19 in the fourth case and showed them that my calculations were
2 : 2 7 P M 20 better than theirs.

2 : 2 7 P M 21 Q. And did BP agree with you that your calculations for that
2 : 2 7 P M 22 case were better?

2 : 2 7 P M 23 A. Yes, they did.

2 : 2 7 P M 24 Q. For that modeling did BP ask you to assume a flow rate of
2 : 2 7 P M 25 the 5,000 barrels per day?

RONALD DYKHUIZEN, PH.D. - VOIR DIRE

2 : 2 7 P M 1 A. Yes. That was one of the boundary conditions we were
2 : 2 7 P M 2 given to use.
2 : 2 7 P M 3 Q. Did you share other flow modeling with BP during the
2 : 2 7 P M 4 response?
2 : 2 7 P M 5 A. All during the response, any calculation I did was shared
2 : 2 8 P M 6 with BP, yes.
2 : 2 8 P M 7 Q. Did that include flow rate calculations?
2 : 2 8 P M 8 A. Yes.
2 : 2 8 P M 9 Q. Did anyone from BP ever complain to you about your
2 : 2 8 P M 10 calculations or the support the national labs were providing
2 : 2 8 P M 11 during the response?
2 : 2 8 P M 12 A. No. They seemed pleased with the support, and nobody ever
2 : 2 8 P M 13 told me that my calculations were incorrect.
2 : 2 8 P M 14 MR. CERNICH: Your Honor, the United States tenders
2 : 2 8 P M 15 Dr. Dykhuizen as an expert in mechanical engineering, fluid
2 : 2 8 P M 16 mechanics, and multiphase flow.
2 : 2 8 P M 17 THE COURT: All right. Do you have any other
2 : 2 8 P M 18 questions other than what was in your Daubert motion?
2 : 2 8 P M 19 MR. REGAN: Other than Daubert motion, I'll take it
2 : 2 8 P M 20 up on the cross-examination, Your Honor.
2 : 2 8 P M 21 THE COURT: Very well.
2 : 2 8 P M 22 I'll accept him. Go ahead.
2 : 2 8 P M 23 MR. CERNICH: Thank you, Your Honor.
2 : 2 8 P M 24 DIRECT EXAMINATION
25

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 2 8 P M 1 **BY MR. CERNICH:**

2 : 2 8 P M 2 **Q.** Dr. Dykhuizen, did you write an expert report and a

2 : 2 8 P M 3 rebuttal report in this case?

2 : 2 8 P M 4 **A.** Yes, I did.

2 : 2 8 P M 5 **MR. CERNICH:** Could we please have TREX-11452,

2 : 2 8 P M 6 please.

2 : 2 8 P M 7 **BY MR. CERNICH:**

2 : 2 8 P M 8 **Q.** Dr. Dykhuizen, is this your expert report in this case?

2 : 2 8 P M 9 **A.** Yes. This is the title page of my expert report.

2 : 2 8 P M 10 **Q.** Could we have TREX 11463-R, please.

2 : 2 9 P M 11 Is this your rebuttal report?

2 : 2 9 P M 12 **A.** Yes. This is the title page of my rebuttal report.

2 : 2 9 P M 13 **Q.** Do you adopt these reports as your expert testimony in

2 : 2 9 P M 14 this case?

2 : 2 9 P M 15 **A.** Yes, I do.

2 : 2 9 P M 16 **MR. CERNICH:** In addition, Your Honor, the United

2 : 2 9 P M 17 States would like to offer into evidence these reports, which

2 : 2 9 P M 18 are marked as Exhibits 11452 and 11463-R. Dr. Dykhuizen's CV

2 : 2 9 P M 19 is included with his initial report. Each report lists the

2 : 2 9 P M 20 materials he considered in forming his opinions.

2 : 2 9 P M 21 **THE COURT:** All right. Those will be admitted.

2 : 2 9 P M 22 **MR. CERNICH:** Thank you.

2 : 2 9 P M 23 **BY MR. CERNICH:**

2 : 2 9 P M 24 **Q.** Turning to your expert opinions in this case,

2 : 2 9 P M 25 Dr. Dykhuizen, what were you asked to do?

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 2 9 P M 1 A. I was asked to calculate the flow from the Macondo well at
2 : 2 9 P M 2 any period of time I thought I had enough data to perform an
2 : 2 9 P M 3 estimate. And I was also asked to integrate that flow to find
2 : 2 9 P M 4 the integrated cumulative amount released from the reservoir.
2 : 2 9 P M 5 Q. Did you calculate a flow rate through the capping stack?
2 : 2 9 P M 6 A. Yes. That was one of the time periods I used. I
2 : 2 9 P M 7 calculated 53,000 barrels of oil per day through the capping
2 : 3 0 P M 8 stack.
2 : 3 0 P M 9 Q. And did you calculate a flow rate at the time of Top Kill?
2 : 3 0 P M 10 A. Yes. At the time of Top Kill, I estimated over
2 : 3 0 P M 11 60,000 barrels of oil per day.
2 : 3 0 P M 12 Q. And did you calculate a flow rate for the Top Hat period?
2 : 3 0 P M 13 A. Yes. For the Top Hat period, I estimated approximately
2 : 3 0 P M 14 60,000 barrels of oil per day.
2 : 3 0 P M 15 Q. And did you calculate a cumulative, or integrated, flow?
2 : 3 0 P M 16 A. Yes. I estimated 5 million barrels of oil was released
2 : 3 0 P M 17 from the Macondo reservoir.
2 : 3 0 P M 18 Q. Is that your best estimate?
2 : 3 0 P M 19 A. Yes, it is.
2 : 3 0 P M 20 MR. CERNICH: Could I have D-21143, please.
2 : 3 0 P M 21 BY MR. CERNICH:
2 : 3 0 P M 22 Q. Is this a summary of your expert opinions in this case?
2 : 3 0 P M 23 A. Yes, it is.
2 : 3 0 P M 24 Q. Could I go to D-21122, please.
2 : 3 0 P M 25 And is this a demonstrative summarizing your three

RONALD DYKHUIZEN, PH.D. - DIRECT

2:30 PM 1 individual flow rate calculations on that time line?

2:30 PM 2 A. Yes, it is.

2:30 PM 3 Q. Dr. Dykhuizen, are you being compensated for your work in

2:30 PM 4 this case?

2:30 PM 5 A. I received my regular salary. Department of Justice has

2:31 PM 6 negotiated with my employer to pay for the time that I'm not

2:31 PM 7 working directly for my employer.

2:31 PM 8 Q. And did you have any involvement in those negotiations?

2:31 PM 9 A. No, I did not.

2:31 PM 10 Q. Now, I'd like to walk through each of your calculations.

2:31 PM 11 Let's start with the capping stack.

2:31 PM 12 And you said you calculated a flow rate of

2:31 PM 13 53,000 barrels per day out of the capping stack?

2:31 PM 14 A. Yes, that is correct.

2:31 PM 15 Q. Did you prepare any demonstratives to assist you in

2:31 PM 16 explaining your calculations?

2:31 PM 17 A. Yes, I have.

2:31 PM 18 **MR. CERNICH:** Could we go to 21100.1.

2:31 PM 19 **BY MR. CERNICH:**

2:31 PM 20 Q. Is this the capping stack, Dr. Dykhuizen?

2:31 PM 21 A. Yes. That's a representation of the capping stack with

2:31 PM 22 the kill line on the left and the choke line on the right.

2:31 PM 23 Q. And how did the capping stack allow you to calculate flow

2:31 PM 24 rates?

2:31 PM 25 A. The capping stack allowed me to calculate flow rates

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 1 P M 1 because I had a well-defined geometry that the flow was going
2 : 3 2 P M 2 through. I have a pressure gauge in the bottom of the capping
2 : 3 2 P M 3 stack that allows me to measure an upstream pressure. We're
2 : 3 2 P M 4 dumping to the sea at either one of the two points, with the
2 : 3 2 P M 5 middle ram closed. I can see if I can do that. The middle ram
2 : 3 2 P M 6 is right here.

2 : 3 2 P M 7 So I have a pressure, let's say, at the exit of the
2 : 3 2 P M 8 kill line, a pressure gauge here, a known pressure difference.
2 : 3 2 P M 9 And then I would try to estimate the flow through that path
2 : 3 2 P M 10 when this path was blocked and this path was blocked based on
2 : 3 2 P M 11 those two pressures.

2 : 3 2 P M 12 **MR. CERNICH:** Could we go to D-21101, please.

2 : 3 2 P M 13 **BY MR. CERNICH:**

2 : 3 2 P M 14 **Q.** Does this demonstrative assist in explaining how you
2 : 3 2 P M 15 calculated those flow rates?

2 : 3 2 P M 16 **A.** Yes. What I've tried to show here is just a standard flow
2 : 3 2 P M 17 meter. This could be used in single-phase flow or multiphase
2 : 3 2 P M 18 flow. We put an obstruction in the middle of the device here
2 : 3 2 P M 19 that is represented by this green orifice. We measure the
2 : 3 3 P M 20 pressure upstream and the pressure downstream.

2 : 3 3 P M 21 By knowing the change in pressure, or the difference
2 : 3 3 P M 22 in pressure; by knowing the resistance -- I could look it up
2 : 3 3 P M 23 because of the known geometry of the orifice; by knowing the
2 : 3 3 P M 24 equation of state, I know the density; and I only have one
2 : 3 3 P M 25 equation to determine the velocity. The change in the pressure

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 3 P M 1 helps me to determine the velocity.

2 : 3 3 P M 2 Then with the velocity I can multiply it by the
2 : 3 3 P M 3 density, multiply it by the appropriate area; and the density
2 : 3 3 P M 4 times the velocity times the area is the mass flow rate. And I
2 : 3 3 P M 5 can express that in standard barrels of oil per day.

2 : 3 3 P M 6 Q. Are these standard fluid mechanics equations?

2 : 3 3 P M 7 A. Yes. These are standard equations you'd find in a
2 : 3 3 P M 8 first-year undergraduate course.

2 : 3 3 P M 9 Q. When did you first perform your capping stack
2 : 3 3 P M 10 calculations?

2 : 3 3 P M 11 A. We knew the capping stack was going to be installed days
2 : 3 3 P M 12 before. We knew the geometry of the capping stack. So we had
2 : 3 3 P M 13 generated spreadsheets to do this calculation, and we did them
2 : 3 4 P M 14 within hours of getting the pressure data.

2 : 3 4 P M 15 Q. And why did you first perform those calculations?

2 : 3 4 P M 16 A. Knowing the flow from the well is very important for well
2 : 3 4 P M 17 integrity. There was a potential that the well had holes below
2 : 3 4 P M 18 grade that we didn't know about; and if we closed the well and
2 : 3 4 P M 19 now the oil was forced to go out the holes underground, that
2 : 3 4 P M 20 oil could percolate to the surface and create an even worse
2 : 3 4 P M 21 disaster than we had with the oil coming up the top, because
2 : 3 4 P M 22 now there would be no way to plug the system.

2 : 3 4 P M 23 Q. Dr. Dykhuizen, did you use three methods to calculate flow
2 : 3 4 P M 24 rates through the capping stack?

2 : 3 4 P M 25 A. Yes, I divided it into three methods.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 4 P M 1 Q. And was Method 1 flow rates through the kill line of the
2 : 3 4 P M 2 capping stack?
2 : 3 4 P M 3 A. Yes.
2 : 3 4 P M 4 MR. CERNICH: Could we go to D-21102, please.
2 : 3 4 P M 5 BY MR. CERNICH:
2 : 3 4 P M 6 Q. Would you please explain to the judge your Method 1
2 : 3 4 P M 7 calculations.
2 : 3 4 P M 8 A. Sure. We have the pressure here upstream. We have
2 : 3 5 P M 9 identified in red a number of resistances. Even the valves
2 : 3 5 P M 10 that are open provide a certain amount of resistance. We have
2 : 3 5 P M 11 an exit pressure. So with the known pressures and the known
2 : 3 5 P M 12 resistances in between, I calculate a flow rate.
2 : 3 5 P M 13 And we had two types of calculations, subtypes here.
2 : 3 5 P M 14 I could have all the flow being forced through the kill line,
2 : 3 5 P M 15 like it was in some time periods, and that would be the total
2 : 3 5 P M 16 flow coming out of the Macondo well. And there were other
2 : 3 5 P M 17 times where we had -- below the system we were collecting some
2 : 3 5 P M 18 flow to send up to a ship and, therefore, I would just add the
2 : 3 5 P M 19 measured collection rate to the amount of flow that was going
2 : 3 5 P M 20 through the kill line. If I had a reduced flow going through
2 : 3 5 P M 21 the kill line, I ended up measuring a reduced pressure with a
2 : 3 5 P M 22 pressure gauge.
2 : 3 5 P M 23 Q. Did you use something called K-factors to account for the
2 : 3 5 P M 24 pipe bends and contractions?
2 : 3 6 P M 25 A. Yes. We used Ks to calculate for all the resistances. We

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 6 P M 1 looked up Ks from standard textbook references.

2 : 3 6 P M 2 Q. What are K-factors?

2 : 3 6 P M 3 A. K-factors are a measure of resistance. The higher the

2 : 3 6 P M 4 K-value, the tougher it is to push the flow through the system.

2 : 3 6 P M 5 Q. And what sort of standard engineering text did you use?

2 : 3 6 P M 6 A. My preferred text was the Crane manual, which is used in

2 : 3 6 P M 7 the U.S.; but I also looked in a text called Miller and another

2 : 3 6 P M 8 by a Dillchek (phonetic) that are used in other countries,

2 : 3 6 P M 9 trying to find as many representations of K-factors and

2 : 3 6 P M 10 geometries as close as possible to the geometries that we have

2 : 3 6 P M 11 here.

2 : 3 6 P M 12 Q. Did you also calculate flow rates through the capping

2 : 3 6 P M 13 stack choke line?

2 : 3 6 P M 14 A. Yes, I did. I called that Method 2.

2 : 3 6 P M 15 MR. CERNICH: Can we go to D-21103.

2 : 3 6 P M 16 BY MR. CERNICH:

2 : 3 6 P M 17 Q. Would you please explain to the judge your Method 2

2 : 3 6 P M 18 calculation.

2 : 3 6 P M 19 A. Method 2 is essentially the same. We have the same

2 : 3 6 P M 20 upstream pressure. We have a slightly different downstream

2 : 3 7 P M 21 pressure because this exit is a different elevation. So as I

2 : 3 7 P M 22 get higher up, the pressure is reduced a little. We have many

2 : 3 7 P M 23 more resistances. But it allows us an independent way of

2 : 3 7 P M 24 calculating the flow, another flow estimate for essentially the

2 : 3 7 P M 25 same time period.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 7 P M 1 And none of the time periods that I chose to do this
2 : 3 7 P M 2 analysis did we have any collection, so all the flow that I
2 : 3 7 P M 3 chose to do the analysis was what I calculate the flow through
2 : 3 7 P M 4 the system here.

2 : 3 7 P M 5 Q. Was this the choke valve that ultimately shut in the
2 : 3 7 P M 6 Macondo well?

2 : 3 7 P M 7 A. Yes. This choke valve here was what we used to turn off
2 : 3 7 P M 8 the well. All the flow was forced through this system. We
2 : 3 7 P M 9 closed this valve in a number of small increments, in case we
2 : 3 7 P M 10 saw the pressures going someplace that we were concerned about.
2 : 3 7 P M 11 We didn't want the pressures to be so large that it would blow
2 : 3 7 P M 12 apart the capping stack, so we did this slowly.

2 : 3 7 P M 13 And we -- this is what was used to turn off the well.
2 : 3 8 P M 14 Once this valve was closed, the well stopped flowing.

2 : 3 8 P M 15 Q. Did you also calculate flow rates as the choke valve was
2 : 3 8 P M 16 being closed?

2 : 3 8 P M 17 A. Yes. This method could be used during the process of
2 : 3 8 P M 18 closing the choke valve.

2 : 3 8 P M 19 And we saw some interesting, unexpected results. As
2 : 3 8 P M 20 we first closed the choke valve, the model indicated that the
2 : 3 8 P M 21 flow was increasing. This didn't seem logical to us, and I
2 : 3 8 P M 22 still don't think it's logical.

2 : 3 8 P M 23 But eventually, as we continued to close the choke
2 : 3 8 P M 24 valve, the flow predicted from the model showed that the flow
2 : 3 8 P M 25 was decreasing, and eventually it showed that the flow was

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 3 8 P M 1 zero.

2 : 3 8 P M 2 We had some concerns and that led us to have less
2 : 3 8 P M 3 confidence in our calculated flows than we would have otherwise
2 : 3 8 P M 4 because we had this anomalous calculation.

2 : 3 8 P M 5 Q. Does that make your calculations unreliable?

2 : 3 8 P M 6 A. No. That just forces me to use a larger estimate of the
2 : 3 9 P M 7 uncertainty than I might have used otherwise.

2 : 3 9 P M 8 Q. Now, did you also use a third method, something you called
2 : 3 9 P M 9 the "alternate method," to calculate flow through the capping
2 : 3 9 P M 10 stack?

2 : 3 9 P M 11 A. Yes. A third method was also used.

2 : 3 9 P M 12 MR. CERNICH: Could we go to D-21105.

2 : 3 9 P M 13 BY MR. CERNICH:

2 : 3 9 P M 14 Q. Does this demonstrative illustrate the time periods you
2 : 3 9 P M 15 used for your alternate method of calculation?

2 : 3 9 P M 16 A. Yes. In the alternate method, we had some time period
2 : 3 9 P M 17 where the flow through the capping stack was reduced because we
2 : 3 9 P M 18 were collecting oil below in the BOP and, therefore, only part
2 : 3 9 P M 19 of the flow went up through the capping stack. Other time
2 : 3 9 P M 20 periods, these valves were closed and all the flow went through
2 : 3 9 P M 21 the capping stack.

2 : 3 9 P M 22 I can formulate equations for both of those
2 : 3 9 P M 23 conditions and by manipulating the equations, I can predict not
2 : 4 0 P M 24 only the flow for these two conditions, but I can also predict
2 : 4 0 P M 25 the resistances. So this takes away my requirement of looking

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 0 P M 1 up resistances and trying to justify their value. This allows
2 : 4 0 P M 2 me to calculate the resistances.

2 : 4 0 P M 3 MR. CERNICH: Could we go to D-21104, please.

2 : 4 0 P M 4 BY MR. CERNICH:

2 : 4 0 P M 5 Q. How does the alternate method differ -- differ from
2 : 4 0 P M 6 Methods 1 and 2?

2 : 4 0 P M 7 A. Well, the Method 1 and 2 are simple. You have two
2 : 4 0 P M 8 pressures and their resistance. Here I have two pressures, but
2 : 4 0 P M 9 I need two flowing conditions with at least a portion of the
2 : 4 0 P M 10 flow measured, and that portion that I have measured is the
2 : 4 0 P M 11 portion collected.

2 : 4 0 P M 12 So knowing the portion collected and knowing these
2 : 4 0 P M 13 two conditions and the two different pressures I get, I can
2 : 4 0 P M 14 combine these equations and predict not only the flow rate at
2 : 4 0 P M 15 both of those two times, but predict what the resistance is,
2 : 4 0 P M 16 and I get resistances very similar to what I calculate in a
2 : 4 0 P M 17 normal, straightforward method.

2 : 4 1 P M 18 Q. Did you compare the results of your three methods?

2 : 4 1 P M 19 A. Yes, I did.

2 : 4 1 P M 20 MR. CERNICH: Could we go to D-21106.

2 : 4 1 P M 21 BY MR. CERNICH:

2 : 4 1 P M 22 Q. Does this demonstrative show your comparison of your three
2 : 4 1 P M 23 methods?

2 : 4 1 P M 24 A. Yes. I attempted Method 1, or at least I presented
2 : 4 1 P M 25 Method 1 three different times. I've actually attempted it

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 1 P M 1 more times, but it got redundant. All the results were very
2 : 4 1 P M 2 similar.

2 : 4 1 P M 3 Method 2, we're presenting the fully open case.

2 : 4 1 P M 4 And the alternate method is combining the -- this
2 : 4 1 P M 5 case and that case together to get one alternate method.

2 : 4 1 P M 6 And the other alternate method, I combine the third
2 : 4 1 P M 7 case and the first case and I get these six cases with all
2 : 4 1 P M 8 approximately the same flow rate.

2 : 4 1 P M 9 I averaged the six cases and I get 53,000 barrels of
2 : 4 1 P M 10 oil per day, which constitutes my best estimate of what the
2 : 4 1 P M 11 flow is from the well.

2 : 4 2 P M 12 Q. Dr. Dykhuizen, since July of 2010, have you done anything
2 : 4 2 P M 13 to improve or refine your calculations?

2 : 4 2 P M 14 A. I've redone the calculations many times with different
2 : 4 2 P M 15 assumptions to try to find out what -- how sensitive they were
2 : 4 2 P M 16 to different assumptions and changing geometries.

2 : 4 2 P M 17 Q. Did you explore multiphase effects?

2 : 4 2 P M 18 A. Yes. One of the criticisms that was identified in the
2 : 4 2 P M 19 original DOE-NNSA report was we were using single-phase
2 : 4 2 P M 20 K-factors and were they applicable to this multiphase flow.

2 : 4 2 P M 21 So I went into the literature, picked out a classic
2 : 4 2 P M 22 paper that is in use all -- all -- in many different fields and
2 : 4 2 P M 23 Chisholm correlation provides correlations for K-factors for
2 : 4 2 P M 24 multiphase flow.

2 : 4 2 P M 25 I recalculated the flow with multiphase flow factors,

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 2 P M 1 found out that the flow increased, my estimate increased by
2 : 4 2 P M 2 approximately 4 percent. I considered that 4 percent small
2 : 4 3 P M 3 compared to my original 20 percent error bar that I applied to
2 : 4 3 P M 4 my flows, and so I considered that the effect of multiphase
2 : 4 3 P M 5 flow was not a significant effect.

2 : 4 3 P M 6 Q. Did you also consider the spacing of the flow elements,
2 : 4 3 P M 7 the elbows and contractions in the capping stack?

2 : 4 3 P M 8 A. Yes. That concern was also identified in the original
2 : 4 3 P M 9 report. We were concerned that the tabulated values of
2 : 4 3 P M 10 K-factors were generated from experiments. And the experiments
2 : 4 3 P M 11 would, say, place an elbow preceded by a long, straight pipe
2 : 4 3 P M 12 and followed by a long, straight pipe.

2 : 4 3 P M 13 In this example, we did not have that geometry. The
2 : 4 3 P M 14 elbow was followed closely by some valves, followed closely by
2 : 4 3 P M 15 another elbow. This is very standard. That effect is
2 : 4 3 P M 16 typically ignored. We can attack that approximation a number
2 : 4 3 P M 17 of different ways.

2 : 4 4 P M 18 One way is the alternate method makes no assumption
2 : 4 4 P M 19 about what the K-values are and calculates the proper K-values
2 : 4 4 P M 20 with these elements placed where they are. Also --

2 : 4 4 P M 21 Q. Dr. Dykhuizen, can I stop you there?

2 : 4 4 P M 22 MR. CERNICH: Your Honor, there's a pending motion
2 : 4 4 P M 23 that you have on appeal regarding Dr. Dykhuizen's reliance on
2 : 4 4 P M 24 one of our relied-upon experts that is permitted under the
2 : 4 4 P M 25 Court's order, rec doc 11087. And before Dr. Dykhuizen goes

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 4 P M 1 into this part of his testimony, I just wanted to alert you to
2 : 4 4 P M 2 that pending motion.

2 : 4 4 P M 3 Judge -- Magistrate Judge Shushan issued an
2 : 4 4 P M 4 order excluding Dr. Dykhuizen and other U.S. experts' reliance
2 : 4 4 P M 5 on Dr. Bushnell. We opposed -- and we appealed that motion to
2 : 4 4 P M 6 you.

2 : 4 4 P M 7 **THE COURT:** Okay. I did look at this. I didn't
2 : 4 4 P M 8 realize this was coming up with this witness. Tell me what the
2 : 4 4 P M 9 issue is again, Mr. Regan.

2 : 4 5 P M 10 **MR. REGAN:** Yes, Your Honor. The issue is that
2 : 4 5 P M 11 Dr. Bushnell is an expert that the United States is not calling
2 : 4 5 P M 12 and has not been designated as one who they're relying upon
2 : 4 5 P M 13 either as a testifying expert or as a non-testifying
2 : 4 5 P M 14 relied-upon expert. He didn't fit into either category.

2 : 4 5 P M 15 Because of that, it is not proper for their --
2 : 4 5 P M 16 their testifying experts to rely upon him. That issue was
2 : 4 5 P M 17 briefed before Judge Shushan in Record Document 11352 --

2 : 4 5 P M 18 **THE COURT:** So as I recall, the protocol was going to
2 : 4 5 P M 19 be that if one expert was going to rely on a non-testifying
2 : 4 5 P M 20 expert's opinion on anything, the non-testifying expert's
2 : 4 5 P M 21 opinion would have to be disclosed in the testifying expert's
2 : 4 5 P M 22 report and then that non-testifying expert's deposition
2 : 4 6 P M 23 testimony -- the relevant portions of that non-testifying
2 : 4 6 P M 24 expert's deposition testimony would be admitted.

2 : 4 6 P M 25 Is that -- am I recalling that right?

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 6 P M 1 **MR. CERNICH:** Right. And that's the procedure we
2 : 4 6 P M 2 followed here, Your Honor. Dr. Dykhuizen specifically relies
2 : 4 6 P M 3 upon Dr. Bushnell in his expert report. BP argued in its
2 : 4 6 P M 4 original motion that Dr. Dykhuizen was simply using
2 : 4 6 P M 5 Dr. Bushnell to corroborate his results. Magistrate Judge
2 : 4 6 P M 6 Shushan agreed with the United States that he was not, but then
2 : 4 6 P M 7 added another layer to the analysis that he had to somehow
2 : 4 6 P M 8 describe an analysis of Dr. Bushnell's work in his report.

2 : 4 6 P M 9 That requirement to describe an analysis is not
2 : 4 6 P M 10 in Rule 703 and it's not in the Court's order. Had we known
2 : 4 6 P M 11 that, we would have included such analysis. That order was
2 : 4 6 P M 12 actually issued after expert reports were done, after expert
2 : 4 7 P M 13 depositions are done.

2 : 4 7 P M 14 Mr. Regan questioned Dr. Dykhuizen during his
2 : 4 7 P M 15 deposition and asked him specifically about his reliance on
2 : 4 7 P M 16 Dr. Bushnell in this case.

2 : 4 7 P M 17 **THE COURT:** Let me ask the witness: What is it
2 : 4 7 P M 18 that -- without describing what the result was, but what is it
2 : 4 7 P M 19 that Dr. Bushnell did that's different than what you did?

2 : 4 7 P M 20 **THE WITNESS:** Dr. Bushnell was able to perform a
2 : 4 7 P M 21 calculation to show that the effect of the -- he did a number
2 : 4 7 P M 22 of things, but in this particular case was to show that the
2 : 4 7 P M 23 effect of closely placed flow elements did not impact the --
2 : 4 7 P M 24 resulted in a flow rate very similar to mine and, therefore, by
2 : 4 7 P M 25 implication, since he had all the flow elements in their proper

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 8 P M 1 location, that I should not be concerned with the fact that the
2 : 4 8 P M 2 flow elements were close together.

2 : 4 8 P M 3 **MR. REGAN:** Yes, Your Honor. As Judge Shushan ruled,
2 : 4 8 P M 4 she first read Dr. Dykhuizen's report where he just references
2 : 4 8 P M 5 Dr. Bushnell's opinions as providing confidence that his
2 : 4 8 P M 6 approach was correct. And as Judge Shushan wrote in her
2 : 4 8 P M 7 report -- this is Record No. 11352 in her opinion -- "The
2 : 4 8 P M 8 report by Dr. Dykhuizen does not demonstrate any independent
2 : 4 8 P M 9 analysis of the computational fluid dynamics models constructed
2 : 4 8 P M 10 and used by Dr. Bushnell, nor does he rely on Dr. Bushnell's
2 : 4 8 P M 11 analysis in forming any of his opinions."

2 : 4 8 P M 12 And that's the key, he's not relying upon it,
2 : 4 8 P M 13 he's just bringing in another expert by saying, Well, I see
2 : 4 8 P M 14 what he's done over there and it gives me confidence --

2 : 4 8 P M 15 **THE COURT:** It seems like he's relying on it in a
2 : 4 8 P M 16 sense. He's relying on it -- he didn't do -- you didn't do a
2 : 4 8 P M 17 separate analysis of what Dr. Bushnell did; that's what
2 : 4 9 P M 18 Mr. Regan says?

2 : 4 9 P M 19 **THE WITNESS:** I did not repeat his analysis, no.

2 : 4 9 P M 20 **THE COURT:** But you relied on it in what sense? To
2 : 4 9 P M 21 corroborate or confirm support which you came up with? Tell me
2 : 4 9 P M 22 how you relied on it.

2 : 4 9 P M 23 **THE WITNESS:** I tried to demonstrate -- one criticism
2 : 4 9 P M 24 that was given to me was that the resistances I used were based
2 : 4 9 P M 25 on experiments where the flow elements were far apart.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 4 9 P M 1 Dr. Bushnell received a very similar result as I got by placing
2 : 4 9 P M 2 the flow elements close together, which justifies me assuming
2 : 4 9 P M 3 that they were sufficiently far apart that I could use the
2 : 4 9 P M 4 K-factors that I used in my report.

2 : 4 9 P M 5 THE COURT: Okay. I'm going to let him make
2 : 4 9 P M 6 reference to that. Go ahead and move on.

2 : 4 9 P M 7 MR. CERNICH: Thank you, Your Honor.

2 : 4 9 P M 8 THE COURT: So I don't know if you had actually posed
2 : 5 0 P M 9 a question or not.

2 : 5 0 P M 10 MR. CERNICH: Well, I had posed a question and I
2 : 5 0 P M 11 stopped Dr. Dykhuizen before I --

2 : 5 0 P M 12 THE COURT: Okay. So get back to where you were.

2 : 5 0 P M 13 MR. CERNICH: Yes, Your Honor.

2 : 5 0 P M 14 BY MR. CERNICH:

2 : 5 0 P M 15 Q. You were about to -- I believe you were about to talk
2 : 5 0 P M 16 about Dr. Bushnell.

2 : 5 0 P M 17 A. Dr. Bushnell performed a CFD analysis, which is
2 : 5 0 P M 18 essentially a three-dimensional analysis of the flow by -- and
2 : 5 0 P M 19 he showed -- he placed every flow element in their exact
2 : 5 0 P M 20 position, or at least as exact as we know. He was able to come
2 : 5 0 P M 21 up with a flow rate that was very similar to my flow rate;
2 : 5 0 P M 22 therefore, it implies that my assumption to use K-factors based
2 : 5 0 P M 23 on widely separated flow elements was justified because he came
2 : 5 0 P M 24 up with a very similar result that I do solving the same
2 : 5 0 P M 25 problem.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 0 P M 1 Q. And did Dr. Bushnell use something called "computational
2 : 5 0 P M 2 fluid dynamics"?

2 : 5 1 P M 3 A. Yes, he did.

2 : 5 1 P M 4 Q. And are you familiar with computational fluid dynamics?

2 : 5 1 P M 5 A. Yes. I've done computational fluid dynamics myself. In
2 : 5 1 P M 6 my position now, I direct a number of people doing
2 : 5 1 P M 7 computational fluid dynamics and they report their results to
2 : 5 1 P M 8 me. I try to make sure that that analysis is done correctly.
2 : 5 1 P M 9 I check their results, I check their work, similar to me
2 : 5 1 P M 10 reviewing Dr. Bushnell's work.

2 : 5 1 P M 11 Q. Just in a nutshell, can you tell Judge Barbier what
2 : 5 1 P M 12 computational fluid dynamics is?

2 : 5 1 P M 13 A. Yes. If you have a piping system with elbows and Ts and
2 : 5 1 P M 14 crosses, you would represent that with a bunch of little sugar
2 : 5 1 P M 15 cubes representing small volumes, much smaller than the
2 : 5 1 P M 16 diameter of the pipe. Then you would watch the flow in three
2 : 5 1 P M 17 dimensions as it would go around corners and what sort of
2 : 5 1 P M 18 eddies you would get and so on.

2 : 5 1 P M 19 In my calculations, I just get an average velocity in
2 : 5 2 P M 20 the pipe. And so his calculations are much more accurate than
2 : 5 2 P M 21 mine.

2 : 5 2 P M 22 Q. Did you consider -- and what do you mean by "more
2 : 5 2 P M 23 accurate"?

2 : 5 2 P M 24 A. More --

2 : 5 2 P M 25 MR. REGAN: Your Honor --

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 2 PM 1 **THE WITNESS:** More accurate is more detailed.

2 : 5 2 PM 2 **MR. CERNICH:** I'm not presenting --

2 : 5 2 PM 3 **MR. REGAN:** At a certain point we now have

2 : 5 2 PM 4 Dr. Dykhuizen testifying as Dr. Bushnell as to the work that he

2 : 5 2 PM 5 did. All he did was look at the results and say they were the

2 : 5 2 PM 6 same as his.

2 : 5 2 PM 7 **MR. CERNICH:** I'm not going any further, Your Honor.

2 : 5 2 PM 8 I just wanted to establish that Dr. Dykhuizen had a basis to

2 : 5 2 PM 9 rely on this work.

2 : 5 2 PM 10 **THE COURT:** All right.

2 : 5 2 PM 11 **MR. CERNICH:** I'll move on.

2 : 5 2 PM 12 **BY MR. CERNICH:**

2 : 5 2 PM 13 **Q.** Did you consider temperature sensitivities in your

2 : 5 2 PM 14 calculations?

2 : 5 2 PM 15 **A.** That was also a concern that was raised in the original

2 : 5 2 PM 16 report. In the original report, we had a base case of

2 : 5 2 PM 17 180 degrees F. We repeated the calculation with 200 degrees F

2 : 5 2 PM 18 and got 2 percent reduction in flow, and that was presented.

2 : 5 2 PM 19 If you -- I was given criticism that I should use

2 : 5 2 PM 20 220 degrees F. That would also give another 2 percent

2 : 5 2 PM 21 reduction, although I do not agree with using 220 degrees F.

2 : 5 3 PM 22 **Q.** Okay. Why did you use 180 F in your original

2 : 5 3 PM 23 calculations?

2 : 5 3 PM 24 **A.** The temperature of the flow was always unknown. I had

2 : 5 3 PM 25 asked BP engineers for a measurement or a calculation. Their

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 3 P M 1 measurements and calculations were changing with time as
2 : 5 3 P M 2 different people would model it and they would use different
2 : 5 3 P M 3 assumptions. The current assumption at the time when I
2 : 5 3 P M 4 originally did those calculations was provided to Dr. Ratzell
2 : 5 3 P M 5 by BP and then provided to me as 180 degrees F.

2 : 5 3 P M 6 And so that was what we used as a base case. We also
2 : 5 3 P M 7 determined that the 200 degrees F knowing that BP had
2 : 5 3 P M 8 previously given us numbers of 200 degrees F. And so we wanted
2 : 5 3 P M 9 to cover a range and demonstrate the sensitivity of our result
2 : 5 3 P M 10 to a range in temperatures.

2 : 5 3 P M 11 Q. In performing your calculations to the capping stack, did
2 : 5 3 P M 12 you rely on pressure data from BP?

2 : 5 3 P M 13 A. Yes. BP provided me with the pressure data that I needed.

2 : 5 4 P M 14 Q. Did you rely on collection rates from BP?

2 : 5 4 P M 15 A. Yes. I needed collection rates for the alternate methods
2 : 5 4 P M 16 and even for the Methods 1 and 2, BP provided those also.

2 : 5 4 P M 17 Q. And the capping stack geometry?

2 : 5 4 P M 18 A. BP provided the capping stack geometry to us.

2 : 5 4 P M 19 Q. Did you expect BP to provide you with accurate data?

2 : 5 4 P M 20 A. Yes, I did.

2 : 5 4 P M 21 Q. Did you examine the geometry of the capping stack after it
2 : 5 4 P M 22 was recovered to shore?

2 : 5 4 P M 23 A. Yes. I went to Michoud and saw the capping stack, and I
2 : 5 4 P M 24 witnessed the measurements of the capping stack.

2 : 5 4 P M 25 Q. And how did those measurements compare with the geometry

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 4 P M 1 you used in your initial calculations?

2 : 5 4 P M 2 A. They were very close, within a few thousandths, except for

2 : 5 4 P M 3 one exception. I redid the calculations using the exact

2 : 5 4 P M 4 measurements that were provided from that session and got less

2 : 5 4 P M 5 than a 1 percent change.

2 : 5 4 P M 6 Q. Did you consider any potential uncertainty in your capping

2 : 5 4 P M 7 stack calculations?

2 : 5 4 P M 8 A. Yes. I assigned an uncertainty based on my expert

2 : 5 4 P M 9 judgment. Essentially, this is an uncalibrated flow meter. We

2 : 5 5 P M 10 have some resistance down there that we can estimate and it's

2 : 5 5 P M 11 used in multiphase flow.

2 : 5 5 P M 12 If I have an uncalibrated multiphase flow meter in my

2 : 5 5 P M 13 work at Sandia, I would not assign an uncertainty -- I would --

2 : 5 5 P M 14 I would assign an uncertainty of approximately 20 percent.

2 : 5 5 P M 15 Q. Do you recall saying at your deposition something like,

2 : 5 5 P M 16 all my estimates are inaccurate?

2 : 5 5 P M 17 A. Yes. That was an accurate statement of what I said.

2 : 5 5 P M 18 Q. Did you mean that your estimates are wrong or unreliable?

2 : 5 5 P M 19 A. No. I like to think that my estimates are reliable, but

2 : 5 5 P M 20 in any model of any system, estimates have a certain

2 : 5 5 P M 21 uncertainty to it and I tried to express my uncertainty. And

2 : 5 5 P M 22 that makes all my models and all anybody's models inaccurate.

2 : 5 5 P M 23 Q. To some degree?

2 : 5 6 P M 24 A. To some degree. Some models are more accurate than

2 : 5 6 P M 25 others.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 6 P M 1 Q. Is 53,000 barrels a day your best estimate?

2 : 5 6 P M 2 A. That is my estimate.

2 : 5 6 P M 3 Q. And the -- what was the uncertainty range that you

2 : 5 6 P M 4 ascribed to your estimate?

2 : 5 6 P M 5 A. Plus or minus 20 percent, so nominally that's 43,000 to

2 : 5 6 P M 6 63,000. We would expect 53,000 to be the best guess. You

2 : 5 6 P M 7 would have a bell curve centered at 53,000. Once you got to 43

2 : 5 6 P M 8 or 63, the probabilities would be small. Like if you flipped a

2 : 5 6 P M 9 coin ten times, you would expect to get five heads and five

2 : 5 6 P M 10 tails, maybe four and six. There's a chance of getting all

2 : 5 6 P M 11 10 heads, but that probability is very small.

2 : 5 6 P M 12 Q. And is the flow rate through the capping stack, in your

2 : 5 6 P M 13 opinion, just as likely to be 20 percent higher than

2 : 5 6 P M 14 53,000 barrels per day as it is to be lower?

2 : 5 6 P M 15 A. Yes.

2 : 5 6 P M 16 Q. Do you consider yourself conservative when it comes to

2 : 5 7 P M 17 uncertainty?

2 : 5 7 P M 18 A. I have that reputation. I would hate to have somebody

2 : 5 7 P M 19 show up with a calculation that is definitive and shows that

2 : 5 7 P M 20 the answer is not within the range I specify, so I quite often

2 : 5 7 P M 21 have larger uncertainty ranges than other engineers put

2 : 5 7 P M 22 forward.

2 : 5 7 P M 23 Q. Dr. Dykhuizen, do you know a BP employee named Trevor

2 : 5 7 P M 24 Hill?

2 : 5 7 P M 25 A. Yes. I met him on a number of occasions.

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 7 P M 1 Q. And who is Mr. Hill?

2 : 5 7 P M 2 A. Mr. Hill is obviously a senior engineer at BP. He came

2 : 5 7 P M 3 from England to help in the response, and I interacted with him

2 : 5 7 P M 4 in Houston a number of times.

2 : 5 7 P M 5 Q. And what did you discuss with him?

2 : 5 7 P M 6 A. Any of my calculations I would discuss with him. He was

2 : 5 7 P M 7 interested in all my calculations. He seemed particularly

2 : 5 7 P M 8 interested in the calculations that involved my estimate of the

2 : 5 7 P M 9 flow.

2 : 5 7 P M 10 MR. CERNICH: Could we go to TREN-6196.

2 : 5 7 P M 11 BY MR. CERNICH:

2 : 5 8 P M 12 Q. Have you seen this document before, Dr. Dykhuizen?

2 : 5 8 P M 13 A. Yes. I've reviewed this document.

2 : 5 8 P M 14 Q. Is this a PowerPoint presentation prepared by Mr. Hill

2 : 5 8 P M 15 dated August 17th, 2010?

2 : 5 8 P M 16 A. Yes, it is.

2 : 5 8 P M 17 MR. CERNICH: Could we go to call-out

2 : 5 8 P M 18 TREN-6196.4.1.US.

2 : 5 8 P M 19 BY MR. CERNICH:

2 : 5 8 P M 20 Q. And here in the presentation, Mr. Hill writes that -- it's

2 : 5 8 P M 21 titled "Estimate of Flow Rate on July 14/15." And the first

2 : 5 8 P M 22 bullet, "Information from preparation and execution of well

2 : 5 8 P M 23 integrity test may be used to estimate flow rate from MC 252 to

2 : 5 8 P M 24 GoM on July 14/15."

2 : 5 8 P M 25 Do you use information from the preparation and

RONALD DYKHUIZEN, PH.D. - DIRECT

2 : 5 8 P M 1 execution of the well integrity test to estimate the flow rate?

2 : 5 8 P M 2 A. Yes. That's exactly what I did in Method 1, 2, and 3.

2 : 5 9 P M 3 Q. And he writes: "The flow rate estimate may be made by

2 : 5 9 P M 4 prorating against different vessel collection rates and direct

2 : 5 9 P M 5 calculation by modeling of 3-ram stack piping."

2 : 5 9 P M 6 Is that what you did, Dr. Dykhuizen?

2 : 5 9 P M 7 A. Yes. The first one is the alternate method, and the

2 : 5 9 P M 8 bottom line is Methods 1 and 2.

2 : 5 9 P M 9 Q. Did you ever ask Trevor Hill whether BP had calculated

2 : 5 9 P M 10 flow rates through the capping stack?

2 : 5 9 P M 11 A. I assume that he had done that since it's a fairly simple

2 : 5 9 P M 12 calculation. He told me -- and I asked. He told me that that

2 : 5 9 P M 13 information was proprietary and he would not share it with me.

2 : 5 9 P M 14 Q. At any point during the response or otherwise, did BP

2 : 5 9 P M 15 share any of its capping stack flow rate estimates with you?

2 : 5 9 P M 16 A. No, I did not see any during the response.

2 : 5 9 P M 17 Q. Did you later have the opportunity to review any of BP's

2 : 5 9 P M 18 capping stack calculations?

2 : 5 9 P M 19 A. Yes. Since I've been contacted by Department of Justice,

2 : 5 9 P M 20 I've reviewed some.

2 : 5 9 P M 21 Q. Did you review capping stack calculations by BP engineers

2 : 5 9 P M 22 Farah Saidi and Adam Ballard?

3 : 0 0 P M 23 A. Yes, I reviewed those too.

3 : 0 0 P M 24 Q. Do you know Richard Lynch?

3 : 0 0 P M 25 A. He was a vice president of BP. I met him during the

RONALD DYKHUIZEN, PH.D. - DIRECT

3:00 PM 1 response.

3:00 PM 2 Q. Did you read his deposition testimony regarding BP's

3:00 PM 3 capping stack flow rate calculations?

3:00 PM 4 A. Yes, I did.

3:00 PM 5 MR. CERNICH: Could we go to D-21123, please.

3:00 PM 6 BY MR. CERNICH:

3:00 PM 7 Q. Does this demonstrative summarize the documents you

3:00 PM 8 reviewed?

3:00 PM 9 A. Yes, it summarizes these three documents.

3:00 PM 10 Q. And Mr. Lynch testified: "All I know is after the fact, I

3:00 PM 11 believe" -- I'm sorry, let me start over.

3:00 PM 12 "Answer: All I know is after the fact now, I would

3:00 PM 13 know that we -- somebody in the team -- team, I believe,

3:00 PM 14 calculated 56,000 barrels per day.

3:00 PM 15 "Question: Do you have any reason to doubt that

3:00 PM 16 calculation?

3:00 PM 17 "Answer: That's a pretty straight calculation. No,

3:00 PM 18 I don't."

3:00 PM 19 Did you review that testimony?

3:00 PM 20 A. Yes, I did.

3:00 PM 21 Q. And is the next -- the next estimate the one prepared by

3:00 PM 22 Ms. Saidi?

3:01 PM 23 A. Yes.

3:01 PM 24 Q. What did she calculate?

3:01 PM 25 A. She calculated 51,500 standard barrels a day.

RONALD DYKHUIZEN, PH.D. - DIRECT

3:01PM 1 Q. What did Dr. Ballard calculate?

3:01PM 2 A. He had two attempts at the alternate method, and they both

3:01PM 3 field numbers around 60,000 barrels of oil per day.

3:01PM 4 Q. All right. Did you read the depositions of these

3:01PM 5 individuals?

3:01PM 6 A. Yes, I did.

3:01PM 7 Q. Did BP ever inform you that they had verified the

3:01PM 8 Government capping stack flow rate predictions of 51 to

3:01PM 9 54,000 barrels per day?

3:01PM 10 A. No, BP did not inform me of that.

3:01PM 11 **MR. CERNICH:** Could I have TRES-11191, please.

3:01PM 12 And could I have the call-out 11191.1.US.

3:01PM 13 **BY MR. CERNICH:**

3:01PM 14 Q. Have you seen this document before?

3:01PM 15 A. Yes, I have.

3:01PM 16 Q. Is this a note reporting a calculation prepared by

3:01PM 17 Ms. Saidi?

3:01PM 18 **MR. REGAN:** Objection, Your Honor. I don't think the

3:01PM 19 witness has the foundation to say that.

3:01PM 20 **BY MR. CERNICH:**

3:01PM 21 Q. Dr. Dykhuizen, did you read the deposition of Trevor Hill?

3:01PM 22 A. Yes, I did.

3:01PM 23 Q. Was Mr. Hill questioned about this document in his

3:02PM 24 deposition?

3:02PM 25 A. Yes.

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 0 2 P M 1 Q. And what did he testify?

3 : 0 2 P M 2 A. He testified that this was a note from Farah Saidi saying

3 : 0 2 P M 3 that she had confirmed the government prediction which she

3 : 0 2 P M 4 represented as being 51 to 54,000 barrels of oil per day.

3 : 0 2 P M 5 Q. This says: "K-factor calculated based on 3-K method."

3 : 0 2 P M 6 Do you know what the 3-K method is?

3 : 0 2 P M 7 A. 3-K method is attempt to be a little more accurate than

3 : 0 2 P M 8 simply looking up values of K from tables. In this particular

3 : 0 2 P M 9 flow regime, the 3-K method would yield identical K-factors to

3 : 0 2 P M 10 what I used. The correction factors are nil for the conditions

3 : 0 2 P M 11 that we are looking at here.

3 : 0 2 P M 12 Q. And does the bottom of this note say, "Government

3 : 0 2 P M 13 prediction verified, 51 to 54 K"?

3 : 0 2 P M 14 A. Yes, it does.

3 : 0 2 P M 15 Q. Does any BP expert in this case propose an opposing

3 : 0 2 P M 16 capping stack flow rate calculation to yours?

3 : 0 2 P M 17 A. I have not seen an opposing capping stack calculation, no.

3 : 0 3 P M 18 Q. Dr. Dykhuizen, I'd like to move on to your Top Kill flow

3 : 0 3 P M 19 rate calculation. What was your Top Kill flow rate

3 : 0 3 P M 20 calculation?

3 : 0 3 P M 21 A. This calculation tried to estimate the flow coming from

3 : 0 3 P M 22 the well representative of the time period during Top Kill.

3 : 0 3 P M 23 Q. And what was that number?

3 : 0 3 P M 24 A. I obtained a number of over 60,000 barrels of oil per day.

3 : 0 3 P M 25 Q. Did you also calculate a lower bound estimate?

RONALD DYKHUIZEN, PH.D. - DIRECT

3:03 PM 1 A. Yes. I had to make a number of assumptions to get the
3:03 PM 2 over 60,000 barrels of oil per day, but I found that I could
3:03 PM 3 reformulate the equations in a conservative manner that would
3:03 PM 4 allow me not to make a number of assumptions and I calculate a
3:03 PM 5 hard lower bound of 43,000 barrels of oil per day as a lower
3:03 PM 6 bound.

3:03 PM 7 Q. Did you use pressure pumping data from Top Kill --
3:03 PM 8 pressure and pumping data from Top Kill to prepare that
3:03 PM 9 calculation?

3:03 PM 10 A. Yes, I did. That was provided to me from BP.

3:03 PM 11 Q. Did you prepare any demonstratives to assist in explaining
3:04 PM 12 your Top Kill calculation?

3:04 PM 13 A. Yes, I have.

3:04 PM 14 **MR. CERNICH:** Can we go to D-21117, please.

3:04 PM 15 **BY MR. CERNICH:**

3:04 PM 16 Q. Can you explain to Judge Barbier how you calculated a
3:04 PM 17 lower bound flow rate for the time of Top Kill?

3:04 PM 18 A. Yes, I can. This is a depiction of the BOP. We're
3:04 PM 19 injecting mud at the bottom, right on top of the test ram. The
3:04 PM 20 test ram is open during the process. And the mud was supposed
3:04 PM 21 to travel down the well and stop the well from flowing. The
3:04 PM 22 mud did not travel down the well. Top Kill was unsuccessful.

3:04 PM 23 During the time period of the accident, it was
3:04 PM 24 thought that maybe the mud traveled down the well a little bit
3:04 PM 25 and went out one of the burst disks. That was later discounted

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 0 4 P M 1 on inspection of the well, that mud did not flow in that path.

3 : 0 4 P M 2 And so I assumed all the mud, instead of going down
3 : 0 5 P M 3 the well, went up the well. That's a reasonable assumption
3 : 0 5 P M 4 because maybe initially some of the mud went down the well, but
3 : 0 5 P M 5 eventually everything steadied out and the BOP pressure gauge
3 : 0 5 P M 6 was giving a relatively constant reading. That implied the
3 : 0 5 P M 7 amount of mud in the well was either zero and nonchanging or a
3 : 0 5 P M 8 constant value and unchanging.

3 : 0 5 P M 9 So if the mud in the well is unchanging, all the mud
3 : 0 5 P M 10 has to be moving up. So with a known pump rate of the mud, I
3 : 0 5 P M 11 know how much mud is flowing up. I formulate some equations.
3 : 0 5 P M 12 I now know the resistance I can calculate of the BOP and the
3 : 0 5 P M 13 LMRP above because I know the pressure below or an estimate of
3 : 0 5 P M 14 the pressure based on the BOP pressure reading. I know the
3 : 0 5 P M 15 pressure at the top because I have -- I'm releasing to the sea.
3 : 0 6 P M 16 I can back out a resistance.

3 : 0 6 P M 17 I back out a very conservative resistance because I'm
3 : 0 6 P M 18 assuming the oil flow is zero. We did not achieve pressure
3 : 0 6 P M 19 significant enough to stop the well from flowing oil. That was
3 : 0 6 P M 20 determined because we didn't achieve pressures that were
3 : 0 6 P M 21 required to shut in the well. Those pressures were determined
3 : 0 6 P M 22 on the well integrity test, what pressures did we get when we
3 : 0 6 P M 23 shut in the well? So by assuming the oil flow is zero, I get a
3 : 0 6 P M 24 very conservative value for the resistance. Really, the flow
3 : 0 6 P M 25 was more than just mud. It had some oil flow also.

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 0 6 P M 1 So with this conservative value of the resistance, I
3 : 0 6 P M 2 then go to a time period when I'm not injecting mud, predict
3 : 0 6 P M 3 how much oil flow I have through the system, and then correct
3 : 0 6 P M 4 for closing the test ram, because the test ram was closed most
3 : 0 7 P M 5 of the time.

3 : 0 7 P M 6 And I can predict a conservative lower bound of
3 : 0 7 P M 7 43,000 standard barrels of oil per day.

3 : 0 7 P M 8 Q. Now, you used the PT-B pressure gauge that was down at the
3 : 0 7 P M 9 bottom of the BOP for this?

3 : 0 7 P M 10 A. Yes.

3 : 0 7 P M 11 Q. And you used the ambient seabed pressure in your
3 : 0 7 P M 12 calculations?

3 : 0 7 P M 13 A. Yes, I did.

3 : 0 7 P M 14 Q. And is what -- in your opinion, what is the likelihood
3 : 0 7 P M 15 that the flow rate was less than 43,000 barrels per day during
3 : 0 7 P M 16 the time of Top Kill?

3 : 0 7 P M 17 A. I don't think that the -- the probability it was less than
3 : 0 7 P M 18 43,000 is very small. This is a very hard lower bound that I
3 : 0 7 P M 19 have calculated based on a very conservative assumption.

3 : 0 7 P M 20 MR. CERNICH: Could we go to D-21118, please.

3 : 0 7 P M 21 BY MR. CERNICH:

3 : 0 7 P M 22 Q. And now could you explain to Judge Barbier your best
3 : 0 7 P M 23 estimate of the Top Kill flow rate?

3 : 0 7 P M 24 A. The best estimate is much more uncertain because now I
3 : 0 8 P M 25 have three things flowing in the well: I've got mud flowing, I

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 0 8 P M 1 have oil flowing, and I have gas flowing. I have to come up
3 : 0 8 P M 2 with properties, effective properties for a mixture of all
3 : 0 8 P M 3 three of those phases. I did that and documented it into my
3 : 0 8 P M 4 report.

3 : 0 8 P M 5 I came up with 60,000 standard barrels of oil per
3 : 0 8 P M 6 day -- actually, more than 60,000 standard barrels of oil per
3 : 0 8 P M 7 day. To get the solution with an iterative method, I guessed
3 : 0 8 P M 8 60, went around the loop and got 70, said, Well, that's close
3 : 0 8 P M 9 to my initial guess; I will quit. This procedure is not very
3 : 0 8 P M 10 accurate. Ideally, I guess 60, go around the loop, I would get
3 : 0 8 P M 11 60 back.

3 : 0 8 P M 12 So I probably could have -- maybe should have now
3 : 0 8 P M 13 guessed 65, gone around the loop and got 64, guessed 64 1/2,
3 : 0 8 P M 14 gone around the loop and got 64 1/2, and eventually converged.
3 : 0 8 P M 15 But since I knew this method was approximate, I didn't think
3 : 0 9 P M 16 that it justified that effort. So I just left it as more than
3 : 0 9 P M 17 60,000 barrels of oil per day.

3 : 0 9 P M 18 Q. Is your best estimate for the Top Kill period greater than
3 : 0 9 P M 19 60,000 barrels per day?

3 : 0 9 P M 20 A. Yes.

3 : 0 9 P M 21 Q. And was this similar to your alternate method that you
3 : 0 9 P M 22 used in the capping stack?

3 : 0 9 P M 23 A. Yes. The equations that I used here are very similar, if
3 : 0 9 P M 24 not identical, to the alternate method, yes.

3 : 0 9 P M 25 Q. And are they similar to the equations and formulas that

RONALD DYKHUIZEN, PH.D. - DIRECT

3:09 PM 1 Dr. Ballard used in his capping stack calculations?

3:09 PM 2 A. Yes. He used the same set of equations, except he was

3:09 PM 3 only applying it to the capping stack. He didn't apply it to

3:09 PM 4 the BOP during the Top Kill period.

3:09 PM 5 Q. Were flow rates before and after Top Kill approximately

3:09 PM 6 the same as your Top Kill best estimate?

3:09 PM 7 A. Yes, it was.

3:09 PM 8 Q. And what is the basis for that opinion?

3:09 PM 9 A. You can look at the BOP pressure gauge at the bottom of

3:09 PM 10 the BOP and see that that pressure gauge yielded a consistent

3:10 PM 11 value for time periods before and after the Top Kill event.

3:10 PM 12 **MR. CERNICH:** Could we go to TREN-5066, please.

3:10 PM 13 **BY MR. CERNICH:**

3:10 PM 14 Q. Have you seen this document before, Dr. Dykhuizen?

3:10 PM 15 A. Yes, I have.

3:10 PM 16 **MR. CERNICH:** Could we go to TREN-5066.1.1.US.

3:10 PM 17 **BY MR. CERNICH:**

3:10 PM 18 Q. This is an e-mail from Paul Tooms, dated June 11, 2010.

3:10 PM 19 Do you know Mr. Tooms?

3:10 PM 20 A. Yes, I met Mr. Tooms a number of times. He seemed to be

3:10 PM 21 leading all the engineers at Houston and in the response.

3:10 PM 22 **MR. CERNICH:** And it's to a number of BP employees,

3:10 PM 23 including James Dupree, Your Honor, who testified last week

3:10 PM 24 during the source control part of this case.

3:10 PM 25 **BY MR. CERNICH:**

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 10 PM 1 Q. The subject is "Historical BOP Pressure," and there's an
3 : 10 PM 2 attachment, "BOP Pressure History."
3 : 10 PM 3 Did I read that correctly?
3 : 10 PM 4 A. Yes.
3 : 10 PM 5 Q. Did you review the attachments to this document as well?
3 : 10 PM 6 A. Yes, I did.
3 : 10 PM 7 MR. CERNICH: Could we go to 5066.1.2.US.
3 : 11 PM 8 BY MR. CERNICH:
3 : 11 PM 9 Q. And Mr. Tooms writes here: "Attached is a chart showing
3 : 11 PM 10 BOP pressure over time."
3 : 11 PM 11 He says: "A number of points can be taken from the
3 : 11 PM 12 graphs, including, No. 1, pressures above and across the BOP
3 : 11 PM 13 with test rams closed are broadly the same now as they were
3 : 11 PM 14 prior to Top Kill. This suggests that overall flow rates have
3 : 11 PM 15 not changed much, unless there is some unexplained mechanism in
3 : 11 PM 16 the well."
3 : 11 PM 17 Did I read that correctly?
3 : 11 PM 18 A. Yes, you did.
3 : 11 PM 19 Q. Are you and Mr. Tooms in agreement that the pressure
3 : 11 PM 20 suggests that overall flow rates have not changed much before
3 : 11 PM 21 and after Top Kill?
3 : 11 PM 22 A. Yes.
3 : 11 PM 23 MR. CERNICH: Can we go to 5066.3.1.US.
3 : 11 PM 24 BY MR. CERNICH:
3 : 11 PM 25 Q. What is this chart, Dr. Dykhuizen?

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 11 PM 1 A. This is from the attachment. This is a chart. If we just
3 : 11 PM 2 look at the top, it's showing BOP pressure with changes on a
3 : 11 PM 3 number of days. These three low values are obtained with the
3 : 12 PM 4 test ram open because we needed the test ram open when we were
3 : 12 PM 5 performing the three different phases of Top Kill. So that
3 : 12 PM 6 represents a reduction in the resistance of the BOP because we
3 : 12 PM 7 opened one of the valves.

3 : 12 PM 8 But if we ignore those and just look at the rest of
3 : 12 PM 9 them, we see a generally decreasing pressure with time that's
3 : 12 PM 10 consistent with the conditions aren't changing much and also
3 : 12 PM 11 consistent with the general observation that the reservoir is
3 : 12 PM 12 depleting and the flow is slowly reducing with time over this
3 : 12 PM 13 time period.

3 : 12 PM 14 But, in general, the flow rate after and the flow
3 : 12 PM 15 rate before are the same.

3 : 12 PM 16 Q. Did BP engineer Tim Lockett perform modeling of the Top
3 : 12 PM 17 Kill after the Top Kill?

3 : 12 PM 18 A. Yes. He performed modeling based on different modeling
3 : 13 PM 19 than mine, but, yes.

3 : 13 PM 20 Q. Did he use OLGA to do that modeling?

3 : 13 PM 21 A. Yes, he used OLGA to do that modeling.

3 : 13 PM 22 Q. What's OLGA?

3 : 13 PM 23 A. OLGA is an industry standard code for calculating pressure
3 : 13 PM 24 drop for oil flow through piping systems, and they simulated
3 : 13 PM 25 the well as a piping system, which is a logical use of OLGA.

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 13 PM 1 Q. Did you read Dr. Lockett's deposition?

3 : 13 PM 2 A. Yes, I did.

3 : 13 PM 3 MR. CERNICH: Can we go to TRES-9452.

3 : 13 PM 4 BY MR. CERNICH:

3 : 13 PM 5 Q. Have you seen this document, Dr. Dykhuizen?

3 : 13 PM 6 A. Yes, I have.

3 : 13 PM 7 MR. CERNICH: Go to 94512.1.1.US.

3 : 13 PM 8 BY MR. CERNICH:

3 : 13 PM 9 Q. Is this Dr. Lockett's modeling?

3 : 13 PM 10 A. Yes. This is an e-mail discussing Dr. Lockett's modeling

3 : 13 PM 11 of Top Kill.

3 : 13 PM 12 Q. This is dated June 29th, 2010, from Tim Lockett to Trevor

3 : 13 PM 13 Hill, who we already discussed.

3 : 13 PM 14 "Trevor, I've now looked at Top Kill No. 1 and 2

3 : 14 PM 15 using the same resistance and well PI as are needed to get a

3 : 14 PM 16 first pass 'reasonable' match to Top Kill No. 3... Attached is

3 : 14 PM 17 my previous write-up extended with these latest results."

3 : 14 PM 18 Did I read that correctory?

3 : 14 PM 19 A. Yes.

3 : 14 PM 20 MR. CERNICH: Can we go to TRES-9452.2.1.US.

3 : 14 PM 21 BY MR. CERNICH:

3 : 14 PM 22 Q. And this lists data.

3 : 14 PM 23 Dr. Dykhuizen, did you also use some of this data for

3 : 14 PM 24 your Top Kill calculation?

3 : 14 PM 25 A. I just used Top Kill 3 data, which was the third attempt

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 14 PM 1 at Top Kill, yes.

3 : 14 PM 2 Q. Do you recall what Dr. Lockett concluded was the flow rate
3 : 14 PM 3 range during the Top Kill?

3 : 14 PM 4 A. He concluded between 44,000 and 77,000 barrels of oil per
3 : 14 PM 5 day.

3 : 14 PM 6 Q. Do you know whether the rates he calculated were with the
3 : 14 PM 7 test rams opened or closed?

3 : 14 PM 8 A. I understood his were based with the test ram open.
3 : 15 PM 9 Therefore, they aren't completely consistent with mine. We
3 : 15 PM 10 should reduce his numbers by approximately 10 percent to be
3 : 15 PM 11 consistent with mine.

3 : 15 PM 12 MR. CERNICH: Could we go to 9452.9.1.US.

3 : 15 PM 13 BY MR. CERNICH:

3 : 15 PM 14 Q. Did Dr. Lockett write, "The implication is that the flow
3 : 15 PM 15 rate from the well is now probably in the range of 44,000 to
3 : 15 PM 16 77,000 stbl per day"?

3 : 15 PM 17 A. Yes, he wrote that.

3 : 15 PM 18 Q. Does BP's expert, Dr. Johnson, criticize your Top Kill
3 : 15 PM 19 flow rate calculations?

3 : 15 PM 20 A. Yes. He has a number of criticisms of my Top Kill
3 : 15 PM 21 calculations.

3 : 15 PM 22 Q. Now, Dr. Johnson contends that you didn't account for
3 : 15 PM 23 erosion. How do you respond to that?

3 : 15 PM 24 A. I assumed erosion was small during the Top Kill event, and
3 : 15 PM 25 if any erosion occurred, it was counterbalanced by extra

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 16 PM 1 resistance added by the junk.

3 : 16 PM 2 Q. He also said that you didn't consider the density of the

3 : 16 PM 3 Junk Shot. How do you respond to that?

3 : 16 PM 4 A. That didn't seem to be a reasonable concern. The junk was

3 : 16 PM 5 injected very early in the Top Kill, not during the time

3 : 16 PM 6 periods that I chose to analyze. Therefore, the junk was not

3 : 16 PM 7 flowing during the time period that I analyzed, so it shouldn't

3 : 16 PM 8 impact the flowing density that I used.

3 : 16 PM 9 Q. Now, he also argues that you should have analyzed other

3 : 16 PM 10 Top Kill periods. How do you respond to that?

3 : 16 PM 11 A. I could analyze other Top Kill periods. He chose to do

3 : 16 PM 12 that using my model, which I assume it means he accepts my

3 : 16 PM 13 model. And he did it for Top Kill 1, I think. And he followed

3 : 16 PM 14 my procedure and logically got a lower lower bound. I have no

3 : 16 PM 15 problem with that. A lower lower bound is not of interest.

3 : 17 PM 16 To say that my age is -- has a lower bound of 50

3 : 17 PM 17 gives people some information. To say that my age has a lower

3 : 17 PM 18 bound of 10 is equally correct but doesn't give anybody enough

3 : 17 PM 19 information -- or as much information as a lower bound of my

3 : 17 PM 20 age is 50.

3 : 17 PM 21 Q. So does a higher lower bound give you more information?

3 : 17 PM 22 A. Yes. A higher lower bound is something that an engineer

3 : 17 PM 23 would desire to get.

3 : 17 PM 24 Q. Now, Dr. Dykhuizen, I'd like to move on to your Top Hat

3 : 17 PM 25 calculations. Could -- what flow rates did you calculate using

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 17 PM 1 Top Hat 4?

3 : 17 PM 2 A. I calculated, when Top Hat 4 was installed on the well, a
3 : 17 PM 3 flow rate of approximately 60,000 barrels of oil per day.

3 : 17 PM 4 Q. The Court has already seen some images of Top Hat 4, so
3 : 17 PM 5 we'll skip the additional images right now.

3 : 18 PM 6 How long was the Top Hat installed on the well?

3 : 18 PM 7 A. A month and 10 days or a month and a half, somewhere along
3 : 18 PM 8 that line.

3 : 18 PM 9 Q. And did you calculate flow rates using Top Hat 4 during
3 : 18 PM 10 the response?

3 : 18 PM 11 A. Yes. During the response, this was really our first
3 : 18 PM 12 indication, based on our own calculations, that the well was
3 : 18 PM 13 flowing a significant amount.

3 : 18 PM 14 Q. And when did you do those calculations?

3 : 18 PM 15 A. We did it as soon as the pressure gauge was installed on
3 : 18 PM 16 the Top Hat 4. Top Hat 4 was initially installed without a
3 : 18 PM 17 pressure gauge. So we needed pressure measurements to do that
3 : 18 PM 18 calculation.

3 : 18 PM 19 Q. Did you share those calculations with BP in June of 2010?

3 : 18 PM 20 A. Yes, I did.

3 : 18 PM 21 Q. Did anyone from BP express disagreement with your
3 : 18 PM 22 calculations at that time?

3 : 18 PM 23 A. No, not to me; and none was relayed to me if they
3 : 18 PM 24 expressed it to other people.

3 : 18 PM 25 Q. And did you perform additional Top Hat 4 flow rate

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 18 PM 1 calculations as part of your expert work in this case?

3 : 18 PM 2 A. Yes. I tried to reproduce the calculations in a more
3 : 19 PM 3 conservative manner, so that they would be more defensible.

3 : 19 PM 4 Q. And how did you do it in a more conservative manner?

3 : 19 PM 5 A. Well, the original calculations were based on a visual
3 : 19 PM 6 reading of a pressure gauge. The pressure gauge was known to
3 : 19 PM 7 be inaccurate, and we had to read it based on putting a camera
3 : 19 PM 8 on it and reading the gauge.

3 : 19 PM 9 Now, whether the camera was looking straight on to
3 : 19 PM 10 the gauge or with an angle, that would always give people
3 : 19 PM 11 uncertainty.

3 : 19 PM 12 So I was able to find a lower limit of the pressure
3 : 19 PM 13 based on the procedures that were used when Top Hat 4 was
3 : 19 PM 14 installed.

3 : 19 PM 15 Q. What do you mean by "the procedures"?

3 : 19 PM 16 A. Well, it was -- Top Hat was installed with a rubber skirt
3 : 19 PM 17 around the bottom and it was supposed to seal against the well.
3 : 20 PM 18 The skirt did not seal against the well. It was damaged while
3 : 20 PM 19 it was installed. So we were very concerned that we didn't
3 : 20 PM 20 want to suck water into the Top Hat. Because if we sucked
3 : 20 PM 21 water in, we might form hydrates and the hydrates might clog
3 : 20 PM 22 the system and make the Top Hat useless.

3 : 20 PM 23 So to keep water from sucking in, the BP engineers
3 : 20 PM 24 were required to make sure that the pressure underneath the
3 : 20 PM 25 Top Hat was sufficient; not water, oil, and gas was always

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 0 P M 1 flowing out. And so they had the ability to adjust the
3 : 2 0 P M 2 pressure in the Top Hat by closing valves on the top to make
3 : 2 0 P M 3 sure that oil and gas was always flowing out.

3 : 2 0 P M 4 Well, I calculated what pressure that had to be to
3 : 2 0 P M 5 make sure that oil and gas was always flowing out. I think
3 : 2 0 P M 6 that pressure ended up to be about 1.1 psi. Not very large,
3 : 2 1 P M 7 but just enough pressure to make sure that oil was always
3 : 2 1 P M 8 flowing out.

3 : 2 1 P M 9 As a matter of fact, at that pressure, zero oil would
3 : 2 1 P M 10 be flowing out, but at least we wouldn't have water flowing in.
3 : 2 1 P M 11 So that gave me a minimum value of the pressure in the Top Hat
3 : 2 1 P M 12 that I could use to calculate flow out the vents in the top of
3 : 2 1 P M 13 the Top Hat.

3 : 2 1 P M 14 Q. And is that pressure lower than the pressure you used for
3 : 2 1 P M 15 your Top Hat 4 calculations in 2010?

3 : 2 1 P M 16 A. Yes. I used the measured value, which is approximately
3 : 2 1 P M 17 2 psi, and now I'm using 1.1 psi to force the oil out the
3 : 2 1 P M 18 vents, which gives me a lower estimate and a more defensible
3 : 2 1 P M 19 estimate. I don't have to make assumptions about how accurate
3 : 2 1 P M 20 the gauge is.

3 : 2 1 P M 21 MR. CERNICH: Could we go to D-21109.

3 : 2 1 P M 22 BY MR. CERNICH:

3 : 2 1 P M 23 Q. Can you explain your lower bound estimate in light of the
3 : 2 1 P M 24 discussion you've already given to the judge about the pressure
3 : 2 2 P M 25 gauge -- could you explain this?

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 2 P M 1 A. Okay. Here is a depiction of the Top Hat. It didn't fit
3 : 2 2 P M 2 on very well, so it was cocked. This rubber seal was supposed
3 : 2 2 P M 3 to go around this flange and it didn't fit very well and it
3 : 2 2 P M 4 broke upon installation.

3 : 2 2 P M 5 We're collecting oil up the top. I have a
3 : 2 2 P M 6 measurement of that given to me from BP. So I know that fairly
3 : 2 2 P M 7 certainly. Certain with -- with low uncertainty. We have flow
3 : 2 2 P M 8 going out three of these vents. The fourth one was closed.
3 : 2 2 P M 9 They closed this many to make sure that we had oil leaking out
3 : 2 2 P M 10 the bottom. So with my internal pressure, the flow is driven
3 : 2 2 P M 11 by this internal pressure of 1.1 psi and also driven by the
3 : 2 2 P M 12 fact that the oil is lighter and wants to escape. So we have a
3 : 2 3 P M 13 buoyancy force. I calculate a lower bound of 18,000 barrels of
3 : 2 3 P M 14 oil per day coming out the three vents.

3 : 2 3 P M 15 Then I also know that, on the last day, they
3 : 2 3 P M 16 collected approximately 25,000 barrels of oil per day. Or at
3 : 2 3 P M 17 least for a period of a few hours, they were collecting that
3 : 2 3 P M 18 much.

3 : 2 3 P M 19 So they're collecting that much. We have 18,000
3 : 2 3 P M 20 going out the three vents. I add those two together, I get
3 : 2 3 P M 21 43,000, which assigns zero flow out the skirt, which leads me
3 : 2 3 P M 22 to believe this is a very good lower limit that I can use.

3 : 2 3 P M 23 Now, since this 25,000 was on the last day, in my
3 : 2 3 P M 24 view, the flow of oil is decreasing with time, due to depletion
3 : 2 3 P M 25 of reservoir. Any lower bound I can establish on the last day

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 3 P M 1 must be a lower bound on previous days. And so I can use this
3 : 2 4 P M 2 lower bound on any day, and 43,000 seems -- is my lower bound.
3 : 2 4 P M 3 Q. Is your -- in your opinion, is there any likelihood that
3 : 2 4 P M 4 the flow rate was below 43,000 barrels per day through the
3 : 2 4 P M 5 Top Hat?
3 : 2 4 P M 6 A. No, I think there was a very small probability of below
3 : 2 4 P M 7 43,000 barrels per day. This is a reasonable hard lower bound.
3 : 2 4 P M 8 MR. CERNICH: Could we go to D-21110?
3 : 2 4 P M 9 BY MR. CERNICH:
3 : 2 4 P M 10 Q. How did you arrive at your best estimate?
3 : 2 4 P M 11 A. The best estimate, I needed to add some to the skirt. I
3 : 2 4 P M 12 can also add some because my flow is -- out the vents is a
3 : 2 4 P M 13 lower bound. I could increase that some. We know we are
3 : 2 4 P M 14 collecting what we're collecting. But I did the flow of the
3 : 2 5 P M 15 skirt in a different method.
3 : 2 5 P M 16 We know that the collection changed suddenly by 10-
3 : 2 5 P M 17 or 15,000 barrels of oil per day at different time periods, and
3 : 2 5 P M 18 we're observing that. As a matter of fact, we had video that
3 : 2 5 P M 19 we looked at. So we've looked at the skirt flow coming out
3 : 2 5 P M 20 when we had a significant amount of collection, and then we
3 : 2 5 P M 21 looked at the skirt flow an hour later or a few minutes later
3 : 2 5 P M 22 after the collection stopped.
3 : 2 5 P M 23 And we said, gee, we can't tell the difference
3 : 2 5 P M 24 between when the collection is going and when the collection
3 : 2 5 P M 25 stops. It seems to be about the same. That tells me that the

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 5 P M 1 flow coming out the skirt must be at least in the order of
3 : 2 5 P M 2 20,000 or 10- or 15,000 barrels per day, because if we can't
3 : 2 5 P M 3 see a change, then the change must be small compared to the
3 : 2 6 P M 4 flow coming out.

3 : 2 6 P M 5 So I assigned 20,000 as a round number for the flow
3 : 2 6 P M 6 out the skirt. We add the 20,000 to the 43,000, and we get
3 : 2 6 P M 7 60,000. Since 20,000's a round number, I can round the 43,000
3 : 2 6 P M 8 to 40.

3 : 2 6 P M 9 Q. Thank you, Dr. Dykhuizen.

3 : 2 6 P M 10 BP expert Dr. Johnson criticized your calculations;
3 : 2 6 P M 11 is that correct?

3 : 2 6 P M 12 A. Yes. He criticized these calculations, also.

3 : 2 6 P M 13 Q. And he criticized the K-factor for the skirt and he
3 : 2 6 P M 14 contended that the vent and skirt flows could not be treated
3 : 2 6 P M 15 independently. How do you respond?

3 : 2 6 P M 16 A. He didn't like the K-factor that I assigned in my original
3 : 2 6 P M 17 calculation of the skirt, and he said, due to the fact that I
3 : 2 6 P M 18 was using the wrong K-factor, I was off by two or three orders
3 : 2 7 P M 19 of magnitude in flow. In other words, the flow should have
3 : 2 7 P M 20 been a factor of 100 or 1,000 less than I predicted.

3 : 2 7 P M 21 I thought that was ridiculous. It didn't make any
3 : 2 7 P M 22 sense whatsoever. I responded in my rebuttal four or five
3 : 2 7 P M 23 different ways why I was right and he was wrong.

3 : 2 7 P M 24 He since came back in his deposition and conceded
3 : 2 7 P M 25 that I was right and calculated flows and presented in a

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 7 P M 1 produced document that were very similar to mine. He also
3 : 2 7 P M 2 calculated the flows independently out the skirt and the vent,
3 : 2 7 P M 3 which was the same way that I calculated it. So I assume he
3 : 2 7 P M 4 took back his criticism that I could calculate those
3 : 2 7 P M 5 independently.

3 : 2 7 P M 6 Q. Dr. Dykhuizen, now I'd like to move on to your cumulative
3 : 2 7 P M 7 or integrated estimate. What is that estimate?

3 : 2 7 P M 8 A. I estimate that there's 5 million barrels of oil that came
3 : 2 8 P M 9 out of the reservoir.

3 : 2 8 P M 10 Q. When did you first prepare an integrated flow estimate?

3 : 2 8 P M 11 A. That was first prepared with Dr. Ratzell for the NNSA
3 : 2 8 P M 12 report.

3 : 2 8 P M 13 Q. And what was your estimate then?

3 : 2 8 P M 14 A. The estimate then was presented as 4.9 million barrels of
3 : 2 8 P M 15 oil.

3 : 2 8 P M 16 Q. Since then, did you consider the effects of temperature
3 : 2 8 P M 17 and the final reservoir pressure on your calculation?

3 : 2 8 P M 18 A. Yes. The temperature has the same effect on the
3 : 2 8 P M 19 integrated calculation as it does on the flow of the last day,
3 : 2 8 P M 20 a 2 percent change in temperature for every 20 degrees rise --
3 : 2 8 P M 21 2 percent change in the flow rate for every 20 degrees rise in
3 : 2 8 P M 22 temperature.

3 : 2 8 P M 23 Q. And what about the final average reservoir pressure?

3 : 2 8 P M 24 A. I looked at that also. There was some concern that the
3 : 2 8 P M 25 final reservoir pressure was used incorrectly. This was

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 2 9 P M 1 identified in the NNSA report, that a change from 10,050 to
3 : 2 9 P M 2 10,600 resulted in approximately 3 percent change or a
3 : 2 9 P M 3 3 percent reduction in the flow from the reservoir.

3 : 2 9 P M 4 MR. CERNICH: Can we go to D-21119, please.

3 : 2 9 P M 5 BY MR. CERNICH:

3 : 2 9 P M 6 Q. Dr. Dykhuizen, does this demonstrative summarize the
3 : 2 9 P M 7 components of your cumulative estimate?

3 : 2 9 P M 8 A. Yes, it does. We're showing here how the flow changes due
3 : 2 9 P M 9 to the decreasing reservoir pressure. We have decreasing flow
3 : 2 9 P M 10 versus time. To account for erosion, which I think was very
3 : 2 9 P M 11 rapid initially and tails off, I assigned the first two days of
3 : 2 9 P M 12 zero flow. We have a time period from the end of July where
3 : 3 0 P M 13 the flow is reduced, because when we put the capping stack on,
3 : 3 0 P M 14 that adds extra resistance and reduces the flow.

3 : 3 0 P M 15 And we have a time period in June where the flow
3 : 3 0 P M 16 increases, because when we cut off the riser, we have less
3 : 3 0 P M 17 restriction and the flow increases.

3 : 3 0 P M 18 Q. Did you do a calculation for the riser cut-off?

3 : 3 0 P M 19 A. Yes. I did that at the time of the response and redid
3 : 3 0 P M 20 that later on and said that the riser cutoff would be, at most,
3 : 3 0 P M 21 a 4 percent change in flow.

3 : 3 0 P M 22 Q. Did you share that calculation with BP?

3 : 3 0 P M 23 A. Yes, I did.

3 : 3 0 P M 24 Q. And did BP agree with you?

3 : 3 0 P M 25 A. They didn't disagree with me, but I did not see their

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 0 P M 1 calculations either. They seemed to accept it.

3 : 3 0 P M 2 Q. How did you account for erosion in your calculation?

3 : 3 0 P M 3 A. Erosion is difficult to estimate. I think Dr. Stewart

3 : 3 1 P M 4 Griffiths has a very interesting model that he shows that

3 : 3 1 P M 5 erosion is negligible based on BOP pressure measurements.

3 : 3 1 P M 6 However, the BOP pressure measurements started May 8th, so it's

3 : 3 1 P M 7 difficult for me to extract before May 8th. So I assigned zero

3 : 3 1 P M 8 flow for the first two days. You could potentially assign

3 : 3 1 P M 9 half flow for four days or a third flow for six days. That's

3 : 3 1 P M 10 essentially the same. But that's my -- a proxy for erosion.

3 : 3 1 P M 11 We know we didn't have zero flow for the first two days.

3 : 3 1 P M 12 Q. Do you believe that erosion happened quickly?

3 : 3 1 P M 13 A. Yes, I think erosion happens quickly. We have the

3 : 3 1 P M 14 smallest channels in the BOP the first few days. We,

3 : 3 1 P M 15 therefore, have the highest velocities and, most importantly,

3 : 3 1 P M 16 the highest change in velocities in the BOP in the first few

3 : 3 2 P M 17 days.

3 : 3 2 P M 18 I've been told by reservoir engineers that the sand

3 : 3 2 P M 19 production of the well is very high, especially if the well

3 : 3 2 P M 20 starts flowing rapidly, as this well seemed to do.

3 : 3 2 P M 21 Q. Were those BP reservoir engineers?

3 : 3 2 P M 22 A. Yes. BP reservoir engineers told me that, and we were

3 : 3 2 P M 23 discussing that because, when we put on the capping stack and

3 : 3 2 P M 24 we closed it for a number of days, there was a possibility that

3 : 3 2 P M 25 we would have to open the well. And they wanted to make sure

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 2 PM 1 that we were -- the government agreed with opening the well
3 : 3 2 PM 2 very gradually to limit sand production. So they wanted to
3 : 3 2 PM 3 open the well gradually if we ever had to.

3 : 3 2 PM 4 Q. Were they concerned that opening the well quickly would
3 : 3 2 PM 5 result in more sand production?

3 : 3 2 PM 6 A. That was what --

3 : 3 2 PM 7 MR. REGAN: Objection.

3 : 3 2 PM 8 Pardon me, Dr. Dykhuizen.

3 : 3 2 PM 9 Your Honor, the question now is asking
3 : 3 2 PM 10 Dr. Dykhuizen to articulate the concerns of unnamed people
3 : 3 2 PM 11 about some conversation at an unnamed time. I think we're
3 : 3 3 PM 12 getting a little far from being able to even tell if it's
3 : 3 3 PM 13 relevant.

3 : 3 3 PM 14 THE COURT: Are you referring to your conversations
3 : 3 3 PM 15 with BP -- I see a reference to "BP reservoir engineers."

3 : 3 3 PM 16 THE WITNESS: Yes.

3 : 3 3 PM 17 THE COURT: That's who you're talking about?

3 : 3 3 PM 18 THE WITNESS: Yes.

3 : 3 3 PM 19 THE COURT: These are the conversations?

3 : 3 3 PM 20 THE WITNESS: Yes. These were done during the well
3 : 3 3 PM 21 integrity where we had meetings with the government and BP.

3 : 3 3 PM 22 THE COURT: When you said, "They wanted to open the
3 : 3 3 PM 23 well," were they concerned that opening the well quickly would
3 : 3 3 PM 24 result in more sand production -- you're talking about the BP
3 : 3 3 PM 25 reservoir engineers?

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 3 P M 1 THE WITNESS: Yes.

3 : 3 3 P M 2 THE COURT: Okay. Overrule the objection.

3 : 3 3 P M 3 MR. CERNICH: Thank you, Your Honor. I'll try to ask

3 : 3 3 P M 4 better questions.

3 : 3 3 P M 5 THE COURT: Okay.

3 : 3 3 P M 6 BY MR. CERNICH:

3 : 3 3 P M 7 Q. Now, did you testify at your deposition that you ascribed

3 : 3 3 P M 8 a 30 percent uncertainty to your integrated estimate?

3 : 3 3 P M 9 A. Yes, I did.

3 : 3 3 P M 10 Q. Is the cumulative oil discharge as likely to be 30 percent

3 : 3 3 P M 11 greater as it is to be 30 percent less than 5 million barrels?

3 : 3 4 P M 12 A. This one, I don't think is symmetric. I think the

3 : 3 4 P M 13 20 percent greater is probably as far as we can go.

3 : 3 4 P M 14 There are some -- the flow at the last day, I

3 : 3 4 P M 15 assigned a 20 percent -- could be 20 percent greater or

3 : 3 4 P M 16 20 percent less. If I make the flow on the last day 20 percent

3 : 3 4 P M 17 greater, the integral gets to be 20 percent greater.

3 : 3 4 P M 18 But here, we have to worry about a number of things,

3 : 3 4 P M 19 some big and some small. But the biggest one is erosion. And

3 : 3 4 P M 20 erosion only happens in one direction. And so if we account

3 : 3 4 P M 21 for erosion, it's only going to decrease my integral. And

3 : 3 4 P M 22 that's why I have an unsymmetric error bar.

3 : 3 4 P M 23 Q. Does that uncertainty range you described encompass all of

3 : 3 4 P M 24 your uncertainty?

3 : 3 4 P M 25 A. Yes, it does.

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 4 P M 1 Q. And you mentioned if your flow rate is 20 percent higher.
3 : 3 5 P M 2 If the capping stack flow rate is 20 percent higher, does that
3 : 3 5 P M 3 mean the cumulative estimate is also 20 percent higher?
3 : 3 5 P M 4 A. Yes.
3 : 3 5 P M 5 Q. Do you believe your 5-million-barrel estimate is reliable?
3 : 3 5 P M 6 A. Yes, I do.
3 : 3 5 P M 7 Q. Now, we've talked about your uncertainty. Do you apply
3 : 3 5 P M 8 the same uncertainty to other U.S. experts in this case?
3 : 3 5 P M 9 A. I think the other experts know their own models better
3 : 3 5 P M 10 than I do and can apply their own uncertainties to their own
3 : 3 5 P M 11 models. That seems to be a fair way.
3 : 3 5 P M 12 Q. Now, do you know Dr. Griffiths, who's another U.S. expert
3 : 3 5 P M 13 in this case?
3 : 3 5 P M 14 A. Yes. I met Dr. Griffiths 30 years ago and have very --
3 : 3 5 P M 15 fairly infrequent contact him. But recently, he started
3 : 3 5 P M 16 helping in the response on the last few days and I had more
3 : 3 5 P M 17 regular contact with him at the end of July -- June -- end of
3 : 3 6 P M 18 June and through July and August.
3 : 3 6 P M 19 Q. Of 2010?
3 : 3 6 P M 20 A. Of 2010, yes.
3 : 3 6 P M 21 Q. And Dr. Griffiths was also employed at Sandia?
3 : 3 6 P M 22 A. Dr. Griffiths was employed at Sandia originally at the
3 : 3 6 P M 23 site where I was. But before I arrived at Sandia, he moved to
3 : 3 6 P M 24 a separate site a thousand miles away. That's why I don't
3 : 3 6 P M 25 interact with him very often.

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 6 P M 1 Q. Did you review any of Dr. Griffiths' flow estimates in
3 : 3 6 P M 2 2010?

3 : 3 6 P M 3 A. Yes.

3 : 3 6 P M 4 Q. Did you have criticisms of those estimates?

3 : 3 6 P M 5 A. I had a lot of criticisms of his report. I did not think
3 : 3 6 P M 6 his report was very clear, and I tried to get him to explain to
3 : 3 6 P M 7 me his model in greater detail so I could have greater
3 : 3 6 P M 8 confidence in his result.

3 : 3 6 P M 9 Q. Have you since read Dr. Griffiths' peer-reviewed article
3 : 3 6 P M 10 in his expert report?

3 : 3 6 P M 11 A. Yes, I have.

3 : 3 7 P M 12 Q. Do you still have those criticisms?

3 : 3 7 P M 13 A. No. He addressed my criticisms very well. Some of those
3 : 3 7 P M 14 were due to the fact that I didn't understand his model, and
3 : 3 7 P M 15 some of those may have been justified and he expanded his work
3 : 3 7 P M 16 to include my criticisms.

3 : 3 7 P M 17 Q. And what do you think of his work now?

3 : 3 7 P M 18 A. I think his work is an excellent piece of work.

3 : 3 7 P M 19 **MR. CERNICH:** Thank you, Dr. Dykhuizen.

3 : 3 7 P M 20 Your Honor, we're getting close to wrapping up
3 : 3 7 P M 21 here. We're moving on to the rebuttal portion of
3 : 3 7 P M 22 Dr. Dykhuizen's testimony.

3 : 3 7 P M 23 **BY MR. CERNICH:**

3 : 3 7 P M 24 Q. I would like to cover your responses to the BP experts.

3 : 3 7 P M 25 **THE COURT:** How much longer are you going to be?

RONALD DYKHUIZEN, PH.D. - DIRECT

3 : 3 7 P M 1 MR. CERNICH: I would probably say 30 minutes, Your
3 : 3 7 P M 2 Honor.

3 : 3 7 P M 3 THE COURT: Let's go ahead and take a 15-minute
3 : 3 7 P M 4 recess. It's about 3:35, 37, something like that.

3 : 3 7 P M 5 THE DEPUTY CLERK: All rise.

3 : 4 5 P M 6 (WHEREUPON, the Court took a recess.)

3 : 5 9 P M 7 THE DEPUTY CLERK: All rise.

3 : 5 9 P M 8 THE COURT: All right. Please be seated, everyone.
3 : 5 9 P M 9 Mr. Cernich, you may resume.

3 : 5 9 P M 10 MR. CERNICH: Thank you, Your Honor.

3 : 5 9 P M 11 BY MR. CERNICH:

3 : 5 9 P M 12 Q. One more question to finish up your cumulative estimate,
3 : 5 9 P M 13 Dr. Dykhuizen. You talked about -- you testified to the
3 : 5 9 P M 14 concept of a bell curve regarding your capping stack
3 : 5 9 P M 15 calculations.

3 : 5 9 P M 16 Does the same concept apply to your cumulative
3 : 5 9 P M 17 estimate?

3 : 5 9 P M 18 A. Yes, it does. I expect that the 5 million barrels of oil
3 : 5 9 P M 19 total is the best estimate. Now, I just have a skewed bell
3 : 5 9 P M 20 because it only goes 20 percent up and 30 percent down. The
4 : 0 0 P M 21 probability of being 20 percent up is small, and the
4 : 0 0 P M 22 probability of being 30 percent down is small.

4 : 0 0 P M 23 Q. Now, moving on to your rebuttal of BP's experts. You
4 : 0 0 P M 24 write in your report that BP experts Johnson, Momber, and Nesic
4 : 0 0 P M 25 are incorrect when they contend that flow rate was increasing

RONALD DYKHUIZEN, PH.D. - DIRECT

4:00 PM 1 over the course of the blowout.

4:00 PM 2 Do you recall writing that in your report?

4:00 PM 3 A. Yes, I do.

4:00 PM 4 Q. Dr. Nestic proposes that the BOP eroded slowly over the

4:00 PM 5 course of more than a month. Do you disagree with Dr. Nestic?

4:00 PM 6 A. No, I don't think that it could erode slowly over a period

4:00 PM 7 of a month. It had to erode fast initially and then slow down.

4:00 PM 8 Q. Why is that?

4:00 PM 9 A. As we stated before, erosion is dependent on the

4:00 PM 10 velocities. We expect to have high velocities when we have

4:00 PM 11 small anaerobic passages. Unless the passages widen out and

4:00 PM 12 the velocity is reduced, we expect erosion to reduce.

4:00 PM 13 Q. Now, Dr. Johnson proposes a different model for flow over

4:01 PM 14 time than you; is that right?

4:01 PM 15 A. Yes, he does.

4:01 PM 16 Q. What is Dr. Johnson's model?

4:01 PM 17 A. Dr. Johnson also assumes that the flow is increasing over

4:01 PM 18 time, and he justifies that by discounting Dr. Stewart

4:01 PM 19 Griffiths' work. He says that if the erosion in the BOP

4:01 PM 20 happens at a coordinated rate with PI increase at the bottom of

4:01 PM 21 the well, they could happen at such a way that you would not

4:01 PM 22 notice it in the BOP pressure measurement.

4:01 PM 23 I think that's not very likely, to have things happen

4:01 PM 24 at two different points in well-coordinated rates, that we

4:01 PM 25 would not see evidence of it.

RONALD DYKHUIZEN, PH.D. - DIRECT

4:01 PM 1 Q. And what two points are moving at well-coordinated rates?

4:01 PM 2 A. The BOP -- the erosion of the BOP is causing less
4:02 PM 3 resistance in the BOP. And he claims that the PI is changing
4:02 PM 4 at the bottom of the well, that's changing in such a way that
4:02 PM 5 it masks the pressure gauge and does not allow it to respond,
4:02 PM 6 and it stays steady.

4:02 PM 7 Q. Is that believable?

4:02 PM 8 A. I don't think it's believable, no. Stewart Griffiths
4:02 PM 9 gives a much more believable model in his report.

4:02 PM 10 Q. I'd like to move on to your rebuttal of Dr. Zaldivar. The
4:02 PM 11 judge heard a lot about Dr. Zaldivar in the opening.

4:02 PM 12 Did you respond to BP's expert, Zaldivar, in your
4:02 PM 13 report?

4:02 PM 14 A. Yes, I did.

4:02 PM 15 Q. What did Dr. Zaldivar purport to do?

4:02 PM 16 A. He had a very interesting report, because it was very
4:02 PM 17 similar to my Ph.D. thesis. So I took a lot of interest in his
4:03 PM 18 report.

4:03 PM 19 He noticed from observations that the flow coming out
4:03 PM 20 of the end of the riser while it was still attached to the BOP
4:03 PM 21 alternated between a light fluid and a dark fluid, back to a
4:03 PM 22 light fluid, back to a dark fluid, in a very regular pattern.

4:03 PM 23 And he correctly proposes that that is -- means that
4:03 PM 24 part of the flow is mostly gas for a while, and then the change
4:03 PM 25 in color means the flow is mostly liquid, and then mostly gas,

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 0 3 P M 1 and mostly liquid.

4 : 0 3 P M 2 He also noticed that the riser, which was laying
4 : 0 3 P M 3 along the bottom of the Gulf, was rising up due to a bouyant
4 : 0 3 P M 4 force and then going back down again, rising up and going back
4 : 0 3 P M 5 down again, at the same frequency that the colors were changing
4 : 0 3 P M 6 at the end of the riser. And so he correctly concluded that
4 : 0 3 P M 7 those two were related.

4 : 0 4 P M 8 And he said that as the liquid goes through the
4 : 0 4 P M 9 riser, it's a little heavier than the gas and forces the riser
4 : 0 4 P M 10 down; and as the gas goes through -- up the riser -- of course,
4 : 0 4 P M 11 it's not really a riser when it's laying on the bottom, but
4 : 0 4 P M 12 it's called the riser -- but when the gas goes through, it's
4 : 0 4 P M 13 more bouyant and the riser goes up. And so it goes up and down
4 : 0 4 P M 14 when the change in phase goes through that portion of the
4 : 0 4 P M 15 riser.

4 : 0 4 P M 16 And so he generated a numerical model to try to
4 : 0 4 P M 17 predict what flow rates through the system would generate this
4 : 0 4 P M 18 oscillation. So based on his numerical model, he game up with
4 : 0 4 P M 19 a range of flow rates that would generate this oscillation.

4 : 0 4 P M 20 This is very similar to my Ph.D. work where I tried
4 : 0 4 P M 21 to generate a range of flow rates that would result in a
4 : 0 5 P M 22 oscillation in a vertical channel. Lots of the same physics
4 : 0 5 P M 23 but different because it was a vertical channel.

4 : 0 5 P M 24 Q. In your opinion, can Dr. Zaldivar's model quantitatively
4 : 0 5 P M 25 predict the flow rate?

RONALD DYKHUIZEN, PH.D. - DIRECT

4:05 PM 1 A. No, I don't think he can quantitatively predict the flow
4:05 PM 2 rate, mainly because of my first trial in trying to match
4:05 PM 3 experimental data was very poor.

4:05 PM 4 Q. Did you prepare any demonstratives to explain your
4:05 PM 5 opinions on that?

4:05 PM 6 A. Yes, I do.

4:05 PM 7 MR. CERNICH: Could we go to D-21124.

4:05 PM 8 BY MR. CERNICH:

4:05 PM 9 Q. Does this help you explain your opinions, Dr. Dykhuizen?

4:05 PM 10 A. Yes.

4:05 PM 11 MR. REGAN: Your Honor, I would just object to this
4:05 PM 12 demonstrative. This is outside the scope of the two and a half
4:05 PM 13 pages of Dr. Dykhuizen's report that respond to Dr. Zaldivar.
4:05 PM 14 There were some specific statements made as to his complaints,
4:05 PM 15 but I don't believe this is within the scope of those two
4:05 PM 16 pages.

4:05 PM 17 MR. CERNICH: Your Honor, Dr. Dykhuizen spends, as
4:06 PM 18 Mr. Regan points out, two and a half pages of his report
4:06 PM 19 explaining his criticisms of Dr. Zaldivar. We can show you the
4:06 PM 20 pages in the report, and I can have Dr. Dykhuizen explain how
4:06 PM 21 he responds to Dr. Zaldivar in his report. He's using a
4:06 PM 22 demonstrative to explain a concept that is addressed in his
4:06 PM 23 expert report.

4:06 PM 24 THE COURT: All right. Overrule the objection.

4:06 PM 25 THE WITNESS: Dr. Zaldivar, just like what I did,

RONALD DYKHUIZEN, PH.D. - DIRECT

4:06 PM 1 represented the riser by a number of short sections of pipe.
4:06 PM 2 This is a numerical model. So at every dot I would calculate
4:06 PM 3 things like pressure, temperature, how much gas is in that
4:06 PM 4 section, how much liquid is in that section, velocity of the
4:06 PM 5 gas, and the velocity of the liquid. This is a very --
4:06 PM 6 simplification of a numerical method.

4:06 PM 7 And so Dr. Zaldivar has to make some choices.
4:06 PM 8 Some of these choices are obvious: How many dots do I use?
4:07 PM 9 How many cells do I use?

4:07 PM 10 He also does the same thing with time: How many
4:07 PM 11 time steps do I use to represent this oscillation?

4:07 PM 12 So he has to pick sizes of the time steps. And
4:07 PM 13 when we go on in there, we determine type of time steps. There
4:07 PM 14 are different types of time steps that you can take. All of
4:07 PM 15 these will affect the accuracy of his computer model.

4:07 PM 16 But what I would like to say, in my experience
4:07 PM 17 when I did this for my Ph.D. thesis, one thing that's very
4:07 PM 18 subtle, that is not clear, is, I need to find the density as a
4:07 PM 19 function all the way, not only at those points but in between
4:07 PM 20 those points.

4:07 PM 21 And there are some simple ways of doing that. I
4:07 PM 22 could assign the density in this section of pipe equal to the
4:07 PM 23 density at the center of the pipe. That would be a logical
4:08 PM 24 choice. Or I could define the density between this dot and
4:08 PM 25 that dot to be equal to the average density of those -- each of

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 0 8 P M 1 those two points.

4 : 0 8 P M 2 Both of those sound like reasonable choices.

4 : 0 8 P M 3 But I found that my calculation of when the flow turns stable
4 : 0 8 P M 4 or unstable depended on simple choices like that, that the
4 : 0 8 P M 5 numerical method that you use, the way you average properties
4 : 0 8 P M 6 resulted in different ranges of when the flow would be
4 : 0 8 P M 7 unstable.

4 : 0 8 P M 8 So Dr. Zaldivar did not have experimental data
4 : 0 8 P M 9 on at what flow rate does it turn unstable. I had in my
4 : 0 8 P M 10 calculations, I had some experiments. When did the flow rate
4 : 0 8 P M 11 turn unstable? I run my model and I say, does my model match
4 : 0 9 P M 12 the change from stable behavior to unstable behavior?

4 : 0 9 P M 13 And the first time through it didn't, and it
4 : 0 9 P M 14 didn't match at all. So I changed some of my averaging, and I
4 : 0 9 P M 15 changed some of my numerical methods until it did match and
4 : 0 9 P M 16 this validates my code. He never validated his code, because
4 : 0 9 P M 17 he doesn't have any data to validate his code. He doesn't know
4 : 0 9 P M 18 at what flow rate it turns unstable. He just has his first
4 : 0 9 P M 19 prediction of when it turns unstable.

4 : 0 9 P M 20 So that is one of my concerns is that Dr. Zaldivar
4 : 0 9 P M 21 hasn't validated his model.

4 : 0 9 P M 22 **BY MR. CERNICH:**

4 : 0 9 P M 23 **Q.** Did Dr. --

4 : 0 9 P M 24 **MR. REGAN:** Your Honor, I move to strike. There's
4 : 0 9 P M 25 one sentence in the report that says Dr. Zaldivar did not

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 0 9 P M 1 validate his model, then criticizes -- Dr. Dykhuizen criticizes
4 : 0 9 P M 2 oscillary [verbatim] motion, fluid temperatures, and
4 : 0 9 P M 3 sensitivity of certain parameters -- parameters on local
4 : 0 9 P M 4 changes. Running a different model, talking about densities is
4 : 0 9 P M 5 not in the report. It may be in his Ph.D., but it's not
4 : 1 0 P M 6 something that's been disclosed here as an opinion from
4 : 1 0 P M 7 Dr. Dykhuizen.

4 : 1 0 P M 8 **MR. CERNICH:** Your Honor, as an expert, Dr. Dykhuizen
4 : 1 0 P M 9 is bringing his experience to this case. When we look at
4 : 1 0 P M 10 Dr. -- his experience includes his Ph.D. thesis.

4 : 1 0 P M 11 When we look at his report, Dr. Dykhuizen
4 : 1 0 P M 12 writes: "BP retained expert Dr. Zaldivar offers a unique
4 : 1 0 P M 13 method to estimate flow. While it's impressive for
4 : 1 0 P M 14 Dr. Zaldivar to demonstrate chaotic behavior... I do not think
4 : 1 0 P M 15 that the model of this instability can quantitatively predict
4 : 1 0 P M 16 flow rates. The method has never been validated to show that
4 : 1 0 P M 17 it can be used to estimate flow. There are numerous
4 : 1 0 P M 18 approximations that have been made in this study."

4 : 1 0 P M 19 This is what Dr. Dykhuizen is testifying --

4 : 1 0 P M 20 **THE COURT:** All right. I'll overrule the objection.
4 : 1 0 P M 21 I think he's expounding or explaining what he said in his
4 : 1 0 P M 22 report. I think it's fair game. Okay.

4 : 1 0 P M 23 **MR. CERNICH:** Thank you, Your Honor.

4 : 1 0 P M 24 **BY MR. CERNICH:**

4 : 1 0 P M 25 **Q.** Are there other problems -- well, before we move on,

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 10 PM 1 Dr. Dykhuizen, Dr. Zaldivar, did he compare his work to the
4 : 11 PM 2 OLGA computer program?

4 : 11 PM 3 A. Yes, he did, and he presented that as a validation of his
4 : 11 PM 4 computer code. But all that validates is that a steady state
4 : 11 PM 5 flow without a moving riser, because OLGA couldn't have a
4 : 11 PM 6 moving riser, gave results similar to his code.

4 : 11 PM 7 MR. REGAN: Same objection, Your Honor. No
4 : 11 PM 8 discussion of OLGA in his report. This is not in the report.

4 : 11 PM 9 MR. CERNICH: Your Honor, I'll go back to the section
4 : 11 PM 10 of the report.

4 : 11 PM 11 Again, "There are numerous approximations...."

4 : 11 PM 12 "(The sensitivity of the result to the details of the
4 : 11 PM 13 imposed motion is not investigated.) Dr. Zaldivar admits that
4 : 11 PM 14 there is not good data for the oscillatory motion of May 13th,
4 : 11 PM 15 so he uses the same functional form..."

4 : 11 PM 16 The sensitivity of various parameters and models of
4 : 11 PM 17 the predicted -- "He tries to address the sensitivity of
4 : 12 PM 18 various parameters and models on the predicted flow rates. He
4 : 12 PM 19 shows" change -- "that the changes in many global parameters
4 : 12 PM 20 have little impact on the final results he obtains. Some
4 : 12 PM 21 sensitivity studies regarding heat transfer are presented...."

4 : 12 PM 22 "It is most interesting to note that he claims that
4 : 12 PM 23 'the effect of the riser imposition on the estimated flow rates
4 : 12 PM 24 is insignificant.'"

4 : 12 PM 25 Dr. Dykhuizen goes on ad nauseam in his report with

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 12 PM 1 his critiques of Dr. Zaldivar's works. The idea that he has to
4 : 12 PM 2 say "OLGA" in his report...

4 : 12 PM 3 **THE COURT:** Well, your question to him here was, did
4 : 12 PM 4 he compare his work to the OLGA computer model.

4 : 12 PM 5 **MR. CERNICH:** Oh, I'm sorry. I wasn't asking if
4 : 12 PM 6 Dr. Dykhuizen did; I was asking if Dr. Zaldivar did.

4 : 12 PM 7 **THE COURT:** I understand. You said, did he,
4 : 12 PM 8 Dr. Zaldivar, compare his work to the OLGA computer model, and
4 : 12 PM 9 that was the question he was answering.

4 : 12 PM 10 **MR. CERNICH:** Yes, Your Honor. And he said --

4 : 12 PM 11 **THE COURT:** It sounds like he wasn't -- didn't talk
4 : 13 PM 12 about that in his report, did he?

4 : 13 PM 13 **MR. CERNICH:** Well, Dr. Dykhuizen said Dr. Zaldivar
4 : 13 PM 14 has not validated his model, and I was asking whether
4 : 13 PM 15 Dr. Zaldivar's comparison to OLGA validated his model.

4 : 13 PM 16 **THE COURT:** I'm not going to strike the answer, but
4 : 13 PM 17 let's move on. I think you beat that horse to death.

4 : 13 PM 18 **MR. CERNICH:** Okay.

4 : 13 PM 19 **BY MR. CERNICH:**

4 : 13 PM 20 **Q.** So do you also have opinions about the oscillatory motion
4 : 13 PM 21 that Dr. Zaldivar uses for his model?

4 : 13 PM 22 **A.** Yes. I prepared a demonstrative for that also.

4 : 13 PM 23 **MR. CERNICH:** Can we go to D-21125, please.

4 : 13 PM 24 **BY MR. CERNICH:**

4 : 13 PM 25 **Q.** Are these images from Dr. Zaldivar's report?

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 13 PM 1 A. Yes, they are.

4 : 13 PM 2 Q. And is the image at the top there, did you reproduce that

4 : 13 PM 3 into your report, Dr. Dykhuizen?

4 : 13 PM 4 A. Yes, I did.

4 : 14 PM 5 Q. Can you explain to the Judge your opinions regarding

4 : 14 PM 6 Dr. Zaldivar's instability modes?

4 : 14 PM 7 A. Okay. Dr. Zaldivar observed, as I said, the motion of the

4 : 14 PM 8 riser up and down. And that observation is presented as the

4 : 14 PM 9 blue line in the upper plot. He presents the orange line is

4 : 14 PM 10 labeled "predicted," which is not a proper label. This is

4 : 14 PM 11 his -- not -- his code does not predict this motion. He is

4 : 14 PM 12 imposing this motion on the code. This is what he inputs into

4 : 14 PM 13 the code. This is how the riser moves up and down.

4 : 14 PM 14 If you will notice that there are small

4 : 14 PM 15 inconsistencies between what he imposes and what actually

4 : 14 PM 16 happened and nowhere in his report does he say, how was my

4 : 14 PM 17 result sensitive to this approximation? Maybe these

4 : 15 PM 18 differences change the boundaries of where it is.

4 : 15 PM 19 We would like to have him predict -- have the code be

4 : 15 PM 20 able to calculate the motion of the riser, but that was not a

4 : 15 PM 21 capability of this code, so he couldn't do that. And so I

4 : 15 PM 22 understand why he imposed the motion, because his code did not

4 : 15 PM 23 have the capability of predicting the motion.

4 : 15 PM 24 But he imposed a motion that's obviously inaccurate

4 : 15 PM 25 in places, and maybe this has an effect. But moreover, he --

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 15 PM 1 these are -- the bottom are the plots of his code results. He
4 : 15 PM 2 shows he has two modes of oscillation. During one time period,
4 : 15 PM 3 he has a large bump of oil coming through, followed by a small
4 : 15 PM 4 bump of oil, then a large bump of oil, and followed by a small
4 : 15 PM 5 bump of oil.

4 : 15 PM 6 And he tries to correlate this to how light or how
4 : 16 PM 7 dark and what frequencies he has in his video. He doesn't have
4 : 16 PM 8 data for how large the oil slugs are. So he just correlates
4 : 16 PM 9 it, says, This looks like a reasonable representation of my
4 : 16 PM 10 2-peak time period.

4 : 16 PM 11 He also has a 1-peak time period. At a different
4 : 16 PM 12 time period, the oil has a large slug, followed by another
4 : 16 PM 13 large slug, followed by another large slug.

4 : 16 PM 14 Since the densities of these slugs are what's causing
4 : 16 PM 15 the riser to go up and down, we have a problem in accepting
4 : 16 PM 16 Dr. Zaldivar's analysis. Because Dr. Zaldivar only has data
4 : 16 PM 17 for one of these two time periods. And he shows he has an
4 : 16 PM 18 imperfect fit of that data. And then he uses that same
4 : 17 PM 19 imperfect fit for the other time period where we expect the
4 : 17 PM 20 oscillation to be different. And so he never addresses how
4 : 17 PM 21 this impacts the stability boundaries.

4 : 17 PM 22 Q. Dr. Dykhuizen, so did Dr. Zaldivar calculate flow rates on
4 : 17 PM 23 two different dates?

4 : 17 PM 24 A. Yes. He predicted flow rates on May 13th and 16th. One
4 : 17 PM 25 of the time periods had single peaks, which was May 16th. And

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 17 PM 1 then the other time had double peaks, where he saw a different
4 : 17 PM 2 mode of oscillation. So I would expect a different mode of
4 : 17 PM 3 riser motion, and yet he used the same riser motion for both
4 : 17 PM 4 days.

4 : 17 PM 5 Q. And did he only have data for riser motion on one of those
4 : 17 PM 6 days?

4 : 17 PM 7 A. He had data for both days, but he discounted his data for
4 : 17 PM 8 the other day because it was very noisy and he couldn't use it.

4 : 18 PM 9 Q. Do Dr. Zaldivar's flow rate calculations conflict with
4 : 18 PM 10 your calculations for the period between May 13th and May 16th?

4 : 18 PM 11 A. Yes, they do.

4 : 18 PM 12 Q. Now, Dr. Zaldivar also performed some flow rate
4 : 18 PM 13 calculations from the kink leaks; is that right?

4 : 18 PM 14 A. That is correct.

4 : 18 PM 15 Q. What were wrong with -- what was wrong with Dr. Zaldivar's
4 : 18 PM 16 kink calculations?

4 : 18 PM 17 A. That's a fairly simple calculation that I could reproduce
4 : 18 PM 18 without writing a computer code, and I got approximately a
4 : 18 PM 19 factor of 2 higher.

4 : 18 PM 20 Q. And did BP perform any similar calculations during the
4 : 18 PM 21 response?

4 : 18 PM 22 A. BP performed similar calculations, not exactly the same
4 : 18 PM 23 area and pressures, but they got numbers that were much closer
4 : 18 PM 24 to mine. As a matter of fact, higher than mine.

4 : 18 PM 25 Q. And did you review kink leak calculations by Dr. Tim

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 18 PM 1 Lockett?

4 : 18 PM 2 A. Yes, I did.

4 : 18 PM 3 MR. CERNICH: Can we go to 10650, TREN-10650, please.

4 : 18 PM 4 BY MR. CERNICH:

4 : 19 PM 5 Q. Are these Dr. Lockett's calculations?

4 : 19 PM 6 A. Yes, they are.

4 : 19 PM 7 MR. CERNICH: Can we go to TREN-10650.1.1.US.

4 : 19 PM 8 BY MR. CERNICH:

4 : 19 PM 9 Q. And are these flow -- are these flow rates from only the

4 : 19 PM 10 kink?

4 : 19 PM 11 A. Yes. These are flow rates from only the kink. He gets

4 : 19 PM 12 the total flow rate of approximately 11,000 standard barrels a

4 : 19 PM 13 day. But what's most interesting is to look at his equation up

4 : 19 PM 14 here where he calculates the equivalent diameter. So he's

4 : 19 PM 15 representing this odd-shaped hole in the pipe by a round hole

4 : 19 PM 16 of an equivalent diameter, which is much different than

4 : 19 PM 17 Dr. Zaldivar did.

4 : 19 PM 18 Q. And what Dr. Zaldivar do?

4 : 19 PM 19 A. Dr. Zaldivar represented the hole with a hydraulic

4 : 19 PM 20 diameter, which is a different concept than what Dr. Lockett

4 : 19 PM 21 did. Dr. Lockett did it correctly. Dr. Lockett did it the way

4 : 20 PM 22 I did it; Dr. Zaldivar did it differently.

4 : 20 PM 23 Q. And what did you calculate for the kink leaks?

4 : 20 PM 24 A. I calculated for the kink leaks 82,000 -- excuse me,

4 : 20 PM 25 8,200 barrels of oil per day.

RONALD DYKHUIZEN, PH.D. - DIRECT

4:20 PM 1 Q. And approximately what did Dr. Zaldivar calculate?

4:20 PM 2 A. 4,200 -- or 4,900, sorry, approximately half my value.

4:20 PM 3 Q. Now, what did you mean by "hydraulic diameter"?

4:20 PM 4 A. That's difficult to explain. If I may, I would like to
4:20 PM 5 use the easel.

4:20 PM 6 MR. CERNICH: Your Honor, may the witness use the
4:20 PM 7 easel?

4:20 PM 8 THE COURT: We'll have to give him a microphone so
4:20 PM 9 you can hear him.

4:20 PM 10 (Discussion off the record.)

4:21 PM 11 BY MR. CERNICH:

4:21 PM 12 Q. Dr. Dykhuizen, let's use the pad that's over there.

4:21 PM 13 A. Okay. Should I move the pad, or is it fine where it is?

4:21 PM 14 THE COURT: Why don't you help him move it wherever
4:21 PM 15 it's --

4:21 PM 16 MR. CERNICH: Certainly.

4:21 PM 17 THE WITNESS: Okay. In the kink of the riser, there
4:21 PM 18 were some irregular-shaped holes. And I will just represent
4:21 PM 19 the hole as a rectangle. And we have high-pressure fluid
4:22 PM 20 inside and it's pushing oil out the hole.

4:22 PM 21 Dr. Zaldivar represented this as a hole with the
4:22 PM 22 same hydraulic diameter as the actual hole. The hydraulic
4:22 PM 23 diameter as a concept used in piping is 4 times the area of
4:22 PM 24 this O divided by the perimeter of this hole. And the only
4:22 PM 25 reason the 4 is in this equation is if we have a round hole to

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 2 2 P M 1 start with, we'll back out the same diameter as the round hole.

4 : 2 2 P M 2 But what's important to notice is this hydraulic
4 : 2 2 P M 3 diameter model has a different area than the original model.
4 : 2 2 P M 4 So Dr. Zaldivar correctly uses his equations to calculate the
4 : 2 2 P M 5 velocity coming through that hole. But he incorrectly applies
4 : 2 3 P M 6 the area of his model instead of the area of the actual hole,
4 : 2 3 P M 7 and he gets approximately a factor of 2 wrong in the flow
4 : 2 3 P M 8 coming out the kink leak.

4 : 2 3 P M 9 And so I reproduced his calculations, getting
4 : 2 3 P M 10 the same number he did by simulating the error that he did it
4 : 2 3 P M 11 at. Now, I didn't get exactly the same number he did, because
4 : 2 3 P M 12 he probably converts the standard barrels differently than I
4 : 2 3 P M 13 did, but I was within 10 percent. I was off by a factor of 2,
4 : 2 3 P M 14 if I use the proper area.

4 : 2 3 P M 15 So I suspected that he is using the hydraulic
4 : 2 3 P M 16 diameter concept. He represents his holes in his reports with
4 : 2 3 P M 17 a hydraulic diameter.

4 : 2 3 P M 18 **BY MR. CERNICH:**

4 : 2 3 P M 19 **Q.** Dr. Dykhuizen, do Dr. Zaldivar's riser flow calculations
4 : 2 4 P M 20 suffer from the same problem?

4 : 2 4 P M 21 **MR. REGAN:** Your Honor, I'm going to object to this,
4 : 2 4 P M 22 too. "Hydraulic diameter" is not in the report. He talks
4 : 2 4 P M 23 about a K-factor issue. There's one paragraph on this topic.
4 : 2 4 P M 24 They did have an expert on this, and they're not calling him,
4 : 2 4 P M 25 Martinez, and I think what -- they're now using Dr. Dykhuizen

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 2 4 P M 1 to try to bring that testimony in. And we have a report here
4 : 2 4 P M 2 that tells us what the witness is supposed to testify about,
4 : 2 4 P M 3 and "hydraulic diameter" is not set forth in this report.

4 : 2 4 P M 4 **BY MR. CERNICH:**

4 : 2 4 P M 5 **Q.** Dr. Dykhuizen, did you opine in your report that you
4 : 2 4 P M 6 believe Dr. Zaldivar's riser flow rates were also off by a
4 : 2 4 P M 7 factor of 2?

4 : 2 4 P M 8 **A.** Yes, I did.

4 : 2 4 P M 9 **Q.** Okay. And did you learn at some point why Dr. Zaldivar's
4 : 2 4 P M 10 riser flow rates were, in fact, off by a factor of 2?

4 : 2 4 P M 11 **A.** Yes. I listened to Dr. Zaldivar's deposition, and he
4 : 2 4 P M 12 described -- in his calculations, he described it with an error
4 : 2 4 P M 13 in it.

4 : 2 4 P M 14 **MR. REGAN:** Your Honor, that's after the report,
4 : 2 4 P M 15 after the rebuttal report. This is not a witness who was on
4 : 2 5 P M 16 this topic. I have no doubt of his capability to understand
4 : 2 5 P M 17 the topic, but an issue of disclosure here is one where now
4 : 2 5 P M 18 we're having Dr. Dykhuizen testify about something that one of
4 : 2 5 P M 19 the other United States experts, who they're not calling, was
4 : 2 5 P M 20 actually used to cover.

4 : 2 5 P M 21 **MR. CERNICH:** Your Honor, the parties were limited in
4 : 2 5 P M 22 the number of experts that it could bring to trial.

4 : 2 5 P M 23 Dr. Dykhuizen included an opinion in his report that he thought
4 : 2 5 P M 24 Dr. Zaldivar's calculations were off by a factor of 2. In the
4 : 2 5 P M 25 normal course of discovery, Dr. Dykhuizen would have written a

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 2 5 P M 1 report; Dr. Zaldivar would have rebutted -- and would have been
4 : 2 5 P M 2 deposed; Dr. Zaldivar would have written a report and been
4 : 2 5 P M 3 deposed. And before --

4 : 2 5 P M 4 **THE COURT:** Is this talked about in his deposition?
4 : 2 5 P M 5 Was this witness deposed?

4 : 2 5 P M 6 **MR. REGAN:** I deposed him, Your Honor. He references
4 : 2 5 P M 7 K-factors being too large. I think what they're doing is
4 : 2 5 P M 8 they're now trying to use one sentence in his report to bring
4 : 2 5 P M 9 in an expert that they're not calling to talk about a topic
4 : 2 5 P M 10 that is not set forth in his report.

4 : 2 6 P M 11 **MR. CERNICH:** Dr. Zaldivar -- I'm sorry, Your Honor.
4 : 2 6 P M 12 BP had the opportunity to ask -- explore Dr. Dykhuizen's
4 : 2 6 P M 13 calculations or his criticisms of Dr. Zaldivar during his
4 : 2 6 P M 14 deposition. They asked no questions regarding his opinions on
4 : 2 6 P M 15 the -- on his kink leak estimates or Dr. Dykhuizen's opinions
4 : 2 6 P M 16 regarding the flow rates on the riser.

4 : 2 6 P M 17 Dr. Dykhuizen, as he testified, listened to
4 : 2 6 P M 18 Dr. Zaldivar --

4 : 2 6 P M 19 **THE COURT:** Was he asked what he based his opinion on
4 : 2 6 P M 20 that Dr. Zaldivar was off by a factor of 2?

4 : 2 6 P M 21 **MR. CERNICH:** No, Your Honor.

4 : 2 6 P M 22 **MR. REGAN:** He says it in his report, Your Honor. He
4 : 2 6 P M 23 says why. He says he uses a K value of 4. He's talking about
4 : 2 6 P M 24 K values, resistance factors. He doesn't talk about this topic
4 : 2 6 P M 25 of hydraulic diameter. There was a different witness who was

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 2 6 P M 1 covering that issue --

4 : 2 6 P M 2 THE COURT: Okay.

4 : 2 6 P M 3 MR. REGAN: -- for the United States.

4 : 2 6 P M 4 THE COURT: Okay. All right. It sounds like this is

4 : 2 6 P M 5 getting beyond his reports. I'll sustain the objection.

4 : 2 7 P M 6 MR. CERNICH: Thank you, Dr. Dykhuizen.

4 : 2 7 P M 7 BY MR. CERNICH:

4 : 2 7 P M 8 Q. Now, just to -- just to wrap up here, you calculated flow

4 : 2 7 P M 9 rates for three time periods?

4 : 2 7 P M 10 A. Yes, I did.

4 : 2 7 P M 11 MR. CERNICH: Okay. Could we go to D-21122.

4 : 2 7 P M 12 BY MR. CERNICH:

4 : 2 7 P M 13 Q. And does this demonstrative show a timeline with your

4 : 2 7 P M 14 calculations?

4 : 2 7 P M 15 A. Yes, it does.

4 : 2 7 P M 16 Q. And so is this your Top Kill period flow rate calculation?

4 : 2 7 P M 17 A. Yes, it is.

4 : 2 7 P M 18 Q. And what is that?

4 : 2 7 P M 19 A. Over 60,000 barrels a day.

4 : 2 7 P M 20 Q. And is this your Top Hat 4 period estimate?

4 : 2 7 P M 21 A. Yes, it is.

4 : 2 7 P M 22 Q. And what is that estimate?

4 : 2 7 P M 23 A. Approximately 60,000 barrels of oil per day.

4 : 2 7 P M 24 Q. And what is this estimate here?

4 : 2 7 P M 25 A. Oh, that is the capping stack estimate and that is

RONALD DYKHUIZEN, PH.D. - DIRECT

4 : 2 8 P M 1 approximately 53,000 barrels of oil per day.

4 : 2 8 P M 2 MR. CERNICH: Can we go to D-21143, please.

4 : 2 8 P M 3 BY MR. CERNICH:

4 : 2 8 P M 4 Q. And, Dr. Dykhuizen, does this demonstrative summarize your
4 : 2 8 P M 5 opinions in this case?

4 : 2 8 P M 6 A. Yes, it does.

4 : 2 8 P M 7 Q. And in your opinion, are these reliable best estimates?

4 : 2 8 P M 8 A. Yes, they are.

4 : 2 8 P M 9 MR. CERNICH: Thank you, Dr. Dykhuizen.

4 : 2 8 P M 10 Your Honor, we're finished. We'll pass the
4 : 2 8 P M 11 witness.

4 : 2 8 P M 12 THE COURT: Okay.

4 : 2 8 P M 13 CROSS-EXAMINATION

4 : 2 9 P M 14 MR. REGAN: May I proceed, Your Honor?

4 : 2 9 P M 15 THE COURT: Yes.

4 : 2 9 P M 16 BY MR. REGAN:

4 : 2 9 P M 17 Q. Matt Regan on behalf of BP. And this is the
4 : 2 9 P M 18 cross-examination of Dr. Dykhuizen.

4 : 2 9 P M 19 Hello, Dr. Dykhuizen. How are you?

4 : 2 9 P M 20 A. I'm fine. Thank you.

4 : 2 9 P M 21 Q. I'd like to start where you finished. Your
4 : 2 9 P M 22 July 15th estimate of 53,000 barrels per day is based on your
4 : 2 9 P M 23 capping stack work; correct?

4 : 2 9 P M 24 A. That is correct.

4 : 2 9 P M 25 Q. And you have a plus or minus 20 percent error bar on that

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 2 9 P M 1 number; correct?

4 : 2 9 P M 2 A. Yes, I do.

4 : 2 9 P M 3 Q. So that would be a range from 42,400 to 63,600 for that

4 : 2 9 P M 4 single day of flow; correct?

4 : 2 9 P M 5 A. That sounds approximately correct, yes.

4 : 2 9 P M 6 Q. Your 20 percent uncertainty on that number is based on

4 : 2 9 P M 7 your personal experience in measuring and calculating

4 : 2 9 P M 8 multiphase flow; correct?

4 : 2 9 P M 9 A. That is correct.

4 : 2 9 P M 10 Q. I think as you said on direct, even if you had a flow

4 : 2 9 P M 11 meter, you wouldn't expect it to read better than plus or minus

4 : 3 0 P M 12 20 percent?

4 : 3 0 P M 13 A. That's not exactly what I said. I said if I had an

4 : 3 0 P M 14 uncalibrated flow meter, which this is what this is, I wouldn't

4 : 3 0 P M 15 expect it to read any better than that.

4 : 3 0 P M 16 Q. It's your opinion that 5 million barrels of oil were

4 : 3 0 P M 17 released from April 20th to July 15th; correct?

4 : 3 0 P M 18 A. Yes.

4 : 3 0 P M 19 Q. And you base this cumulative estimate by taking your

4 : 3 0 P M 20 53,000 estimate of July 15th and then using a backwards

4 : 3 0 P M 21 extrapolation in time to April 20th and then adding up the area

4 : 3 0 P M 22 for the interval; correct?

4 : 3 0 P M 23 A. That is correct.

4 : 3 0 P M 24 Q. When that estimate was first released, that 5 million

4 : 3 0 P M 25 estimate of 4.9 in August of 2010, you did not believe that any

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 0 P M 1 error bar could be applied to that number; correct?

4 : 3 0 P M 2 A. That is correct, that's what I stated. Obviously, the

4 : 3 0 P M 3 error bar is not more than 100 percent.

4 : 3 0 P M 4 Q. And when that number -- that 4.9 million cumulative number

4 : 3 0 P M 5 was released in the DOE report, you weren't willing to stand

4 : 3 1 P M 6 behind an error bar on that 4.9 million cumulative number then

4 : 3 1 P M 7 either; correct?

4 : 3 1 P M 8 A. That is correct.

4 : 3 1 P M 9 Q. For your expert report in this case now three years later,

4 : 3 1 P M 10 you have a plus or minus 30 percent error bar on your own

4 : 3 1 P M 11 5 million cumulative flow estimate; correct?

4 : 3 1 P M 12 A. That is correct.

4 : 3 1 P M 13 Q. The primary reason for your large 30 percent error

4 : 3 1 P M 14 compared to your 20 percent error on the one-day estimate is

4 : 3 1 P M 15 the impact of erosional processes and knowing when erosion

4 : 3 1 P M 16 stopped; correct?

4 : 3 1 P M 17 A. That is correct.

4 : 3 1 P M 18 Q. And as you said, erosion only happens in one direction;

4 : 3 1 P M 19 correct?

4 : 3 1 P M 20 A. That is correct.

4 : 3 1 P M 21 Q. So not understanding when the erosional processes stopped,

4 : 3 1 P M 22 the impact of that uncertainty is to bring your calculation

4 : 3 1 P M 23 down; correct?

4 : 3 1 P M 24 A. That is correct.

4 : 3 1 P M 25 Q. Now, it depends on where you start, but if you start at

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 1 P M 1 53,000 on the last day and you do the integration to get
4 : 3 2 P M 2 5 million and there is erosional effects or erosional processes
4 : 3 2 P M 3 not accounted for in your estimate, it's going to bring your
4 : 3 2 P M 4 number, the 5 million number, down; correct?
4 : 3 2 P M 5 A. That is correct.
4 : 3 2 P M 6 Q. But looking solely at your own work, even today, looking
4 : 3 2 P M 7 at your own work, your error on that 5 million would be
4 : 3 2 P M 8 significantly larger than 30 percent; correct?
4 : 3 2 P M 9 A. I don't understand your question, so I have a hard time
4 : 3 2 P M 10 agreeing with it.
4 : 3 2 P M 11 Q. If you look solely at your own work, Dr. Dykhuizen, the
4 : 3 2 P M 12 error that you have for your 5 million cumulative estimate --
4 : 3 2 P M 13 that is, if you don't look at Dr. Griffiths and you don't look
4 : 3 2 P M 14 at Dr. Pooladi-Darvish, just look at your own work, your error
4 : 3 2 P M 15 would be greater than 30 percent; correct?
4 : 3 2 P M 16 A. I think that's a fair statement, yes.
4 : 3 2 P M 17 Q. So it's after looking at Dr. Griffiths' work and after
4 : 3 2 P M 18 looking at Dr. Pooladi-Darvish's work and after reviewing the
4 : 3 2 P M 19 record and after testifying about the things you just testified
4 : 3 2 P M 20 to on direct, it's at that point you then can arrive at a plus
4 : 3 3 P M 21 or minus 30 percent error on your 5 million number; correct?
4 : 3 3 P M 22 A. That is correct, although not exactly correct. I -- on
4 : 3 3 P M 23 testimony here today, I put that at plus 20 and minus 30, so
4 : 3 3 P M 24 I'll give you a little bit there.
4 : 3 3 P M 25 Q. Okay. So at the time of your deposition, it was plus or

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 3 P M 1 minus 30 percent on 5 million; correct?

4 : 3 3 P M 2 A. I might have said that. I thought I said it was a

4 : 3 3 P M 3 30 percent error, and if I did say plus or minus 30, I

4 : 3 3 P M 4 apologize.

4 : 3 3 P M 5 Q. No apology necessary. I just want clarity.

4 : 3 3 P M 6 Today, what is your error estimate on your 5 million

4 : 3 3 P M 7 cumulative estimate?

4 : 3 3 P M 8 A. Plus 20 and minus 30.

4 : 3 3 P M 9 Q. So that would be 6 million barrels on the high side and

4 : 3 3 P M 10 3.5 million barrels on the low side?

4 : 3 3 P M 11 A. That is correct.

4 : 3 3 P M 12 Q. And you agree that it is much more likely to be a lower

4 : 3 3 P M 13 value than a higher value between that range?

4 : 3 4 P M 14 A. No, that's not true.

4 : 3 4 P M 15 Q. With respect to your 3.5 to 6.5 range that you testified

4 : 3 4 P M 16 about in your deposition, you agreed it was much more likely to

4 : 3 4 P M 17 be a lower value than a higher value; correct?

4 : 3 4 P M 18 A. That is correct, and that's why my opinion is plus 20 and

4 : 3 4 P M 19 minus 30. It is much more likely to be a lower value than a

4 : 3 4 P M 20 higher value. If you take an integral average underneath the

4 : 3 4 P M 21 bell curve, you're going to come up with more probabilities of

4 : 3 4 P M 22 a lower value.

4 : 3 4 P M 23 Q. I'm going to stay with uncertainties, although we could

4 : 3 4 P M 24 get into probabilities.

4 : 3 4 P M 25 A. Sure.

RONALD DYKHUIZEN, PH.D. - CROSS

4:34 PM 1 Q. But with respect to uncertainty, when we hear your
4:34 PM 2 5 million number, we should think that Dykhuizen's range is 3.5
4:34 PM 3 to 6.0; correct?

4:34 PM 4 A. Yes, I think that's fair.

4:34 PM 5 Q. The range -- the greatest uncertainty for you is erosional
4:34 PM 6 processes; correct?

4:34 PM 7 A. That is correct.

4:35 PM 8 Q. And erosional processes work in one direction; correct?

4:35 PM 9 A. That is correct.

4:35 PM 10 Q. And that direction is to pull that number down, not move
4:35 PM 11 it up; correct?

4:35 PM 12 A. That one effect will pull it down. There are other
4:35 PM 13 effects that will pull it up. That's why we go up to 6.

4:35 PM 14 **MR. REGAN:** If we can put up D-23996-A,
4:35 PM 15 Demonstrative 23996-A.

4:35 PM 16 **BY MR. REGAN:**

4:35 PM 17 Q. Dr. Dykhuizen, I have on the screen a chart that has first
4:35 PM 18 a blue line. Does that appear to be the 53,000 final day rate
4:35 PM 19 that you testified to as your July 15th capping stack flow
4:35 PM 20 estimate?

4:35 PM 21 A. Yes.

4:35 PM 22 Q. And does this line that's then drawn back to Day 3,
4:35 PM 23 April 22nd through 23rd, is that how you calculated your
4:35 PM 24 5-million-barrel estimate?

4:35 PM 25 A. Yes, it is. That's approximately the integral. I don't

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 6 P M 1 know if it's 040 or whatever, but it's somewhere between 4.9
4 : 3 6 P M 2 and 5.

4 : 3 6 P M 3 Q. And again, it's the area under the curve, everything
4 : 3 6 P M 4 underneath the blue line, that adds up, day by day, to
4 : 3 6 P M 5 approximately 5 million?

4 : 3 6 P M 6 A. That is correct.

4 : 3 6 P M 7 Q. To reach 3.5 million, if you're -- to get to a cumulative
4 : 3 6 P M 8 estimate of 3.5 million, your 30 percent low, do you agree that
4 : 3 6 P M 9 you cannot have a flow rate that starts high and ends low?

4 : 3 6 P M 10 A. No, I don't agree with that. I have point estimates at
4 : 3 6 P M 11 the time of Top Hat that's about 60,000, which is above 53,000.
4 : 3 6 P M 12 I also have a Point X estimate at the time of the Top Kill
4 : 3 6 P M 13 which is approximately 60,000. So I would expect, at least in
4 : 3 6 P M 14 that time period, it to be decreasing.

4 : 3 6 P M 15 But once we get farther to the left and where it's
4 : 3 7 P M 16 starting running out of PT-B pressure gauge data to support
4 : 3 7 P M 17 Dr. Griffiths' solution, then the flow has to turn around. So
4 : 3 7 P M 18 I think that it is decreasing at the end period, but it's
4 : 3 7 P M 19 possible that it's increasing at the beginning. And I have it
4 : 3 7 P M 20 increasing at the beginning; I have it going from zero to
4 : 3 7 P M 21 63,000.

4 : 3 7 P M 22 Now, this is just a proxy for erosion. This is not
4 : 3 7 P M 23 my calculation of erosion. I'm saying that for the first few
4 : 3 7 P M 24 days, we will assign zero. I could assign for the first four
4 : 3 7 P M 25 days half flow. And so I go from half flow to full flow after

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 7 P M 1 Day 4. Yes, we have a period of increasing flow due to
4 : 3 7 P M 2 erosion, but that does not have to increase over the entire
4 : 3 7 P M 3 time period of the accident.

4 : 3 7 P M 4 Q. If you use 53,000 as your July 15th number and you use the
4 : 3 7 P M 5 same linear approach that you did for your 5 million number,
4 : 3 8 P M 6 you agree you must start with a lower number as of Day 3 to get
4 : 3 8 P M 7 3.5 million barrels?

4 : 3 8 P M 8 A. I don't think there's anything wrong with that statement.
4 : 3 8 P M 9 That is a true statement.

4 : 3 8 P M 10 Q. That is a true statement.

4 : 3 8 P M 11 If this number is 53,000 as of July 15th and we
4 : 3 8 P M 12 accept your 30 percent error bar, take it to 3.5 million, flow
4 : 3 8 P M 13 would start low and end high, using the linear approach that
4 : 3 8 P M 14 you used for your 5 million estimate; correct?

4 : 3 8 P M 15 A. No. It could start low, it could have a peak in the
4 : 3 8 P M 16 middle, and then end higher. I don't expect that this solution
4 : 3 8 P M 17 makes a lot of physical sense.

4 : 3 8 P M 18 It comes up with an integral that isn't out of my
4 : 3 8 P M 19 bounds, but I don't think the graph that you give seems
4 : 3 8 P M 20 defendable.

4 : 3 8 P M 21 Q. You could have a line that starts low, peaks in the
4 : 3 9 P M 22 middle, and comes back down to 53,000 and still reach
4 : 3 9 P M 23 35 million -- or 3.5 million?

4 : 3 9 P M 24 A. Would you mind if I used my own pointer?

4 : 3 9 P M 25 Q. Sure.

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 3 9 P M 1 A. I think the flow could start low and then go up and then
4 : 3 9 P M 2 follow along the line, and you could come up with an integral
4 : 3 9 P M 3 that is approximately 30 -- 3.5 million barrels a day. I do
4 : 3 9 P M 4 not think that this is a plausible solution that you have. So
4 : 3 9 P M 5 I can come up with a solution that starts low, maybe goes for
4 : 3 9 P M 6 13 days -- starts at 10,000, goes for 13 days, then somewhere
4 : 3 9 P M 7 up here, attaches to my line and then continues down.

4 : 3 9 P M 8 Now, these numbers, I'm making up out of my head.
4 : 3 9 P M 9 I'm just trying to give you an example. This sort of line does
4 : 3 9 P M 10 not seem reasonable to me.

4 : 4 0 P M 11 Q. Okay. So you could have a line that starts low and goes
4 : 4 0 P M 12 up faster, subject to the math actually working, about how high
4 : 4 0 P M 13 you could get, given that you end at 53,000; correct?

4 : 4 0 P M 14 A. That is correct. I think it's pretty clear: At the end,
4 : 4 0 P M 15 we have flow decreasing with time.

4 : 4 0 P M 16 At the beginning, I have a lack of data, and so I
4 : 4 0 P M 17 could start at 10,000 or 20,000, work my way up. And then I
4 : 4 0 P M 18 could work up higher than this because 53,000 could be enough
4 : 4 0 P M 19 of an estimate, and I could end up lower than this because
4 : 4 0 P M 20 53,000 is just an estimate.

4 : 4 0 P M 21 I don't expect 43,000 to be very probable or 63,000
4 : 4 0 P M 22 to be very probable. I expect to end up near 53,000.

4 : 4 0 P M 23 Q. This line that we have here and the one you just testified
4 : 4 0 P M 24 to, both of those flow rate paths or trends are consistent with
4 : 4 0 P M 25 your expert opinion about what the cumulative flow could be?

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 1 P M 1 A. It's consistent with the cumulative flow, yes. It is not
4 : 4 1 P M 2 consistent of what I think a believable flow versus time is.
4 : 4 1 P M 3 Q. But it's consistent with the error bar that you attached
4 : 4 1 P M 4 to your opinion; correct?
4 : 4 1 P M 5 A. Yes.
4 : 4 1 P M 6 Q. When you arrived at the Macondo, you testified that there
4 : 4 1 P M 7 was a variety of things that you worked on. I'd like you to
4 : 4 1 P M 8 just pull up a document that you drafted in late June of 2010,
4 : 4 1 P M 9 TREN-9388.1.1.
4 : 4 1 P M 10 So by June 29th, 2010, you had been at Macondo for --
4 : 4 1 P M 11 at Houston or working on the problem, either in Houston or
4 : 4 1 P M 12 Albuquerque, for about a month and a half?
4 : 4 1 P M 13 A. That is correct.
4 : 4 1 P M 14 Q. And on June 29th, you drafted this document you call a
4 : 4 1 P M 15 "Flow Uncertainty Position," we've marked as TREN-9388;
4 : 4 2 P M 16 correct?
4 : 4 2 P M 17 A. That is correct.
4 : 4 2 P M 18 Q. And you drafted this for Tom Hunter; correct?
4 : 4 2 P M 19 A. That is -- I drafted that and sent it to a number of
4 : 4 2 P M 20 people for review, and it's indicated here that it's going to
4 : 4 2 P M 21 eventually go to Tom Hunter, yes.
4 : 4 2 P M 22 Q. So if we could turn to the first page of your "Flow
4 : 4 2 P M 23 Uncertainty Position," TREN-9389.2.1.
4 : 4 2 P M 24 What you were drafting in this document was all of
4 : 4 2 P M 25 the challenges that you had -- and your team had -- in terms of

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 2 P M 1 trying to determine a flow rate, given the circumstances at
4 : 4 2 P M 2 Macondo; correct?

4 : 4 2 P M 3 A. That is correct.

4 : 4 2 P M 4 Q. So the first thing you talk about, I think -- actually,
4 : 4 2 P M 5 I'd call it the second page, 9389.1.1, there's two pages.

4 : 4 2 P M 6 The first thing you say: "There are many parameters
4 : 4 2 P M 7 that determine the pressure and temperature distribution within
4 : 4 3 P M 8 the well."

4 : 4 3 P M 9 Correct?

4 : 4 3 P M 10 A. That's correct.

4 : 4 3 P M 11 Q. And doing hydraulic analysis, you need to take into
4 : 4 3 P M 12 account pressure and temperature because it can affect density,
4 : 4 3 P M 13 which can then affect -- as we walk through the formulas -- the
4 : 4 3 P M 14 way you ultimately can calculate flow using pressure
4 : 4 3 P M 15 differences; correct?

4 : 4 3 P M 16 A. That is correct.

4 : 4 3 P M 17 Q. You also point out in the second paragraph: "We have a
4 : 4 3 P M 18 single pressure measurement, so a variety of resistance pairs
4 : 4 3 P M 19 can yield the correct BOP pressure."

4 : 4 3 P M 20 Did I read that correctly?

4 : 4 3 P M 21 A. That is correct.

4 : 4 3 P M 22 Q. What you're referring to there is the PT-B gauge; correct?

4 : 4 3 P M 23 A. Yes. That is your single pressure measurement at that
4 : 4 3 P M 24 one.

4 : 4 3 P M 25 Q. Right.

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 3 PM 1 And by a variety of resistance pairs, you're saying
4 : 4 3 PM 2 that: Depending on what you assume about resistance below --
4 : 4 3 PM 3 that is upstream of the PT-B -- and resistance above -- that is
4 : 4 3 PM 4 below the PT-B -- you could have a variety of pairs that patch
4 : 4 3 PM 5 the PT-B pressure?

4 : 4 3 PM 6 A. That is correct.

4 : 4 3 PM 7 Q. And you say in the fourth paragraph: "The geometry of
4 : 4 3 PM 8 flow is also unknown."

4 : 4 3 PM 9 Correct?

4 : 4 3 PM 10 A. That is correct. We didn't know the path and we didn't
4 : 4 3 PM 11 know what obstructions might be there.

4 : 4 4 PM 12 Q. You mention in the fifth paragraph that: "Current
4 : 4 4 PM 13 observations have revealed that the drill pipe that was known
4 : 4 4 PM 14 to exist in the well has slipped from its last known position."

4 : 4 4 PM 15 Correct?

4 : 4 4 PM 16 A. Yes, that is what I wrote.

4 : 4 4 PM 17 Q. If you're doing a hydraulic analysis, the location of the
4 : 4 4 PM 18 drill pipe can impact the nature of your calculation; correct?

4 : 4 4 PM 19 A. That is correct, especially if you're including the drill
4 : 4 4 PM 20 pipe and the flow is going through the center of the pipe.

4 : 4 4 PM 21 Q. It was another unknown?

4 : 4 4 PM 22 A. That is correct.

4 : 4 4 PM 23 Q. And the sixth paragraph, you said: "The current
4 : 4 4 PM 24 observations of the plume out of the cut-off riser reveal two
4 : 4 4 PM 25 distinct colors. This is consistent with the distinct colors

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 4 P M 1 out of the kink holes previously. This implies that there are
4 : 4 4 P M 2 two distinct flow paths through the BOP."

4 : 4 4 P M 3 Correct?

4 : 4 4 P M 4 A. That was a hypothesis I was putting in there, and that was
4 : 4 4 P M 5 exactly what I wrote.

4 : 4 4 P M 6 Q. The question of what the flow path, even in the BOP, was
4 : 4 4 P M 7 uncertain even as of June 29th, 2010; correct?

4 : 4 4 P M 8 A. That is correct.

4 : 4 4 P M 9 Q. And you say in the last paragraph: "A split in flow
4 : 4 5 P M 10 requires a model."

4 : 4 5 P M 11 You're again referring to two paths in the BOP;
4 : 4 5 P M 12 right?

4 : 4 5 P M 13 A. Yes. We think we had two paths in the BOP, and how much
4 : 4 5 P M 14 goes through each path is of interest.

4 : 4 5 P M 15 Q. If we turn the page then to 9389.2.1. The next
4 : 4 5 P M 16 uncertainty you raise is: "Reservoir depletion is another
4 : 4 5 P M 17 important factor."

4 : 4 5 P M 18 Correct?

4 : 4 5 P M 19 A. That is correct.

4 : 4 5 P M 20 Q. So to do a hydraulics analysis, you need to come to an
4 : 4 5 P M 21 assumption about depletion of the reservoir; correct?

4 : 4 5 P M 22 A. That is correct.

4 : 4 5 P M 23 Q. There was only one measured reservoir pressure,
4 : 4 5 P M 24 11,850 psi, that was measured before the accident; correct?

4 : 4 5 P M 25 A. That is correct.

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 5 P M 1 Q. You say in the second paragraph here: "Any model has to
4 : 4 5 P M 2 not only assume various flow paths and resistances; it has to
4 : 4 5 P M 3 account for potential erosion during the long flowing time. It
4 : 4 5 P M 4 is assumed that the kill operation where mud was forced through
4 : 4 5 P M 5 the various paths could have eroded the BOP."

4 : 4 6 P M 6 This, again, is a reference to the impact of erosion,
4 : 4 6 P M 7 if you're trying to do a hydraulics calculation; correct?

4 : 4 6 P M 8 A. That's correct.

4 : 4 6 P M 9 Q. So it's not only that you have to understand the
4 : 4 6 P M 10 resistances, but you need to understand how they might change
4 : 4 6 P M 11 over time; correct?

4 : 4 6 P M 12 A. That is correct.

4 : 4 6 P M 13 Q. And if you are going to do a flow rate that you're adding
4 : 4 6 P M 14 successive days, you need it make sure that whatever the
4 : 4 6 P M 15 resistances were on one day, have they changed or are they the
4 : 4 6 P M 16 same on the next?

4 : 4 6 P M 17 A. That is correct.

4 : 4 6 P M 18 Q. "The model of the system," you write, "will have a lot of
4 : 4 6 P M 19 parameters."

4 : 4 6 P M 20 Correct?

4 : 4 6 P M 21 A. Yes.

4 : 4 6 P M 22 Q. And parameters, we're going to hear a lot about -- at
4 : 4 6 P M 23 least this week -- that's talking about the way you're
4 : 4 6 P M 24 designing the parameter. How would you describe "parameters"
4 : 4 6 P M 25 in your own words?

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 6 P M 1 A. We have a number of parameters. We obviously have
4 : 4 6 P M 2 effective resistances of a parameter that we always use.
4 : 4 6 P M 3 Discharge coefficients and leaks, heat transfer coefficients,
4 : 4 7 P M 4 friction factors, there are many factors that go into a
4 : 4 7 P M 5 calculation.
4 : 4 7 P M 6 Q. And broadly speaking, these are the types of parameters
4 : 4 7 P M 7 that people that do what you do, multiphase flow analyses, have
4 : 4 7 P M 8 to take into account to calculate flow?
4 : 4 7 P M 9 A. Depending on your model, you need to take into account
4 : 4 7 P M 10 more or less of those, but, yes, we have to take into account
4 : 4 7 P M 11 parameters.
4 : 4 7 P M 12 Q. And you say at the bottom -- I'll skip here -- you
4 : 4 7 P M 13 describe an analogy here, what you say: "This is why one
4 : 4 7 P M 14 cannot use an inaccurate model to determine if the well is
4 : 4 7 P M 15 sound. It is not that the sensitivity is low; it is that our
4 : 4 7 P M 16 uncertainties are high."
4 : 4 7 P M 17 Correct?
4 : 4 7 P M 18 A. I think that's correct.
4 : 4 7 P M 19 Q. The number of parameters or the number of things that you
4 : 4 7 P M 20 would have to either know or then assume was a very large
4 : 4 7 P M 21 number; correct?
4 : 4 7 P M 22 A. Depending on your models. Some models have more
4 : 4 7 P M 23 parameters than others. My capping stack model did not have a
4 : 4 7 P M 24 large number of parameters, but the integrated flow, if you
4 : 4 8 P M 25 wanted to do that from first principles, would have lots of

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 8 P M 1 parameters.

4 : 4 8 P M 2 Q. So the challenges to developing a hydraulic estimate of

4 : 4 8 P M 3 flow, as we've seen here in your flow uncertainty document,

4 : 4 8 P M 4 include understanding the fluid properties; correct?

4 : 4 8 P M 5 A. Yes.

4 : 4 8 P M 6 Q. Understanding the equation of state, which is, in essence,

4 : 4 8 P M 7 also included on these; correct?

4 : 4 8 P M 8 A. Yes.

4 : 4 8 P M 9 Q. That includes issues of density, viscosity, impact of

4 : 4 8 P M 10 crude oil; correct?

4 : 4 8 P M 11 A. That's correct.

4 : 4 8 P M 12 Q. You have to understand the temperature distribution;

4 : 4 8 P M 13 correct?

4 : 4 8 P M 14 A. Yes.

4 : 4 8 P M 15 Q. You have to understand the pressure distribution; correct?

4 : 4 8 P M 16 A. Yes.

4 : 4 8 P M 17 Q. You have to understand the geometry, including any changes

4 : 4 8 P M 18 in that geometry; correct?

4 : 4 8 P M 19 A. Yes.

4 : 4 8 P M 20 Q. You have to come to an assessment of flow path; correct?

4 : 4 8 P M 21 A. In some cases, you do not; but in some cases, you do, yes.

4 : 4 8 P M 22 Q. You're dealing, in Macondo, in a multiphase fluid

4 : 4 8 P M 23 environment; correct?

4 : 4 8 P M 24 A. Yes.

4 : 4 8 P M 25 Q. So then you have to determine what's the effect of

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 4 8 P M 1 multiphase flow in this geometry, in this pressure
4 : 4 9 P M 2 distribution, in this temperature distribution; correct?
4 : 4 9 P M 3 A. That is correct.
4 : 4 9 P M 4 Q. You have to make an assumption about reservoir depletion;
4 : 4 9 P M 5 correct?
4 : 4 9 P M 6 A. Yes.
4 : 4 9 P M 7 Q. You have to make an assumption about erosion; correct?
4 : 4 9 P M 8 A. Yes.
4 : 4 9 P M 9 Q. And given the number of assumptions, you then -- as to the
4 : 4 9 P M 10 inputs, you then also have to say, Does my model have potential
4 : 4 9 P M 11 model error; correct?
4 : 4 9 P M 12 A. Yes.
4 : 4 9 P M 13 Q. And the more parameters you put into the model, the higher
4 : 4 9 P M 14 your potential model error; correct?
4 : 4 9 P M 15 A. As long as you use "potential" in that sentence, I think
4 : 4 9 P M 16 we can agree with it, yes.
4 : 4 9 P M 17 Q. So you would agree that, as of -- leading up to the
4 : 4 9 P M 18 capping stack, your team and your personal efforts to try and
4 : 4 9 P M 19 arrive at a definitive flow rate had been stymied, given the
4 : 4 9 P M 20 number of uncertainties that existed?
4 : 4 9 P M 21 A. I think that's correct. The Top Hat was a very -- was a
4 : 4 9 P M 22 calculation, was -- in the sand that we stuck a stick in the
4 : 5 0 P M 23 stand and said, Gee, this looks significant compared to
4 : 5 0 P M 24 5,000 barrels of oil per day that was reported in the press.
4 : 5 0 P M 25 So we had some calculations before capping stack that

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 0 P M 1 were very informative of the flow.

4 : 5 0 P M 2 MR. REGAN: If we could pull TREX-9361.49.1.

4 : 5 0 P M 3 BY MR. REGAN:

4 : 5 0 P M 4 Q. This is out of the DOE-NNSA report.

4 : 5 0 P M 5 Before I read the quote there, Dr. Dykhuizen, you

4 : 5 0 P M 6 were involved in the first drafting of this report; correct?

4 : 5 0 P M 7 A. I wrote the first draft and I reviewed all the drafts

4 : 5 0 P M 8 afterwards.

4 : 5 0 P M 9 Q. The purpose of this was to summarize the arrival --

4 : 5 0 P M 10 summarize the activities that resulted in the flow rate

4 : 5 0 P M 11 estimate that was issued on August 23rd, 2010, at least in

4 : 5 0 P M 12 terms of DOE-NNSA team; correct?

4 : 5 0 P M 13 A. That is correct.

4 : 5 0 P M 14 Q. And here on page 49, it says in the "Summary Conclusions":

4 : 5 1 P M 15 "While there had been attempts throughout post-accident times

4 : 5 1 P M 16 to quantify the instantaneous flow rate, the DOE-NNSA flow team

4 : 5 1 P M 17 and other researchers directed by the DOI were generally

4 : 5 1 P M 18 stymied in these attempts prior to well shut-in, largely

4 : 5 1 P M 19 because of uncertainties in the well geometry, the BOP, and

4 : 5 1 P M 20 reservoir depletion."

4 : 5 1 P M 21 Correct?

4 : 5 1 P M 22 A. That's a correct reading of that statement.

4 : 5 1 P M 23 Q. And that was your experience as a member of that team at

4 : 5 1 P M 24 Macondo; correct?

4 : 5 1 P M 25 A. Yes.

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 1 P M 1 Q. And now the capping stack was installed on July 12th; it
4 : 5 1 P M 2 started to be activated July 14th; the well was shut in
4 : 5 1 P M 3 July 15th; correct?
4 : 5 1 P M 4 A. That is correct.
4 : 5 1 P M 5 Q. I'm going to turn to some of the calculations that you did
4 : 5 1 P M 6 with respect to the capping stack.
4 : 5 1 P M 7 Before we get there, on July 26th, you had a meeting
4 : 5 1 P M 8 with Tom Hunter where you reviewed the efforts that had been
4 : 5 1 P M 9 made to calculate flow prior to the capping stack; do you
4 : 5 1 P M 10 recall that?
4 : 5 1 P M 11 A. Yes, I do.
4 : 5 1 P M 12 Q. Now, if we turn to TREN-9706, this is a copy of that
4 : 5 2 P M 13 PowerPoint. And if we go to 9706.4, this is a summary of those
4 : 5 2 P M 14 efforts; do you see that?
4 : 5 2 P M 15 A. Yes, it is.
4 : 5 2 P M 16 Q. And it includes a number of things including a Top Hat
4 : 5 2 P M 17 calculation; correct?
4 : 5 2 P M 18 A. Yes, it is.
4 : 5 2 P M 19 Q. On June 15th, 2010; is that right?
4 : 5 2 P M 20 A. That is correct.
4 : 5 2 P M 21 Q. And the range of estimates there from the DOE team was
4 : 5 2 P M 22 72,700 to 83,000 with a 51,900 to 104,900 max range; correct?
4 : 5 2 P M 23 A. That's what it states. That's not my memory of this. I
4 : 5 2 P M 24 thought we had 45 to 80. I think I've reviewed documents that
4 : 5 2 P M 25 has that. Obviously, Dr. Ratzell, when writing this report,

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 2 P M 1 has a slightly different range.

4 : 5 2 P M 2 Q. You don't recall that, in fact, the three labs' estimates
4 : 5 2 P M 3 of Top Hat on July 15th, the lowest one was 72,700? You don't
4 : 5 3 P M 4 recall that? And the high range was 83,000?

4 : 5 3 P M 5 A. Those numbers don't ring clear in my mind. It might be
4 : 5 3 P M 6 that they stated that. He's labeling these "Baseline." I
4 : 5 3 P M 7 think what he means by "baseline," since he coordinated these
4 : 5 3 P M 8 calculations, was we were told how much area to assume in the
4 : 5 3 P M 9 skirt and we were told how to proceed with the skirt
4 : 5 3 P M 10 calculation. None of the team really supported those values,
4 : 5 3 P M 11 but we went ahead and did those calculations for him, and
4 : 5 3 P M 12 that's probably what this top number is.

4 : 5 3 P M 13 He gave very small ranges for what to assume in the
4 : 5 3 P M 14 skirt and, therefore, we get a very small range, 73,000 to
4 : 5 3 P M 15 83,000. That was not supported. People redid their
4 : 5 4 P M 16 calculations based on what we felt were accurate at the time.
4 : 5 4 P M 17 I seem to recall 45 to 80. This reports here 52 to 104 -- or
4 : 5 4 P M 18 105. I would have discounted 105 because the well cannot flow
4 : 5 4 P M 19 105,000 barrels a day. But possibly the mathematics of the Top
4 : 5 4 P M 20 Hat did yield 105,000 barrels per day.

4 : 5 4 P M 21 Q. Okay. TRES-11534.1, this is a presentation that was made
4 : 5 4 P M 22 on June 15th with the Top Hat estimates. Do you recognize this
4 : 5 4 P M 23 document?

4 : 5 4 P M 24 A. Yes, I do.

4 : 5 4 P M 25 Q. I think you attached it to your expert report?

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 4 P M 1 A. Yes, I did.

4 : 5 4 P M 2 MR. REGAN: Go to TREX-11534.16.

4 : 5 4 P M 3 BY MR. REGAN:

4 : 5 4 P M 4 Q. Do you see on there, Dr. Dykhuizen, the total oil flow

4 : 5 5 P M 5 estimates of the three national labs ranging from 72,700 to

4 : 5 5 P M 6 83,000?

4 : 5 5 P M 7 A. Yes, that's, again, labeled the baseline case.

4 : 5 5 P M 8 Q. And the largest component of that flow is out of the

4 : 5 5 P M 9 skirt; correct?

4 : 5 5 P M 10 A. That is correct.

4 : 5 5 P M 11 Q. About 50 percent of those numbers; right?

4 : 5 5 P M 12 A. That is correct.

4 : 5 5 P M 13 MR. REGAN: Go back to TREX-9706.5.

4 : 5 5 P M 14 BY MR. REGAN:

4 : 5 5 P M 15 Q. So on July 26th, in reviewing these issues with

4 : 5 5 P M 16 Dr. Hunter, it was the Tri-Lab assessment, of which you were a

4 : 5 5 P M 17 member, that none of the methods listed above provided

4 : 5 5 P M 18 believable max flow results, including the Top Hat estimates;

4 : 5 5 P M 19 correct?

4 : 5 5 P M 20 A. "Believable" is a relative term. If the Top Hat

4 : 5 5 P M 21 calculates 100,000 barrels of oil per day, that is not

4 : 5 5 P M 22 believable because the well geometry can't support that.

4 : 5 5 P M 23 Q. The word "believable" was used by one of the members of

4 : 5 5 P M 24 the team that did the calculations; correct?

4 : 5 5 P M 25 A. Used -- it was written by Dr. Ratzell and he led the

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 6 P M 1 calculations; correct.

4 : 5 6 P M 2 Q. And he found there were too many model uncertainties

4 : 5 6 P M 3 and/or data for quantitative analysis included in the Top Hat

4 : 5 6 P M 4 calculations; correct?

4 : 5 6 P M 5 A. That is correct.

4 : 5 6 P M 6 Q. There's no -- I'm sorry?

4 : 5 6 P M 7 A. That is the reason I tried to put in a lower bound than

4 : 5 6 P M 8 the Top Hat calculation, because the estimates from the Top Hat

4 : 5 6 P M 9 calculation had quite a large error bar to it.

4 : 5 6 P M 10 Q. Later that same week, Dr. Dykhuizen, the week of

4 : 5 6 P M 11 July 26th, you were then told that you needed to have a meeting

4 : 5 6 P M 12 on July 30th to provide a new flow rate for the government to

4 : 5 6 P M 13 announce; correct?

4 : 5 6 P M 14 A. Yes, I think that's true.

4 : 5 6 P M 15 Q. And that deadline, Friday, forced your team to rush to

4 : 5 6 P M 16 complete its calculations; correct?

4 : 5 6 P M 17 A. I'm not going to agree with the word "rushed." I'm also

4 : 5 6 P M 18 not going to agree with the fact that we started those

4 : 5 6 P M 19 calculations those days. We started the calculations the first

4 : 5 6 P M 20 day the capping stack was installed, as I testified.

4 : 5 6 P M 21 Q. There was a spreadsheet model that was used that week to

4 : 5 7 P M 22 calculate the flow rate that was then discussed on Friday;

4 : 5 7 P M 23 correct?

4 : 5 7 P M 24 A. That is correct.

4 : 5 7 P M 25 MR. REGAN: TREX 11456.1.1.

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 7 P M 1 **BY MR. REGAN:**

4 : 5 7 P M 2 Q. The name of the spreadsheet was "Wednesdaynightrush.XLS";

4 : 5 7 P M 3 right?

4 : 5 7 P M 4 A. That is correct. Charlie named this, I think, in an

4 : 5 7 P M 5 attempt at humor.

4 : 5 7 P M 6 Q. Now, Charlie Morrow, he was a person that you worked very

4 : 5 7 P M 7 closely with?

4 : 5 7 P M 8 A. Yes.

4 : 5 7 P M 9 Q. And he had oil and gas experience; is that right?

4 : 5 7 P M 10 A. Yes.

4 : 5 7 P M 11 Q. You found him to be a very reliable and credible asset to

4 : 5 7 P M 12 you as you looked at these problems in 2010?

4 : 5 7 P M 13 A. Yes, he was.

4 : 5 7 P M 14 Q. Is he still at Sandia?

4 : 5 7 P M 15 A. Yes.

4 : 5 7 P M 16 Q. If we can then talk a little bit about the capping stack

4 : 5 7 P M 17 calculations.

4 : 5 7 P M 18 **MR. REGAN:** Can you put up D-21100.1, which I believe

4 : 5 7 P M 19 we saw on your direct.

4 : 5 7 P M 20 **BY MR. REGAN:**

4 : 5 8 P M 21 Q. While that's coming up, with the capping stack, you now

4 : 5 8 P M 22 had a well-defined geometry; correct?

4 : 5 8 P M 23 A. Yes, I think that's a quote out of the report.

4 : 5 8 P M 24 Q. You had calibrated pressure gauge information that you

4 : 5 8 P M 25 trusted; correct?

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 8 P M 1 A. Yes.

4 : 5 8 P M 2 Q. And this is where you described the capping stack being

4 : 5 8 P M 3 equivalent to an uncalibrated flow meter?

4 : 5 8 P M 4 A. That is correct.

4 : 5 8 P M 5 Q. You said the calculations that are set forth on

4 : 5 8 P M 6 D-21101.1 -- we'll come to it later.

4 : 5 8 P M 7 "The calculations are standard, first-year

4 : 5 8 P M 8 undergraduate course-type calculations"; is that right?

4 : 5 8 P M 9 A. That's correct.

4 : 5 8 P M 10 Q. But you had three national labs doing the calculations;

4 : 5 8 P M 11 correct?

4 : 5 8 P M 12 A. That is correct?

4 : 5 8 P M 13 Q. Ph.D.'s all around.

4 : 5 8 P M 14 A. I'm not sure if that's correct, but most of them had

4 : 5 8 P M 15 Ph.D.'s. Charlie Morrow did not have a Ph.D.

4 : 5 8 P M 16 Q. Smart guys?

4 : 5 8 P M 17 A. Yes.

4 : 5 8 P M 18 Q. All three labs were looking at the same known geometry;

4 : 5 9 P M 19 correct?

4 : 5 9 P M 20 A. That is correct.

4 : 5 9 P M 21 Q. But the three labs used different K-factors or different

4 : 5 9 P M 22 resistance factors for the same known geometry; right?

4 : 5 9 P M 23 A. That is correct.

4 : 5 9 P M 24 MR. REGAN: TREX-9361.24.1.

25

RONALD DYKHUIZEN, PH.D. - CROSS

4 : 5 9 P M 1 BY MR. REGAN:

4 : 5 9 P M 2 Q. As summarized in the Ratzell report -- again, for a common
4 : 5 9 P M 3 geometry -- the three national labs used different resistance
4 : 5 9 P M 4 factors for the exact same pipes; right?

4 : 5 9 P M 5 A. That is correct. Your laser pointer tends to highlight
4 : 5 9 P M 6 one in particular, which is mine up here. The reason this one
4 : 5 9 P M 7 seems to be different is it's based on a different diameter.
4 : 5 9 P M 8 It is actually very close to, I think, one of the other two. I
4 : 5 9 P M 9 can't do it off the top of my head, but I think it's very close
5 : 0 0 P M 10 to .5.

5 : 0 0 P M 11 Q. The national labs -- the three national labs looking at
5 : 0 0 P M 12 the same geometry had different values for the resistances of
5 : 0 0 P M 13 the flow inside those pipes; correct?

5 : 0 0 P M 14 A. That is correct.

5 : 0 0 P M 15 Q. And that's an uncertainty that is part of the capping
5 : 0 0 P M 16 stack calculations; correct?

5 : 0 0 P M 17 A. You could say that, but we also had the alternate method
5 : 0 0 P M 18 where we didn't use any of these and we let the data determine
5 : 0 0 P M 19 what the resistances were. And the data showed that the
5 : 0 0 P M 20 resistances were approximately the same and we got
5 : 0 0 P M 21 approximately the same flow rate. So we performed the flow
5 : 0 0 P M 22 calculations without using these tables.

5 : 0 0 P M 23 I also only support the column that says "Sandia
5 : 0 0 P M 24 National Laboratory." That's my work. And the other two, I'm
5 : 0 0 P M 25 not supporting in my expert report.

RONALD DYKHUIZEN, PH.D. - CROSS

5:00 PM 1 Q. Have I read correctly that the three national labs,
5:00 PM 2 looking at the exact same geometry to do hydraulics
5:01 PM 3 calculations, came up with different K-factors for that
5:01 PM 4 geometry. Did I read that chart correctly?

5:01 PM 5 A. That is correct.

5:01 PM 6 Q. Those three labs were also looking at the same flowing
5:01 PM 7 fluid through the wellbore; correct?

5:01 PM 8 A. That is correct.

5:01 PM 9 Q. But each of the three national labs treated it
5:01 PM 10 differently; correct?

5:01 PM 11 A. Treated the fluid differently is what I mean by it?

5:01 PM 12 Q. Yes.

5:01 PM 13 A. Yes.

5:01 PM 14 Q. They had different equations of state; right?

5:01 PM 15 A. That is correct.

5:01 PM 16 Q. So all three labs were attempting to model multiphase flow
5:01 PM 17 out of the capping stack, but they all handled it a little
5:01 PM 18 differently; correct?

5:01 PM 19 A. That is correct.

5:01 PM 20 Q. In your calculations, you did not model or try to
5:01 PM 21 determine the type of flow regime or the way the multiphase
5:01 PM 22 flow would actually progress through the capping stack;
5:01 PM 23 correct?

5:01 PM 24 A. That is correct. I did not determine a flow regime. I
5:01 PM 25 used K-factors, which implicitly assume that you have

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 0 2 P M 1 homogenous flow, that the liquid and the gas are flowing at the
5 : 0 2 P M 2 same velocities through the capping stack.

5 : 0 2 P M 3 Q. So homogenous flow is an assumption about how the
5 : 0 2 P M 4 multiphase fluid is going to behave in this geometry?

5 : 0 2 P M 5 A. That is correct, but the alternate method supports that
5 : 0 2 P M 6 assumption.

5 : 0 2 P M 7 Q. Method 3 that you talked about on direct, that one flows
5 : 0 2 P M 8 when the choke line was closed; correct?

5 : 0 2 P M 9 A. I think we got Method 2 but, yes, I did one with the choke
5 : 0 2 P M 10 line closing.

5 : 0 2 P M 11 Q. The choke line geometry was much more complex than the
5 : 0 2 P M 12 kill line geometry in the capping stack?

5 : 0 2 P M 13 A. Yes, it was.

5 : 0 2 P M 14 Q. And all three national labs predicted that the flow would
5 : 0 2 P M 15 increase when the valve was closed rather than decrease with
5 : 0 2 P M 16 the choke valve; correct?

5 : 0 2 P M 17 A. Not only did three national labs predict that, but a
5 : 0 2 P M 18 number of other people had similar predictions, given the data,
5 : 0 3 P M 19 yes.

5 : 0 3 P M 20 Q. That was a non-physical result?

5 : 0 3 P M 21 A. That is correct.

5 : 0 3 P M 22 Q. And that outcome led you to have further uncertainty about
5 : 0 3 P M 23 the capping stack flow rate calculation; correct?

5 : 0 3 P M 24 A. That is correct. I think that is a very good
5 : 0 3 P M 25 representation of my position.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 0 3 P M 1 Q. At the meeting on July 30th, 2010, with Dr. Hunter and
5 : 0 3 P M 2 Secretary Chu -- you attended that meeting by phone; correct?

5 : 0 3 P M 3 A. That is correct.

5 : 0 3 P M 4 Q. And your team represented through Dr. Ratzell that there
5 : 0 3 P M 5 was insufficient information to perform an uncertainty analysis
5 : 0 3 P M 6 on flow rate and total flow at the time of that meeting;
5 : 0 3 P M 7 correct?

5 : 0 3 P M 8 A. I don't recall that statement at the time of the meeting,
5 : 0 3 P M 9 but that represents probably Dr. Ratzell's position, yes.

5 : 0 3 P M 10 MR. REGAN: TREX-8635.96.3.

5 : 0 4 P M 11 BY MR. REGAN:

5 : 0 4 P M 12 Q. Do you recognize this as one of the slides that was shown
5 : 0 4 P M 13 at the July 30th meeting, Dr. Dykhuizen?

5 : 0 4 P M 14 A. My memory isn't that good, but I will take your word for
5 : 0 4 P M 15 it that it's one of the slides, yes.

5 : 0 4 P M 16 Q. It's consistent with your memory that your team told the
5 : 0 4 P M 17 assembled group that, as of July 30th, 2010, you had
5 : 0 4 P M 18 insufficient information to perform an uncertainty analysis on
5 : 0 4 P M 19 flow rate and total flow at the time of meeting?

5 : 0 4 P M 20 A. Yes. I did not disagree with your concept of the
5 : 0 4 P M 21 statement; I just don't recall that statement being made. It
5 : 0 4 P M 22 probably was since you present this viewgraph to me.

5 : 0 4 P M 23 Q. And it lists some of the uncertainty sources there on the
5 : 0 4 P M 24 tenth line, including model form, boundary and initial
5 : 0 4 P M 25 conditions, and other model parameters; correct?

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 0 4 P M 1 A. Yes.

5 : 0 4 P M 2 Q. During that meeting, you voiced your permanent view of

5 : 0 4 P M 3 what the appropriate uncertainty was for the capping stack

5 : 0 4 P M 4 calculation; correct?

5 : 0 4 P M 5 A. Which meeting are we at, please? I forgot.

5 : 0 5 P M 6 Q. July 30th, 2010.

5 : 0 5 P M 7 A. And the next meeting was the 31st?

5 : 0 5 P M 8 Q. Yes, sir. One was a Friday and one was a Saturday.

5 : 0 5 P M 9 A. I'm not on certain which one of those two meetings I

5 : 0 5 P M 10 expressed my concern. But, yes, at one of those two meetings,

5 : 0 5 P M 11 I expressed a concern about uncertainty values.

5 : 0 5 P M 12 Q. At that meeting, you expressed that you believed that the

5 : 0 5 P M 13 minimum uncertainty on the capping stack number should be plus

5 : 0 5 P M 14 or minus 20 percent; correct?

5 : 0 5 P M 15 A. Yes. At one of those two meetings. I can't recall right

5 : 0 5 P M 16 now which one it was, but I recall we had a discussion. There

5 : 0 5 P M 17 were some values presented for uncertainty and my vote was for

5 : 0 5 P M 18 20 percent.

5 : 0 5 P M 19 Q. At some point after you articulated your uncertainty, you

5 : 0 5 P M 20 heard Secretary Chu say that he believed the uncertainty should

5 : 0 5 P M 21 be 10 percent; correct?

5 : 0 5 P M 22 A. That is correct. I think the first voice I heard said it

5 : 0 5 P M 23 was plus or minus 5 percent. I said that it was plus or minus

5 : 0 6 P M 24 20 percent, because I thought 5 percent was ridiculous. And it

5 : 0 6 P M 25 seemed that Dr. Chu, attending by phone, but he has a unique

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 0 6 P M 1 voice, I think that he said plus or minus 10 percent as a
5 : 0 6 P M 2 compromise.

5 : 0 6 P M 3 Q. Now, your coworker we spoke of a minute ago, Charlie
5 : 0 6 P M 4 Morrow, he also disagreed with 10 percent uncertainty on that
5 : 0 6 P M 5 53,000 estimate; correct?

5 : 0 6 P M 6 A. That is correct. He voiced an opinion of 30 percent.

5 : 0 6 P M 7 Q. So Charlie Morrow, the Sandia employee who had oil and gas
5 : 0 6 P M 8 experience, believed that the appropriate uncertainty for the
5 : 0 6 P M 9 July 15th estimate of 53,000 was plus or minus 30 percent;
5 : 0 6 P M 10 correct?

5 : 0 6 P M 11 A. That is correct.

5 : 0 6 P M 12 Q. And that was based on his oil and gas experience; correct?

5 : 0 6 P M 13 A. I would assume so, yes, that he based it on his
5 : 0 6 P M 14 experience. I don't recall that he did any formal analysis.

5 : 0 6 P M 15 Q. And just as you have a higher uncertainty for your
5 : 0 6 P M 16 cumulative, as opposed to your July 15th number, Charlie Morrow
5 : 0 7 P M 17 also had a higher uncertainty on the cumulative number than
5 : 0 7 P M 18 30 percent for July 15th; correct?

5 : 0 7 P M 19 A. I have no idea what his uncertainty was, but if he's a
5 : 0 7 P M 20 bright guy and he has 30 percent uncertainty on the final day,
5 : 0 7 P M 21 he should have higher than 30 percent uncertainty for the
5 : 0 7 P M 22 integral.

5 : 0 7 P M 23 Q. That's what make sense; correct?

5 : 0 7 P M 24 A. That's the only thing that makes sense, correct.

5 : 0 7 P M 25 MR. REGAN: TRES-8809.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 0 7 P M 1 **BY MR. REGAN:**

5 : 0 7 P M 2 **Q.** This is the August 2nd press release that was issued with
5 : 0 7 P M 3 the 4.9 million cumulative flow estimate. In the first
5 : 0 7 P M 4 paragraph with the highlight that starts with "Washington."

5 : 0 7 P M 5 Do you see in the last sentence there, Dr. Dykhuizen,
5 : 0 7 P M 6 that the official estimate said that the uncertainty would be
5 : 0 7 P M 7 plus or minus approximately 10 percent?

5 : 0 7 P M 8 **A.** I see that statement. I haven't read the whole paragraph
5 : 0 7 P M 9 because I'm trying to listen to you and read at the same time
5 : 0 8 P M 10 and I'm not that quick. I assume this means for the -- let me
5 : 0 8 P M 11 read the paragraph, please.

5 : 0 8 P M 12 **Q.** If we need to highlight a portion of it for you, just let
5 : 0 8 P M 13 us know.

5 : 0 8 P M 14 **A.** This says the uncertainty is plus or minus 10 percent.
5 : 0 8 P M 15 I'm not sure that it applies to the total or to the flow on the
5 : 0 8 P M 16 final day or for all of it. If it applies for all it or if it
5 : 0 8 P M 17 just applies to either one, I disagree with that statement
5 : 0 8 P M 18 either way.

5 : 0 8 P M 19 **MR. REGAN:** TREX-8809.1.1.

5 : 0 9 P M 20 **BY MR. REGAN:**

5 : 0 9 P M 21 **Q.** You know that the Ratzel report that was issued, that we
5 : 0 9 P M 22 looked at a minute ago, also had a 10 percent uncertainty on
5 : 0 9 P M 23 the final flow rate date -- flow rate and a 10 percent
5 : 0 9 P M 24 uncertainty on the cumulative flow rate; correct?

5 : 0 9 P M 25 **A.** That is correct. I disagreed with it then; I disagree

RONALD DYKHUIZEN, PH.D. - CROSS

5:09 PM 1 with it now. I was not the author of that report. I voiced my
5:09 PM 2 disagreement at the time.

5:09 PM 3 Q. And if the estimate released on August 2nd, 2010, which
5:09 PM 4 the Ratzel report or the DOE report was supposed to be
5:09 PM 5 documenting -- if it also had 10 percent for the final flow
5:09 PM 6 rate and 10 percent for the cumulative, you disagree with that?

5:09 PM 7 A. Yes, I would disagree with that. But the excerpt you
5:09 PM 8 showed me just said a 10 percent error, and I'm not certain
5:09 PM 9 what it applied to because the quote you showed me was vague.

5:09 PM 10 Q. Fair enough.

5:09 PM 11 If we go back, then, to the DOE report, 9361.1.
5:09 PM 12 This, again, is the report that documents the activities that
5:10 PM 13 happened on July 30th and 31st to arrive at that August 2nd
5:10 PM 14 flow rate estimate; correct?

5:10 PM 15 A. That is correct.

5:10 PM 16 Q. Now, amongst the three national labs, there were a number
5:10 PM 17 of different flow rate predictions for just the capping stack;
5:10 PM 18 correct?

5:10 PM 19 A. That is correct.

5:10 PM 20 MR. REGAN: If we could go to Demonstrative 24406.

5:10 PM 21 BY MR. REGAN:

5:10 PM 22 Q. This is a demonstrative, Dr. Dykhuizen, that pulls the
5:10 PM 23 14 flow rate estimates that are found in Exhibit 9361 from the
5:10 PM 24 three national labs from the four different ways that capping
5:10 PM 25 stack flows were estimated.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 10 PM 1 Are you with me?

5 : 10 PM 2 A. That is correct.

5 : 10 PM 3 Q. Okay. The number that you are testifying to is 53,000;

5 : 10 PM 4 correct?

5 : 10 PM 5 A. Which is the average of the bottom six numbers. Those are

5 : 10 PM 6 the numbers that I calculated, yes.

5 : 10 PM 7 Q. It's not the average of the combined three national labs'

5 : 10 PM 8 calculations of capping stack flows; correct?

5 : 11 PM 9 A. I'm here to represent my opinions, not the opinions of the

5 : 11 PM 10 combined three national labs, yes.

5 : 11 PM 11 Q. But the other national labs had qualified engineers doing

5 : 11 PM 12 those calculations; correct?

5 : 11 PM 13 A. Yes, they had qualified engineers. I'm not sure that

5 : 11 PM 14 their teams were as good as mine. I had Charlie Morrow and

5 : 11 PM 15 they did not have Charles Morrow.

5 : 11 PM 16 Q. But you would agree with me that the number 53,000 is the

5 : 11 PM 17 second-highest estimate of the 14 that were made from the

5 : 11 PM 18 capping stack; correct?

5 : 11 PM 19 A. I demonstrated in my testimony today that 53,000 is the

5 : 11 PM 20 average of the bottom six numbers on your chart.

5 : 11 PM 21 **MR. REGAN:** D-24407.

5 : 11 PM 22 **BY MR. REGAN:**

5 : 11 PM 23 Q. If I take those 14 numbers and I just put them highest to

5 : 11 PM 24 lowest, you would agree with me that the 53,000 estimate, which

5 : 11 PM 25 is one of your Sandia estimates, is the second-highest estimate

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 12 PM 1 that was made for capping stack; correct?

5 : 12 PM 2 A. That is correct. And also, the 55,300 is also a Sandia

5 : 12 PM 3 estimate.

5 : 12 PM 4 Q. The 55,300, the highest number on the chart that we have

5 : 12 PM 5 on the board, 24407, that was made on the choke line closure;

5 : 12 PM 6 correct?

5 : 12 PM 7 A. That is correct.

5 : 12 PM 8 Q. That was the one where you had the anomaly of predicting

5 : 12 PM 9 flow increasing when the valve was closing; correct?

5 : 12 PM 10 A. We didn't have the anomaly on the other ones because we

5 : 12 PM 11 didn't have the opportunity to take any data on the other ones.

5 : 12 PM 12 55,300 may be the most accurate. As a matter of

5 : 12 PM 13 fact, increasing the flow as the valve was changing, was

5 : 12 PM 14 closing, maybe should indicate to us that there was more flow

5 : 12 PM 15 coming out than we thought.

5 : 12 PM 16 I only weighted that number by one-sixth, and I come

5 : 12 PM 17 up with my average of 53,000.

5 : 12 PM 18 Q. The fact is, Dr. Dykhuizen, that 53,000 number that we see

5 : 12 PM 19 in the report and that we heard you testify to today is an

5 : 12 PM 20 upper bound estimate on the flow out of the capping stack;

5 : 12 PM 21 correct?

5 : 13 PM 22 A. No, it's not, because there are many variables that go

5 : 13 PM 23 into that calculation. We have temperature uncertainty. We

5 : 13 PM 24 have a model uncertainty. We have a number of uncertainties.

5 : 13 PM 25 We have an uncalibrated flow meter. It could be 20 percent

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 13 PM 1 higher or it could be 20 percent lower.

5 : 13 PM 2 Q. Dr. Ratze1 described that 53,000 number to you as being an
5 : 13 PM 3 upper bound, did he not?

5 : 13 PM 4 A. Yes, he did. In one of my reviews of the report, I said,
5 : 13 PM 5 "I do not understand what you mean by 'upper bound,' and I
5 : 13 PM 6 suggest you delete that from the report."

5 : 13 PM 7 It made no sense to me. That was not my position.

5 : 13 PM 8 MR. REGAN: TREX-9379.1.2.

5 : 13 PM 9 BY MR. REGAN:

5 : 13 PM 10 Q. This is the e-mail from Dr. Ratze1 to you with a draft of
5 : 13 PM 11 the report that we were just looking at previously.

5 : 13 PM 12 And he writes to you in the second paragraph: "I
5 : 14 PM 13 need you to also redo some of your analyses in the report,
5 : 14 PM 14 working with an upper bound of 53K-bopd rather than 51K. Why -
5 : 14 PM 15 everyone else is quoting our 53K as the shut-in flow rate based
5 : 14 PM 16 on the July 30-31 meetings and government press release, and I
5 : 14 PM 17 think, to be consistent, we should stay there as well. I
5 : 14 PM 18 thought hard on working to 51K and decided we should use 53K,
5 : 14 PM 19 calling it our upper bound estimate (which is true if I believe
5 : 14 PM 20 the pipe flow results for choke line). I frankly do not want
5 : 14 PM 21 any backpedaling on numbers, and as you and I are both aware,
5 : 14 PM 22 53 or 51 are equally suspect - if we were to continually refine
5 : 14 PM 23 our work, as example, we would be using 1600 psi, not 1800 psi
5 : 14 PM 24 based on the continuing refinements by Hsieh right around
5 : 14 PM 25 July 30-31."

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 14 PM 1 Did I read his e-mail to you correctly?

5 : 14 PM 2 A. Yes, you did.

5 : 15 PM 3 Q. Did Dr. Ratze[redacted] represent in his e-mail to you that 53,000

5 : 15 PM 4 was an upper bound estimate?

5 : 15 PM 5 A. He used that in his second draft of the report. I do

5 : 15 PM 6 not -- I could not figure out what he meant by upper bound. It

5 : 15 PM 7 seemed vague. It did not represent my opinion of the flow. I

5 : 15 PM 8 asked him to change that wording in the report that he added to

5 : 15 PM 9 my first draft. I do not see 53,000 was an upper bound.

5 : 15 PM 10 Q. The 53,000 flow rate for July 15th represents the

5 : 15 PM 11 conditions that existed in the well, in the BOP, and the

5 : 15 PM 12 capping stack as of that date; correct?

5 : 15 PM 13 A. Could you repeat the question.

5 : 15 PM 14 Q. Sure. The 53,000 estimate for July 15th represents or

5 : 15 PM 15 reflects the conditions that existed on that day, July 15th, in

5 : 15 PM 16 the well, in the BOP, and the capping stack?

5 : 16 PM 17 A. That is correct. I can't disagree with that statement.

5 : 16 PM 18 Q. There's nothing about the work on your capping stack flow

5 : 16 PM 19 rate that would give you a conclusion that the well was in the

5 : 16 PM 20 exact same condition for the preceding 85 days?

5 : 16 PM 21 A. No. There was no data from the capping stack that

5 : 16 PM 22 would -- that would allow me to find flow from the previous

5 : 16 PM 23 days. I was just using pressures reported from the capping

5 : 16 PM 24 stack on the last day.

5 : 16 PM 25 Q. You mentioned, I think, a couple times on direct, this

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 16 PM 1 notion of conversion to stock tank barrels. Do you recall
5 : 16 PM 2 talking about that just as a generality?

5 : 16 PM 3 A. Yes.

5 : 16 PM 4 Q. Now, go to 9361.71. This, again, is the DOE report that
5 : 16 PM 5 you drafted and reviewed. At the very top --

5 : 17 PM 6 You can highlight the very top.

5 : 17 PM 7 Do you see there it's describing the equation of
5 : 17 PM 8 state that was used by Sandia? We can go to the preceding page
5 : 17 PM 9 if it would be helpful for you, but that's the section of the
5 : 17 PM 10 report.

5 : 17 PM 11 What I'd like to direct your attention to is the
5 : 17 PM 12 second bullet. It says: "SNL created computer routines to do
5 : 17 PM 13 the following."

5 : 17 PM 14 And then it says: "Flash crude oil into liquid and
5 : 17 PM 15 gas phases as required and based on the pressure drops
5 : 17 PM 16 calculated above."

5 : 17 PM 17 Do you see that?

5 : 17 PM 18 A. Yes.

5 : 17 PM 19 Q. Okay. Did you use a particular type of flash process to
5 : 17 PM 20 convert your mass flow rates into a stock tank barrel flow
5 : 17 PM 21 rate?

5 : 17 PM 22 A. Yes, we did.

5 : 17 PM 23 Q. What did you use?

5 : 17 PM 24 A. We used a single-stage flash.

5 : 17 PM 25 Q. Did you in any way in your expert reports in this case,

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 17 PM 1 Dr. Dykhuizen, rely upon the work of Dr. Zick?

5 : 17 PM 2 A. In my expert report, when I wrote that, I saw some results

5 : 17 PM 3 of Dr. Zick. And it -- they were close to what I had, but, no,

5 : 18 PM 4 I did not need to use his report.

5 : 18 PM 5 Q. But for purposes of the calculation of the number in the

5 : 18 PM 6 end of July, as reflected in the DOE-NNSA report, you used a

5 : 18 PM 7 single-stage flash process?

5 : 18 PM 8 A. Yes. Dr. Morrow's code -- Mr. Morrow's code was set up to

5 : 18 PM 9 do it that way. It's a much more long and involved process to

5 : 18 PM 10 use his code for a multiphase flash process.

5 : 18 PM 11 Q. Do you recall, Dr. Dykhuizen, when you were drafting the

5 : 18 PM 12 first draft of this report, that you described the model as --

5 : 18 PM 13 using a fictional initial state?

5 : 18 PM 14 A. Yes. I used that and ever regretted using that phrase.

5 : 19 PM 15 Q. Let me show it to you, Exhibit 9924.1.1, which is an

5 : 19 PM 16 e-mail that attaches a draft dated August 3rd, 2010. So

5 : 19 PM 17 9924.1.1. Then I'll go to the attachment, 9924.3.2.

5 : 19 PM 18 In your first draft of the report, did you describe

5 : 19 PM 19 as follows, when talking about extrapolating back, "Note, this

5 : 19 PM 20 describes a fictional initial state since the model implicitly

5 : 19 PM 21 assumed that the well geometry does not change during the

5 : 19 PM 22 85 days of flowing this well. In fact, many geometry changes

5 : 19 PM 23 occurred. These include, but are not limited to, the riser and

5 : 19 PM 24 kink being cut off, junk shots and erosion"?

5 : 19 PM 25 Did you write those words, Dr. Dykhuizen?

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 19 PM 1 A. Yes, I wrote those words.

5 : 19 PM 2 Q. And you wrote them in the context of describing the
5 : 20 PM 3 extrapolation back from capping stack to the beginning of the
5 : 20 PM 4 flow period; correct?

5 : 20 PM 5 A. That's not complete. What I did was extrapolate back to a
5 : 20 PM 6 fictional state, which was true, and said that if nothing
5 : 20 PM 7 changed, we would have this value.

5 : 20 PM 8 But then I said, "We need to account for the
5 : 20 PM 9 changes," and so I have to have a 4 percent increase when I go
5 : 20 PM 10 backwards. Instead of putting the capping stack on, I have to
5 : 20 PM 11 take the capping stack off.

5 : 20 PM 12 And then I have to have a 4 percent decrease when
5 : 20 PM 13 I -- instead of cutting the riser off, I have to cut the riser
5 : 20 PM 14 back on. So my final calculations included those, and this
5 : 20 PM 15 intermediate step was never used to perform the integral.

5 : 20 PM 16 Q. In your draft of this part of the report, and as reflected
5 : 21 PM 17 in the final, the model used to extrapolate back does not
5 : 21 PM 18 account for erosion; correct?

5 : 21 PM 19 A. That is correct. The model does not have an erosion term
5 : 21 PM 20 in it. The only way I account for erosion is my proxy of
5 : 21 PM 21 assigning zero flow for the first two days.

5 : 21 PM 22 MR. REGAN: If we could go back to D-23996-A.

5 : 21 PM 23 BY MR. REGAN:

5 : 21 PM 24 Q. You would also agree, Dr. Dykhuizen, that the further away
5 : 21 PM 25 that we get from July 15th, the further we move backwards in

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 1 P M 1 time away from that capping stack calculation with its known
5 : 2 1 P M 2 geometry and pressures, the less confidence you have in the
5 : 2 1 P M 3 actual calculation of a given flow rate on a given day?
5 : 2 1 P M 4 A. Yes, and that's mainly due to erosion.
5 : 2 1 P M 5 Q. If this 53,000 is adjusted to your 20 percent low number
5 : 2 2 P M 6 of 42,400, it brings your whole curve down; correct?
5 : 2 2 P M 7 A. That is correct. And if I adjust it up, it brings the
5 : 2 2 P M 8 whole curve up.
5 : 2 2 P M 9 Q. I think you testified about that part on your direct, so I
5 : 2 2 P M 10 just want to balance it out.
5 : 2 2 P M 11 A. I'm sorry. I didn't mean to be unfair. I should say it
5 : 2 2 P M 12 both ways, both times.
5 : 2 2 P M 13 Q. So if the 53,000 number moves up, your total cumulative
5 : 2 2 P M 14 moves up; correct?
5 : 2 2 P M 15 A. That is correct.
5 : 2 2 P M 16 Q. And if the 53,000 moves down, your cumulative moves down;
5 : 2 2 P M 17 correct?
5 : 2 2 P M 18 A. That is correct.
5 : 2 2 P M 19 Q. Do you agree, Dr. Dykhuizen, that it's very unlikely that
5 : 2 2 P M 20 you understated the -- overstated the amount of depletion in
5 : 2 2 P M 21 the reservoir, that is, from the initial 11,850 to the final
5 : 2 2 P M 22 number that you have for 53,000?
5 : 2 2 P M 23 A. This original calculation might have an error due to the
5 : 2 2 P M 24 reservoir pressure, and correcting for that error might give
5 : 2 3 P M 25 you 3 percent less flow, as I indicate in the -- as indicated

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 3 P M 1 in the NNSA report.

5 : 2 3 P M 2 Q. But by holding resistances constant -- that is, assuming
5 : 2 3 P M 3 that the geometry did not change, other than riser cut and
5 : 2 3 P M 4 capping stack -- but having a model that allows the reservoir
5 : 2 3 P M 5 depletion to be part of the model, this model is preordained to
5 : 2 3 P M 6 predict a flow rate that goes from high to low?

5 : 2 3 P M 7 A. That is correct.

5 : 2 3 P M 8 Q. Now, are you an expert in erosion, Dr. Dykhuizen?

5 : 2 3 P M 9 A. No, I'm not an expert in erosion. But I've been in
5 : 2 3 P M 10 programs where erosion has been important, yes.

5 : 2 3 P M 11 Q. In your initial expert report you stated that you believed
5 : 2 3 P M 12 all significant erosion was complete by the end of the second
5 : 2 3 P M 13 day of the blowout; correct?

5 : 2 3 P M 14 A. No. Excuse me. Could you repeat the question.

5 : 2 4 P M 15 Q. Sure. In your expert report you stated that you believed
5 : 2 4 P M 16 all significant erosion was complete by the end of the second
5 : 2 4 P M 17 day after the blowout?

5 : 2 4 P M 18 A. I might have said that. That sounds like a logical
5 : 2 4 P M 19 number. I think that's reasonable.

5 : 2 4 P M 20 But that's a proxy for erosion, to put that in my
5 : 2 4 P M 21 model. It could go on for four days at half flow or six days
5 : 2 4 P M 22 at a third flow. To say that it's complete after two days --
5 : 2 4 P M 23 obviously, there was erosion on the last day, but it's not
5 : 2 4 P M 24 significant erosion on the last day.

5 : 2 4 P M 25 Q. So you believe erosion could be taking place throughout

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 4 P M 1 the 86-day time period?

5 : 2 4 P M 2 A. Yes. But what we need to concern ourselves with is the
5 : 2 4 P M 3 rate of erosion, and just because there's erosion on the last
5 : 2 4 P M 4 day doesn't mean that it's significant to the integral.

5 : 2 4 P M 5 Q. Is it correct, Dr. Dykhuizen, that in between your expert
5 : 2 4 P M 6 report and your rebuttal report -- by the time you got your
5 : 2 5 P M 7 rebuttal report, you say erosion now could have been going on
5 : 2 5 P M 8 through May 14th?

5 : 2 5 P M 9 A. That is correct. It was correct in my expert report, but
5 : 2 5 P M 10 maybe I failed to mention that.

5 : 2 5 P M 11 Q. Okay. So in the chart, when it was developed -- when the
5 : 2 5 P M 12 model was developed in the summer of 2010, two days were left
5 : 2 5 P M 13 off as an accommodation or, I think, as you said, a hand wave
5 : 2 5 P M 14 to erosion; correct?

5 : 2 5 P M 15 A. That misquotes me. I think I said "a wave to erosion,"
5 : 2 5 P M 16 but a hand wave is a similar concept.

5 : 2 5 P M 17 MR. REGAN: If we pull up TREX-11453.12.1, which is
5 : 2 5 P M 18 your rebuttal report.

5 : 2 5 P M 19 BY MR. REGAN:

5 : 2 5 P M 20 Q. In your rebuttal report you say in the last sentence here:
5 : 2 5 P M 21 "The agreement of the Griffiths model with the PT-B data" --
5 : 2 5 P M 22 let me start with the first sentence, not in the middle of the
5 : 2 5 P M 23 sentence.

5 : 2 5 P M 24 "Due to the lack of PT-B data in early May, it is
5 : 2 5 P M 25 possible the erosion processes continued past day two, as I

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 6 P M 1 assumed. This is a source of uncertainty in my modeling.
5 : 2 6 P M 2 However, the agreement of the Griffiths model with the PT-B
5 : 2 6 P M 3 data and the lack of significant sand observed in oil
5 : 2 6 P M 4 collection prove to me that erosion did not occur past
5 : 2 6 P M 5 May 14th"; correct?

5 : 2 6 P M 6 A. That's correct.

5 : 2 6 P M 7 Q. Is that the day you want to stand on in terms of your
5 : 2 6 P M 8 opinion as to when you believe the erosional processes that
5 : 2 6 P M 9 mattered ended?

5 : 2 6 P M 10 A. That seems like a reasonable statement. The erosional
5 : 2 6 P M 11 processes that mattered ended at some time before May 14th. It
5 : 2 6 P M 12 could possibly extend all the way to May 14th, or it could have
5 : 2 6 P M 13 ended sooner than May 14th.

5 : 2 6 P M 14 I have no expertise in erosion, as you say. I can
5 : 2 6 P M 15 define where the end is. But I can look at the data, read
5 : 2 6 P M 16 Dr. Griffiths' report, and make an independent conclusion that
5 : 2 6 P M 17 it must have stopped before May 14th.

5 : 2 7 P M 18 I can't say that it stopped on May 14th. I can't say
5 : 2 7 P M 19 that it stopped on May 12th. But it must have stopped before
5 : 2 7 P M 20 May 14th. Six days of erosion is stopping before May 14th.

5 : 2 7 P M 21 Q. Well, May 14th was 24 days into the accident; correct?

5 : 2 7 P M 22 A. I understand that. But six days -- the erosion could have
5 : 2 7 P M 23 stopped at six days, and that would have been well before
5 : 2 7 P M 24 May 14th.

5 : 2 7 P M 25 Q. You're aware that as of May 19th, a new hole appeared in

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 7 P M 1 the riser; correct?

5 : 2 7 P M 2 A. I'm not aware of the exact date, but that sounds

5 : 2 7 P M 3 approximately right. Yes.

5 : 2 7 P M 4 Q. You would agree that the appearance of these holes in the

5 : 2 7 P M 5 riser kink is evidence of a continuing erosion process?

5 : 2 7 P M 6 A. It's a continuing erosion process at that location, yes, I

5 : 2 7 P M 7 will agree with that. It doesn't indicate that there was

5 : 2 7 P M 8 significant erosion in flow paths that mattered. I'm relying

5 : 2 8 P M 9 on Dr. Stewart Griffiths' analysis for that.

5 : 2 8 P M 10 Q. I'm going to turn to PT-B for a little bit.

5 : 2 8 P M 11 I'd like to bring up D-24369.

5 : 2 8 P M 12 Dr. Dykhuizen, we talked -- maybe it was with

5 : 2 8 P M 13 Dr. Hunter. But the PT-B gauge was at the bottom of the BOP;

5 : 2 8 P M 14 correct?

5 : 2 8 P M 15 A. Yes.

5 : 2 8 P M 16 Q. And if I use the term "upstream of PT-B," do you

5 : 2 8 P M 17 understand that to mean things that are below, that is, the

5 : 2 8 P M 18 reservoir and the well and the drill pipe below the PT-B gauge?

5 : 2 8 P M 19 A. Correct.

5 : 2 8 P M 20 Q. If I go to 24370, if I use the term "downstream of PT-B,"

5 : 2 8 P M 21 do you appreciate that or do you agree with me that would

5 : 2 8 P M 22 reflect the BOP, the riser, or anything that's above the BOP?

5 : 2 8 P M 23 A. That is correct.

5 : 2 8 P M 24 Q. Now, we talked earlier about the fact that the PT-B

5 : 2 8 P M 25 pressure gauges are in between those upstream and downstream

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 2 8 P M 1 environments; correct?

5 : 2 8 P M 2 A. That is correct.

5 : 2 8 P M 3 Q. And the PT-B pressure gauge, what it reads is the

5 : 2 8 P M 4 collective impact of what's going on below it and what's going

5 : 2 9 P M 5 on above it; correct?

5 : 2 9 P M 6 A. Essentially, it is an average of the sea pressure and the

5 : 2 9 P M 7 reservoir pressure, and while you weight that average, it

5 : 2 9 P M 8 depends on the resistance upstream and the resistance

5 : 2 9 P M 9 downstream.

5 : 2 9 P M 10 Q. Exhibit D-24401.

5 : 2 9 P M 11 See if we have this right, Dr. Dykhuizen. If we see

5 : 2 9 P M 12 PT-B pressure decrease, that could be caused by two phenomena.

5 : 2 9 P M 13 Relative to the wellbore, if the BOP resistance decreases, you

5 : 2 9 P M 14 would expect to see PT-B pressure decrease; correct?

5 : 2 9 P M 15 A. That is correct.

5 : 2 9 P M 16 Q. Conversely, if the reservoir or wellbore resistance

5 : 2 9 P M 17 increased, you, again, would see PT-B pressure decrease?

5 : 2 9 P M 18 A. Yes.

5 : 2 9 P M 19 Q. Let's talk now about PT-B going up. If PT-B pressure

5 : 2 9 P M 20 increases, that could be caused by either the reservoir or the

5 : 2 9 P M 21 wellbore resistance decreasing; correct?

5 : 2 9 P M 22 A. Yeah. It took me a while to figure out that I'm supposed

5 : 3 0 P M 23 to look diagonally through your graph instead of vertically,

5 : 3 0 P M 24 but, yes.

5 : 3 0 P M 25 Q. Yes?

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 0 P M 1 And similarly, PT-B pressure will increase if the BOP
5 : 3 0 P M 2 resistance increases; correct?

5 : 3 0 P M 3 A. That is correct.

5 : 3 0 P M 4 Q. Finally, if you had a situation where BOP resistance
5 : 3 0 P M 5 decreased or wellbore resistance decreased, you would expect
5 : 3 0 P M 6 flow to increase; correct?

5 : 3 0 P M 7 A. Yes.

5 : 3 0 P M 8 Q. If you had a situation where the reservoir wellbore became
5 : 3 0 P M 9 more resistant or the BOP became more resistant, you would
5 : 3 0 P M 10 expect flow to decrease; correct?

5 : 3 0 P M 11 A. That is also correct.

5 : 3 0 P M 12 Q. And as of the time of the DOE-NNSA report, there was
5 : 3 0 P M 13 skepticism about the PT-B gauge; correct?

5 : 3 0 P M 14 A. Yes.

5 : 3 0 P M 15 Q. There was questions about its accuracy because of
5 : 3 0 P M 16 variations in the readings that you would get off that gauge
5 : 3 0 P M 17 during the course of the 86 days of flow; correct?

5 : 3 0 P M 18 A. Yes. There was great concern during the response about
5 : 3 1 P M 19 the PT-B gauge.

5 : 3 1 P M 20 Q. You were skeptical of the validity of the PT-B pressure
5 : 3 1 P M 21 gauge readings in 2010; correct?

5 : 3 1 P M 22 A. Everybody was skeptical. I might have been least
5 : 3 1 P M 23 skeptical of all, but, yes, I was still skeptical.

5 : 3 1 P M 24 Q. Dr. Hunter was skeptical about that gauge; correct?

5 : 3 1 P M 25 A. And he was on the other extreme. He was the most

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 1 P M 1 skeptical about that gauge.

5 : 3 1 P M 2 Q. And you say -- you understand that Dr. Griffiths' work
5 : 3 1 P M 3 relies extremely heavily on the PT-B pressure gauge; correct?

5 : 3 1 P M 4 A. Yes. He has performed an analysis to show that you can
5 : 3 1 P M 5 get some very interesting results out of that gauge.

5 : 3 1 P M 6 Q. But in 2010, you were not only skeptical of PT-B, you were
5 : 3 1 P M 7 also skeptical of Dr. Griffiths' work; correct?

5 : 3 1 P M 8 A. Well, at one point in 2010 I was, but as the year
5 : 3 1 P M 9 proceeded, I got less skeptical of his work. He started
5 : 3 1 P M 10 addressing my concerns.

5 : 3 1 P M 11 But, yes, there was one point in 2010, I was
5 : 3 2 P M 12 significantly concerned about Dr. Griffiths' work.

5 : 3 2 P M 13 MR. REGAN: Pull up TREX 11435.1.1.

5 : 3 2 P M 14 BY MR. REGAN:

5 : 3 2 P M 15 Q. This is an e-mail that you sent to Dr. Griffiths in August
5 : 3 2 P M 16 of 2010. And you wrote Dr. Griffiths and you told him that you
5 : 3 2 P M 17 liked his approach.

5 : 3 2 P M 18 But in the middle -- "however, if the parameter that
5 : 3 2 P M 19 I find is non-physical (i.e., heat transfer problem where a
5 : 3 2 P M 20 negative emissivity provides the best fit of the data) then one
5 : 3 2 P M 21 might question the model. The model at that point becomes a
5 : 3 2 P M 22 curve-fitting exercise, and if one has enough free parameters,
5 : 3 2 P M 23 then you can fit any data set (even if the model is bad).
5 : 3 2 P M 24 Extrapolation of such a model beyond the range of the data is
5 : 3 2 P M 25 then very suspect."

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 2 P M 1 That's what you wrote to him in August of 2010;
5 : 3 2 P M 2 correct?

5 : 3 2 P M 3 A. Yes. That was my opinion on that day.

5 : 3 2 P M 4 Q. You also challenged his very small error rates, plus or
5 : 3 2 P M 5 minus 80, on flow rates; correct?

5 : 3 2 P M 6 A. That is correct.

5 : 3 2 P M 7 MR. REGAN: Go to TREX-11436.2.1.

5 : 3 2 P M 8 BY MR. REGAN:

5 : 3 2 P M 9 Q. This is another e-mail you sent to Dr. Griffiths in
5 : 3 3 P M 10 September of 2010 about his work. And did you write to
5 : 3 3 P M 11 Dr. Griffiths in this e-mail, Dr. Dykhuizen: "I do not think
5 : 3 3 P M 12 your analysis provides an independent calculation of the flow
5 : 3 3 P M 13 rate at any time in the accident response due to errors in the
5 : 3 3 P M 14 model"?

5 : 3 3 P M 15 A. Yes, I wrote that.

5 : 3 3 P M 16 MR. REGAN: And in the middle paragraph, Donnie, if
5 : 3 3 P M 17 we could -- Number 3, yes. Can you just make that a little
5 : 3 3 P M 18 bigger, that paragraph.

5 : 3 3 P M 19 BY MR. REGAN:

5 : 3 3 P M 20 Q. You talk about his treatment of PI.

5 : 3 3 P M 21 A. Yes.

5 : 3 3 P M 22 Q. And in the middle of that paragraph -- it's about the
5 : 3 3 P M 23 fourth line -- I can point at it on the screen if that helps --
5 : 3 3 P M 24 you say: "The PI, or productivity index, is unknown, and this
5 : 3 3 P M 25 has prevented anybody from using the part from the reservoir

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 3 P M 1 pressure to any pressure to calculate a flow rate. At best,
5 : 3 3 P M 2 one can use an infinite PI and calculate a maximum flow. Or
5 : 3 3 P M 3 one can model the flow within the reservoir to estimate the
5 : 3 4 P M 4 upper limit on PI and calculate a more realistic maximum flow.
5 : 3 4 P M 5 But the resistance across the damaged concrete plug is unknown
5 : 3 4 P M 6 and potentially important."

5 : 3 4 P M 7 Did you write that to Dr. Griffiths about his model
5 : 3 4 P M 8 and analysis in 2010?

5 : 3 4 P M 9 A. There's two points in -- I did write that, but there's two
5 : 3 4 P M 10 points I'd like to make. First, when I wrote this, I assumed
5 : 3 4 P M 11 he was arbitrarily imposing a PI of 50; and later, when he
5 : 3 4 P M 12 rewrote his model in greater detail so I could see, I could see
5 : 3 4 P M 13 that he was determining from the data a PI of 50. So that is
5 : 3 4 P M 14 one concept.

5 : 3 4 P M 15 Also, I've tried to read the expert reports of other
5 : 3 4 P M 16 people, and I've learned since then that there is a lot more
5 : 3 4 P M 17 known about the concrete plug at the bottom of the well than I
5 : 3 4 P M 18 knew at the time when I wrote this report.

5 : 3 4 P M 19 Q. With respect to your Top Kill estimate, in 2010, during
5 : 3 5 P M 20 the accident, you did not come to an estimate of flow rate
5 : 3 5 P M 21 during Top Kill; correct?

5 : 3 5 P M 22 A. Could you repeat the question. I'm sorry.

5 : 3 5 P M 23 Q. Yes. Top Kill, you have a best estimate of 60,000 barrels
5 : 3 5 P M 24 per day; correct?

5 : 3 5 P M 25 A. Yes. I characterized that as greater than 60,000 barrels

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 5 P M 1 a day.

5 : 3 5 P M 2 Q. You would also characterize that estimate as having a lot
5 : 3 5 P M 3 of concerns; correct?

5 : 3 5 P M 4 A. Yes. It is a calculation with a significant error bar to
5 : 3 5 P M 5 it. And so I tried to bound that error by coming up with a
5 : 3 5 P M 6 lower bound of 43,000. I can come up with some bound of that
5 : 3 5 P M 7 error.

5 : 3 5 P M 8 Q. You agree that your Top Kill estimate of 60,000 is not
5 : 3 5 P M 9 very accurate; correct?

5 : 3 5 P M 10 A. That is correct. Except I said greater than 60,000 in my
5 : 3 5 P M 11 estimate. But that's correct.

5 : 3 5 P M 12 Q. You don't know the properties of the mud that you're
5 : 3 5 P M 13 modeling; correct?

5 : 3 5 P M 14 A. That is correct. And I especially don't know the
5 : 3 5 P M 15 properties of the mud after I mix it with the oil and the gas.

5 : 3 5 P M 16 Q. You make an assumption that the BOP internally has exactly
5 : 3 6 P M 17 the same resistance during Top Kill as when it's idle; correct?
5 : 3 6 P M 18 T-kill versus K-idle.

5 : 3 6 P M 19 A. That's correct, that's one of the assumptions I make in my
5 : 3 6 P M 20 model.

5 : 3 6 P M 21 Q. You're trying to model three phases of flow; correct?

5 : 3 6 P M 22 A. For my best estimate, yes, I am.

5 : 3 6 P M 23 Q. Again, your best estimate is the 60,000-barrels-a-day
5 : 3 6 P M 24 number; right?

5 : 3 6 P M 25 A. Greater than 60,000 barrels a day, yes.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 6 P M 1 Q. You assumed that all of the mud that was pumped in
5 : 3 6 P M 2 immediately exited the BOP; correct?

5 : 3 6 P M 3 A. I assumed that for the time periods that I was examining,
5 : 3 6 P M 4 not for the entire time period of the Top Kill.

5 : 3 6 P M 5 Q. And if that's not true, your calculation is in error;
5 : 3 6 P M 6 correct?

5 : 3 6 P M 7 A. That is correct.

5 : 3 6 P M 8 Q. You assume that the PT-B pressure, from a time period when
5 : 3 6 P M 9 the top ram -- when the test rams were closed -- that's before
5 : 3 6 P M 10 any Top Kill and after all Top Kill -- the fact that it's the
5 : 3 6 P M 11 same, you conclude that means the resistance did not change;
5 : 3 6 P M 12 correct?

5 : 3 6 P M 13 A. That is correct.

5 : 3 6 P M 14 Q. But, in fact, during Top Kill 3, when the test rams were
5 : 3 6 P M 15 open, there was a pressure change from the beginning of Top
5 : 3 7 P M 16 Kill 3 to the last -- to the end of Top Kill 3; correct?

5 : 3 7 P M 17 A. I don't think that's completely correct. There was a lot
5 : 3 7 P M 18 of variations in the pressure and during Top Kill 3, but it
5 : 3 7 P M 19 returned to approximately the same value.

5 : 3 7 P M 20 Q. Your lower bound depends on what data set from Top Kill
5 : 3 7 P M 21 you analyze; correct?

5 : 3 7 P M 22 A. That is correct. We discussed that in my trial testimony
5 : 3 7 P M 23 here.

5 : 3 7 P M 24 Q. Three Top Kill events; correct?

5 : 3 7 P M 25 A. Yes.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 7 P M 1 Q. You analyzed the third one; right?

5 : 3 7 P M 2 A. That is correct.

5 : 3 7 P M 3 Q. And if you apply your exact methodology to the first one,

5 : 3 7 P M 4 you get a lower lower bound?

5 : 3 7 P M 5 A. That is definitely true.

5 : 3 7 P M 6 Q. Neither calculation is certain?

5 : 3 7 P M 7 A. There are lower bounds. Obviously, the flow is not at the

5 : 3 7 P M 8 lower bound. The lower bound is something higher than that

5 : 3 7 P M 9 calculation.

5 : 3 7 P M 10 Q. Is it your testimony you have zero percent uncertainty on

5 : 3 7 P M 11 your lower bound?

5 : 3 8 P M 12 A. My testimony that the lower bound is a hard lower bound.

5 : 3 8 P M 13 But, yes, there is a small probability that the flow could be

5 : 3 8 P M 14 less than my lower bound.

5 : 3 8 P M 15 Q. And you agree that if we use your exact methodology for

5 : 3 8 P M 16 Top Kill 1, we get a lower lower bound?

5 : 3 8 P M 17 A. That is a correct statement.

5 : 3 8 P M 18 Q. Your Top Hat estimate, also, 60,000 barrels per day;

5 : 3 8 P M 19 correct?

5 : 3 8 P M 20 A. That is correct.

5 : 3 8 P M 21 Q. Your Top Hat estimate is especially inaccurate; correct?

5 : 3 8 P M 22 A. That's correct. It's probably equally as inaccurate as

5 : 3 8 P M 23 the Top Kill calculation.

5 : 3 8 P M 24 Q. Your most accurate is the capping stack, July 15th; right?

5 : 3 8 P M 25 A. That is correct.

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 3 8 P M 1 Q. Plus or minus 20 percent?

5 : 3 8 P M 2 A. That is correct.

5 : 3 8 P M 3 Q. Top Kill is less accurate?

5 : 3 8 P M 4 A. Oh, that's definitely correct.

5 : 3 8 P M 5 Q. No doubt about it?

5 : 3 8 P M 6 A. Yes.

5 : 3 8 P M 7 Q. Top Hat is even less inaccurate -- less accurate?

5 : 3 8 P M 8 A. Well, that's less accurate than the capping stack, but

5 : 3 9 P M 9 it's difficult to say whether it's less accurate than Top Kill.

5 : 3 9 P M 10 They're both inaccurate estimates.

5 : 3 9 P M 11 Q. For your best estimate of 60,000 barrels per day for

5 : 3 9 P M 12 Top Hat, you rely on analyzing the visual evidence from

5 : 3 9 P M 13 videotaped ROV footage; correct?

5 : 3 9 P M 14 A. That's correct.

5 : 3 9 P M 15 Q. After doing that, you arrive at a round number of

5 : 3 9 P M 16 20,000 barrels per day coming out of the skirt; correct?

5 : 3 9 P M 17 A. Yes, a very round number.

5 : 3 9 P M 18 Q. You agree that that is the most inaccurate -- or that is a

5 : 3 9 P M 19 very inaccurate method?

5 : 3 9 P M 20 A. It is an inaccurate method. I think that the logic in

5 : 3 9 P M 21 that 20,000 is pretty reasonable. I have a certain amount

5 : 3 9 P M 22 flowing out to the skirt that I cannot quantify by visual

5 : 4 0 P M 23 observation. And then that changes by 10 or 15,000 because the

5 : 4 0 P M 24 collection rate changes, and I don't see any change in the

5 : 4 0 P M 25 flow, which leads me to believe that the original flow before

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 0 P M 1 it changed was on the order of 20,000, because I have to add
5 : 4 0 P M 2 20,000 and add 10 or 15 to get 30,000 and I don't see any
5 : 4 0 P M 3 change.

5 : 4 0 P M 4 I think I can see a change between flowing at 20 and
5 : 4 0 P M 5 flowing at 30 to 35.

5 : 4 0 P M 6 Q. With respect to what was coming out of the bottom of the
5 : 4 0 P M 7 Top Hat floor, which is called the skirt, you agree that you
5 : 4 0 P M 8 had a very inaccurate method because you didn't know the
5 : 4 0 P M 9 geometry and you had another inaccurate method because you were
5 : 4 0 P M 10 just basing it on visual observation; correct?

5 : 4 0 P M 11 A. Yes. Those are both inaccurate methods, yes.

5 : 4 0 P M 12 Q. And using both of those inaccurate methods, you arrive at
5 : 4 0 P M 13 60,000 barrels per day?

5 : 4 0 P M 14 A. Sure. That sounds reasonable.

5 : 4 1 P M 15 Q. And using an inaccurate method for Top Kill, you arrive at
5 : 4 1 P M 16 60,000 barrels per day?

5 : 4 1 P M 17 A. Greater than 60,000. I keep correcting, but that's fine.

5 : 4 1 P M 18 Q. But those 60,000 barrels per day line up exactly on your
5 : 4 1 P M 19 line for your 5 million cumulative estimate; correct?

5 : 4 1 P M 20 A. Yes, they lie very close to the line. Exactly is -- I
5 : 4 1 P M 21 think for these purposes, they line up very close to the line.

5 : 4 1 P M 22 Q. If we're to see the line of 5 million cumulative flow and
5 : 4 1 P M 23 someone were to put a dot on there for Top Hat and a dot on
5 : 4 1 P M 24 there for Top Kill and say, Dykhuizen has calculated
5 : 4 1 P M 25 60,000 barrels per day for those two numbers, it should be

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 1 P M 1 represented as both of those are very inaccurate?

5 : 4 1 P M 2 A. I give an accuracy of plus or minus 20,000 for both, yes.

5 : 4 1 P M 3 Q. You testified about slug flow. You don't dispute that

5 : 4 1 P M 4 slug flow was observed in May of 2010, do you?

5 : 4 1 P M 5 A. No, I do not.

5 : 4 1 P M 6 Q. Slug flow is a phenomenon of multiphase fluid flow;

5 : 4 2 P M 7 correct?

5 : 4 2 P M 8 A. Yes, it is.

5 : 4 2 P M 9 Q. And slug flow can only occur in certain boundary

5 : 4 2 P M 10 conditions; right?

5 : 4 2 P M 11 A. That is correct.

5 : 4 2 P M 12 Q. And if you can see slug flow, it can possibly inform you

5 : 4 2 P M 13 as to what the boundary conditions are?

5 : 4 2 P M 14 A. I have no problem with Dr. Zaldivar's procedure. I think

5 : 4 2 P M 15 he did something very interesting. I was quite interested in

5 : 4 2 P M 16 his calculations.

5 : 4 2 P M 17 Q. You claimed that -- you criticized Dr. Zaldivar because

5 : 4 2 P M 18 you say his method had never been validated to use -- to show

5 : 4 2 P M 19 that it can be used to estimate flow; correct?

5 : 4 2 P M 20 A. That is correct.

5 : 4 2 P M 21 Q. But, Dr. Dykhuizen, your method for calculating cumulative

5 : 4 2 P M 22 flow here has never been compared to experimental data in order

5 : 4 2 P M 23 to determine whether there was confidence in it; correct?

5 : 4 2 P M 24 A. That's incorrect. My method has been used many times to

5 : 4 2 P M 25 calculate flow, and the method is a standard procedure that

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 3 P M 1 you'll find in any textbook.

5 : 4 3 P M 2 Q. Dr. Dykhuizen, did you ever compare the model you used to
5 : 4 3 P M 3 calculate cumulative flow with experimental data in order to
5 : 4 3 P M 4 determine whether there was confidence?

5 : 4 3 P M 5 A. I'm not sure what you're getting at. I'm using a standard
5 : 4 3 P M 6 procedure. You do not hold a standard procedure to the same
5 : 4 3 P M 7 rigor as you do a computational method.

5 : 4 3 P M 8 Q. You did not perform any independent analysis or modeling
5 : 4 3 P M 9 of how regular in the double-peak or single-peak behavior the
5 : 4 3 P M 10 slug flow was in May of 2010; correct?

5 : 4 3 P M 11 A. No, I took Dr. Zaldivar's word that it was regular.

5 : 4 3 P M 12 Q. You did not perform or disclose any independent analysis
5 : 4 3 P M 13 or modeling of the oscillating motion of the riser's bouyant
5 : 4 3 P M 14 loop; correct?

5 : 4 3 P M 15 A. No, I did not do any independent analysis of the
5 : 4 3 P M 16 oscillation of the bouyant loop.

5 : 4 4 P M 17 Q. You did not express any opinion on Dr. Zaldivar's
5 : 4 4 P M 18 calculation of the riser elevation profile; correct?

5 : 4 4 P M 19 A. I think I had some concerns with that in my report.
5 : 4 4 P M 20 Dr. Zaldivar has quite a bit of his riser buried; therefore, he
5 : 4 4 P M 21 had no idea how deep it was buried, how much oscillation in the
5 : 4 4 P M 22 flow path of the buried riser, and I thought that would be a
5 : 4 4 P M 23 concern.

5 : 4 4 P M 24 Because this sort of oscillation is very sensitive to
5 : 4 4 P M 25 horizontal motions up and down of the riser. If we have

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 4 P M 1 horizontal motions up and down, we can impact the stability
5 : 4 4 P M 2 margins. He has no idea how much it oscillates up and down as
5 : 4 4 P M 3 it's buried.

5 : 4 4 P M 4 Q. You cite a BP document from Julian Austin and Trevor Hill
5 : 4 4 P M 5 to -- with respect to the size of the kink holes. You did that
5 : 4 4 P M 6 on your direct exam. Do you recall doing that?

5 : 4 5 P M 7 A. From --

5 : 4 5 P M 8 Q. Do you want me to show it to you?

5 : 4 5 P M 9 A. I did have something about kink holes. I thought -- but
5 : 4 5 P M 10 that Julian Austin name does not --

5 : 4 5 P M 11 Q. I'm happy to show it to you. I'll just show it to you and
5 : 4 5 P M 12 we'll finish up here.

5 : 4 5 P M 13 MR. REGAN: TREX-10650.2.1.

5 : 4 5 P M 14 BY MR. REGAN:

5 : 4 5 P M 15 Q. I think part of the confusion, Dr. Dykhuizen, is that in
5 : 4 5 P M 16 this exhibit, you were not shown the top part of the document.
5 : 4 5 P M 17 And in the top part of the document, does it not say that the
5 : 4 5 P M 18 estimate of the leaks by Julian were done from interpreting
5 : 4 5 P M 19 photos? Do you see that?

5 : 4 5 P M 20 A. Yes, that's correct.

5 : 4 5 P M 21 Q. So you're relying on this document to support your opinion
5 : 4 5 P M 22 on the size of the kink holes and this document is relying on
5 : 4 5 P M 23 photo interpretation?

5 : 4 5 P M 24 A. No, that's not correct. Let me please explain.
5 : 4 5 P M 25 I tried to reproduce Dr. Zaldivar's kink leak. I

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 6 P M 1 used his areas, not the areas of -- from this document. And I
5 : 4 6 P M 2 could not reproduce his calculations unless I imposed an error.

5 : 4 6 P M 3 I also looked at this e-mail, at least the copied one
5 : 4 6 P M 4 below from Dr. Lockett. I noticed that he used different
5 : 4 6 P M 5 areas. I noticed that he used different pressures. I could
5 : 4 6 P M 6 reproduce his numbers using the correct equations and I could
5 : 4 6 P M 7 also change his -- I could scale his results to the values that
5 : 4 6 P M 8 Dr. Zaldivar did.

5 : 4 6 P M 9 His results do not reproduce Dr. Zaldivar's and they
5 : 4 6 P M 10 do not reproduce mine either, but they're on the right-hand
5 : 4 7 P M 11 side of mine and -- which leads me further to suspect that
5 : 4 7 P M 12 Dr. Zaldivar's calculations were wrong.

5 : 4 7 P M 13 I'm not stating that these were right. I'm stating
5 : 4 7 P M 14 that these used the right equations that should be used. I
5 : 4 7 P M 15 think this gentleman here used different Ks than Dr. Zaldivar
5 : 4 7 P M 16 used and I do not know what K values this person used, so I
5 : 4 7 P M 17 could not reproduce his flows.

5 : 4 7 P M 18 I'm just stating that these flows are greater than
5 : 4 7 P M 19 mine. They are an indication that Dr. Zaldivar is in error.
5 : 4 7 P M 20 And when I try to show what diameter holes that were used by
5 : 4 7 P M 21 Dr. Lockett, they are using the same diameter hole that matches
5 : 4 7 P M 22 the area.

5 : 4 8 P M 23 Dr. Zaldivar uses a hole of his model that does not
5 : 4 8 P M 24 match the area.

5 : 4 8 P M 25 Q. Dr. Dykhuizen, my question was: This is a document that

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 8 P M 1 you relied upon for your calculation? That's correct? That
5 : 4 8 P M 2 was my question.

5 : 4 8 P M 3 A. It's unclear from looking at this. I looked at -- I
5 : 4 8 P M 4 recall an e-mail from Dr. Lockett. You may be correct, that he
5 : 4 8 P M 5 is copying Dr. Lockett's e-mail at the bottom. I do not recall
5 : 4 8 P M 6 the Julian Austin name, no.

5 : 4 8 P M 7 Q. Okay.

5 : 4 8 P M 8 MR. REGAN: If I could go to the ELMO then, please.

5 : 4 8 P M 9 This is just a copy of the same demonstrative
5 : 4 8 P M 10 that we've been using before, D-23996-A. A little more washed
5 : 4 8 P M 11 out, but I have it here on this ELMO.

5 : 4 9 P M 12 BY MR. REGAN:

5 : 4 9 P M 13 Q. But as we just discussed, you have an estimate for
5 : 4 9 P M 14 Top Kill here?

5 : 4 9 P M 15 A. Correct.

5 : 4 9 P M 16 Q. At 60,000?

5 : 4 9 P M 17 A. And you're applying that 59, but that's fine.

5 : 4 9 P M 18 Q. And it's very inaccurate; correct?

5 : 4 9 P M 19 A. That's correct. I apply the inaccuracy as plus or minus
5 : 4 9 P M 20 17,000.

5 : 4 9 P M 21 Q. You have an estimate for Top Hat at the tail end of that
5 : 4 9 P M 22 time period, which would be around Day 70, the end of June, and
5 : 4 9 P M 23 your estimate for that is 60,000 barrels per day. Is that
5 : 4 9 P M 24 right?

5 : 4 9 P M 25 A. That's correct. You're now drawing it in a better

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 4 9 P M 1 location there.

5 : 4 9 P M 2 Q. Also very inaccurate; correct?

5 : 4 9 P M 3 A. That is correct.

5 : 4 9 P M 4 Q. You extrapolate in your chart that you ended your direct
5 : 4 9 P M 5 exam, you said, Well, I can apply that Top Hat estimate
5 : 4 9 P M 6 backwards because I know flow is decreasing. So whatever I
5 : 5 0 P M 7 calculated for July -- June 25th, it must be -- it must be
5 : 5 0 P M 8 lower. You actually did that for your lower bound; correct?

5 : 5 0 P M 9 Let me ask you a new question.

5 : 5 0 P M 10 A. Yes, thank you.

5 : 5 0 P M 11 Q. You have a lower bound of 43,000 barrels per day for
5 : 5 0 P M 12 Top Hat; correct?

5 : 5 0 P M 13 A. Yes.

5 : 5 0 P M 14 Q. And you say that's the lower bound because you assume that
5 : 5 0 P M 15 flow is decreasing over time; right?

5 : 5 0 P M 16 A. No. I say that's a lower bound because I'm ignoring skirt
5 : 5 0 P M 17 flow and have a lower calculation of the vents, but I say that
5 : 5 0 P M 18 I can extrapolate that backwards in time because, in my view,
5 : 5 0 P M 19 the flow is decreasing with time.

5 : 5 0 P M 20 Q. Right. So your lower bound for Top Hat is what,
5 : 5 0 P M 21 approximately 43,000?

5 : 5 0 P M 22 A. That is correct.

5 : 5 0 P M 23 Q. Somewhere around there; is that right?

5 : 5 0 P M 24 A. That looks like a good number.

5 : 5 0 P M 25 Q. And if, in fact, flow rate is increasing over time rather

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 5 0 P M 1 than decreasing over that time, your lower bound can't be
5 : 5 1 P M 2 pushed backwards, that is, towards zero; correct?

5 : 5 1 P M 3 A. If I take your assumption that the flow is increasing with
5 : 5 1 P M 4 time, I cannot extrapolate that backwards.

5 : 5 1 P M 5 Q. You have a lower bound for Top Kill; correct?

5 : 5 1 P M 6 A. Yes.

5 : 5 1 P M 7 Q. Approximately 43,000 barrels per day; correct?

5 : 5 1 P M 8 A. That's correct.

5 : 5 1 P M 9 Q. Right about there; right?

5 : 5 1 P M 10 A. That's correct.

5 : 5 1 P M 11 Q. And from reviewing Dr. Zaldivar's report, you're aware
5 : 5 1 P M 12 that he postulates flow rates from May 13th to May 20th;
5 : 5 1 P M 13 correct?

5 : 5 1 P M 14 A. Yes, he does.

5 : 5 1 P M 15 Q. So that's right around here, Day 23 to about Day 27. And
5 : 5 1 P M 16 do you recall what his flow rates were?

5 : 5 1 P M 17 A. I can guess. 35, I think, was the top; 24 was the low.
5 : 5 1 P M 18 I'm --

5 : 5 1 P M 19 Q. Pretty close. Do you recall that his range was 24,900 to
5 : 5 1 P M 20 35 -- 35,000 -- it was 36,000. Does that sound consistent with
5 : 5 1 P M 21 your review of his report?

5 : 5 2 P M 22 A. Yes.

5 : 5 2 P M 23 Q. So would you agree, Dr. Dykhuizen, that if we use your
5 : 5 2 P M 24 uncertainty range for your cumulative flow of 30 -- of minus
5 : 5 2 P M 25 30 percent off of 5 million, that we would cross through the

RONALD DYKHUIZEN, PH.D. - CROSS

5 : 5 2 P M 1 range of flow rates that are predicted by Dr. Zaldivar,
5 : 5 2 P M 2 understanding you disagree with me?

5 : 5 2 P M 3 A. I think Dr. Zaldivar's estimate should be increased by a
5 : 5 2 P M 4 factor of 2. I don't think they're validated. I think that
5 : 5 2 P M 5 these lower bounds are unlikely because I have a bell curve
5 : 5 2 P M 6 and, therefore, I do not like picking my lower bound and
5 : 5 2 P M 7 saying, this is what we need to do.

5 : 5 2 P M 8 But with those assumptions that you've made, yes, we
5 : 5 2 P M 9 can get a curve that looks very much like your red line.

5 : 5 2 P M 10 Q. I'm going to mark this as D-24496.

5 : 5 2 P M 11 MR. REGAN: And those are the questions that I have,
5 : 5 2 P M 12 Dr. Dykhuizen. Thank you.

5 : 5 3 P M 13 THE WITNESS: Thank you for your time.

5 : 5 3 P M 14 THE COURT: Redirect?

5 : 5 3 P M 15 REDIRECT EXAMINATION

5 : 5 3 P M 16 THE WITNESS: I changed mics. Is mine on? For some
5 : 5 3 P M 17 reason I don't like talking into the lapel mic.

5 : 5 4 P M 18 BY MR. CERNICH:

5 : 5 4 P M 19 Q. Dr. Dykhuizen, Scott Cernich for the United States. I
5 : 5 4 P M 20 have you on redirect.

5 : 5 4 P M 21 Dr. Dykhuizen, you were asked a number of questions
5 : 5 4 P M 22 about the DOE flow analysis report. Do you recall that?

5 : 5 4 P M 23 A. Yes, I do.

5 : 5 4 P M 24 Q. Okay. And do you rely upon that report for your expert
5 : 5 4 P M 25 opinions?

RONALD DYKHUIZEN, PH.D. - REDIRECT

5 : 5 4 P M 1 A. No, I do not. I reference that report to demonstrate my
5 : 5 4 P M 2 equations that I use.

5 : 5 4 P M 3 Q. And do you have more confidence in your calculations than
5 : 5 4 P M 4 the calculations that were prepared by the other national labs?

5 : 5 4 P M 5 A. Yes, I do.

5 : 5 4 P M 6 Q. And do you recall the purpose of the DOA -- DOE-NNSA flow
5 : 5 4 P M 7 analysis report?

5 : 5 4 P M 8 A. The purpose, as clearly stated in the introduction, was to
5 : 5 4 P M 9 provide a basis for how the 53,000 estimate from the press
5 : 5 5 P M 10 release was obtained.

5 : 5 5 P M 11 Q. Was it -- was that report also intended to document the
5 : 5 5 P M 12 work of the Tri-Lab's team during the response with regard to
5 : 5 5 P M 13 flow rate?

5 : 5 5 P M 14 A. Yes, it was.

5 : 5 5 P M 15 Q. Did anyone from the United States ever ask you to change
5 : 5 5 P M 16 or adjust your calculations in any way you thought was
5 : 5 5 P M 17 improper?

5 : 5 5 P M 18 A. No.

5 : 5 5 P M 19 Q. And do engineers ever disagree regarding -- I'm sorry. Do
5 : 5 5 P M 20 engineers ever disagree as to the certainty of calculations?

5 : 5 5 P M 21 A. That's a common area of disagreement. People seem to
5 : 5 5 P M 22 calculate the same things but quite disagree on the
5 : 5 5 P M 23 uncertainty.

5 : 5 5 P M 24 Q. And is it fair for other engineers to have more confidence
5 : 5 5 P M 25 in your -- more confidence in your calculations than you do

RONALD DYKHUIZEN, PH.D. - REDIRECT

5 : 5 5 P M 1 personally?

5 : 5 5 P M 2 A. I guess that's fair.

5 : 5 6 P M 3 Q. And you were asked about various things that cause

5 : 5 6 P M 4 uncertainty during your cross-exam. Do you remember that?

5 : 5 6 P M 5 A. Yes.

5 : 5 6 P M 6 Q. Things like erosion, the geometry, et cetera?

5 : 5 6 P M 7 A. Yes.

5 : 5 6 P M 8 Q. Are all of those things addressed in your error bars that

5 : 5 6 P M 9 you place on your calculations, all of those uncertainties?

5 : 5 6 P M 10 A. Yes, they are.

5 : 5 6 P M 11 Q. Now, you were asked a question about the separation method

5 : 5 6 P M 12 that you used for the fluid in your calculations. Do you

5 : 5 6 P M 13 recall that?

5 : 5 6 P M 14 A. Yes.

5 : 5 6 P M 15 Q. And does -- and you said that you used -- that the EOS

5 : 5 6 P M 16 that you used, the equation of state, was based on a

5 : 5 6 P M 17 single-stage flash?

5 : 5 6 P M 18 A. Yes, it was.

5 : 5 6 P M 19 Q. And does that result in lower flow rates?

5 : 5 6 P M 20 A. That results in the same mass flow rate. The mass flow

5 : 5 6 P M 21 rate is independent. If you use a single-phase flash, you end

5 : 5 6 P M 22 up with lower standard barrels when you convert it to that.

5 : 5 7 P M 23 Q. That was my question, Dr. Dykhuizen. So if you had used a

5 : 5 7 P M 24 multistage EOS characterization of the fluid, you would have

5 : 5 7 P M 25 calculated higher volumes of standard barrels of oil?

RONALD DYKHUIZEN, PH.D. - REDIRECT

5 : 5 7 P M 1 A. That is correct.

5 : 5 7 P M 2 Q. Do you have any opinions regarding the proper method to
5 : 5 7 P M 3 use for separation of oil for the purposes of these
5 : 5 7 P M 4 calculations?

5 : 5 7 P M 5 A. Well, I used single stage because it was easier, so that's
5 : 5 7 P M 6 my opinion. But what the Court should use to convert from mass
5 : 5 7 P M 7 to standard barrels is not of my concern.

5 : 5 7 P M 8 Q. You were asked a variety of questions regarding
5 : 5 7 P M 9 uncertainties in performing hydraulic modeling and the
5 : 5 7 P M 10 information you would need to come up with an estimate. Do you
5 : 5 7 P M 11 recall that?

5 : 5 7 P M 12 A. Yes.

5 : 5 7 P M 13 Q. It was related to a paper, I believe, you wrote back in
5 : 5 8 P M 14 June of 2010?

5 : 5 8 P M 15 A. Yes.

5 : 5 8 P M 16 Q. And were you talking about the work that the NNSA labs
5 : 5 8 P M 17 were doing during the response?

5 : 5 8 P M 18 A. Yes, I was.

5 : 5 8 P M 19 Q. And you were asked some questions regarding Dr. Griffiths'
5 : 5 8 P M 20 work. Do you recall that?

5 : 5 8 P M 21 A. Yes.

5 : 5 8 P M 22 Q. And I know we spoke a bit about this during your direct
5 : 5 8 P M 23 examination, but can you explain to the Court -- well, I
5 : 5 8 P M 24 believe you testified on direct that you did not hold the same
5 : 5 8 P M 25 opinions regarding Dr. Griffiths' work as you expressed in your

RONALD DYKHUIZEN, PH.D. - REDIRECT

5 : 5 8 P M 1 e-mail critique?

5 : 5 8 P M 2 A. When I gave a series of phone and e-mail critiques, I only

5 : 5 8 P M 3 had available some initial drafts of Dr. Griffiths' work and I

5 : 5 8 P M 4 did not understand the full nature of his work and so these

5 : 5 9 P M 5 comments were based on his draft, not his work.

5 : 5 9 P M 6 Later on, he expanded his draft, and he also expanded

5 : 5 9 P M 7 his work and addressed all of my concerns satisfactorily.

5 : 5 9 P M 8 Q. And so does he satisfy all of your concerns regarding his

5 : 5 9 P M 9 work that you expressed in 2010?

5 : 5 9 P M 10 A. Yes.

5 : 5 9 P M 11 Q. And what do you think of his work now?

5 : 5 9 P M 12 A. I think it's an excellent piece of work. He's

5 : 5 9 P M 13 conclusively shown that you can get some very interesting data

5 : 5 9 P M 14 out of PT-B, which originally was treated as not reliable.

5 : 5 9 P M 15 Q. During your cross-examination, Mr. Regan was asking you

5 : 5 9 P M 16 about calculations being accurate. I lost count of the number

5 : 5 9 P M 17 of times he said "accurate." But can you explain what you mean

5 : 5 9 P M 18 by "not very accurate"?

6 : 0 0 P M 19 A. Sure. People tend to believe that scientists can

6 : 0 0 P M 20 calculate things to plus or minus 1 percent, and that seems to

6 : 0 0 P M 21 be the standard being used. My calculations, unfortunately,

6 : 0 0 P M 22 are not to plus or minus 1 percent. My calculations are, in

6 : 0 0 P M 23 some cases, plus or minus 20 percent, in some cases, plus or

6 : 0 0 P M 24 minus 25 percent, and for the integral, plus or minus

6 : 0 0 P M 25 30 percent.

RONALD DYKHUIZEN, PH.D. - REDIRECT

6:00 PM 1 I think this is still an informative calculation. It
6:00 PM 2 should help the Court determine how much was flowing on a
6:00 PM 3 particular day or what the cumulative rate was. That was the
6:00 PM 4 best I could do with the data that I had.

6:00 PM 5 Q. Mr. Regan also asked you -- I'm sorry, Dr. Dykhuizen.
6:00 PM 6 Does the concept of the bell curve apply to all of your
6:01 PM 7 calculations?

6:01 PM 8 A. Yes, it does. You would consider a bell curve to be a
6:01 PM 9 nice, symmetric Liberty Bell. The only time where it gets
6:01 PM 10 different is where we have the cumulative flow where I say it
6:01 PM 11 could be plus 20 percent or minus 30 percent. So you would
6:01 PM 12 have to imagine a bell curve that's still the most likely
6:01 PM 13 value.

6:01 PM 14 The top of the bell curve is at 5 million barrels of
6:01 PM 15 oil. And then once you get to 43 and 63, which are
6:01 PM 16 approximately my extremes, the probability is very small to get
6:01 PM 17 near those extremes.

6:01 PM 18 Q. Now, Mr. Regan asked you about a spreadsheet called
6:01 PM 19 "Wednesday night rush." Do you recall that?

6:01 PM 20 A. Yes.

6:01 PM 21 Q. Were those calculations performed in a rush?

6:01 PM 22 A. No, they weren't. Those -- those calculations had been
6:01 PM 23 performed for a couple weeks by the time the request made was
6:02 PM 24 made to do it for a Friday meeting. So all we had to do was
6:02 PM 25 clean up the spreadsheet, put it into a form that it could be

RONALD DYKHUIZEN, PH.D. - REDIRECT

6:02 PM 1 submitted for Dr. Ratzell to use, and that involves commenting
6:02 PM 2 a spreadsheet.

6:02 PM 3 Spreadsheets don't typically have comments. So we
6:02 PM 4 would comment cells, this input is for the capping -- the
6:02 PM 5 capping stack pressure, this input is for the K value that you
6:02 PM 6 assume for this item. This was not done in a rush. This was
6:02 PM 7 Mr. Morrow's joke that he probably should not have done.

6:02 PM 8 **Q.** And with regard to the capping stack calculations, all of
6:02 PM 9 the BP internal calculations of the flow through the capping
6:03 PM 10 stack that you reviewed, were all of those calculations over
6:03 PM 11 50,000 barrels per day?

6:03 PM 12 **A.** Yes, they were.

6:03 PM 13 **MR. CERNICH:** Could we go to the ELM0, please?

6:03 PM 14 **BY MR. CERNICH:**

6:03 PM 15 **Q.** Dr. Dykhuizen, this is the demonstrative that Mr. Regan
6:03 PM 16 used with you a few moments ago during your cross-examination.
6:03 PM 17 Do you recall that?

6:03 PM 18 **A.** Yes.

6:03 PM 19 **Q.** And I'd like to look at the estimates again that were
6:03 PM 20 plotted out.

6:03 PM 21 Can you point to me where I should put your -- and
6:03 PM 22 this is BP's demonstrative, D-23996-A. Can you point to me
6:03 PM 23 where I should put your Top Kill calculation?

6:03 PM 24 **A.** The Top Kill was right before the riser was cut off, so a
6:03 PM 25 couple days before. We have 60,000. That's above the line.

RONALD DYKHUIZEN, PH.D. - REDIRECT

6 : 0 4 P M 1 It's on the 60.

6 : 0 4 P M 2 Q. So is that about the right place?

6 : 0 4 P M 3 A. Yes, that looks about right.

6 : 0 4 P M 4 Q. Okay. And your --

6 : 0 4 P M 5 A. And it was greater than 60,000, so maybe you should put an

6 : 0 4 P M 6 arrow going up from that point to demonstrate that my best

6 : 0 4 P M 7 estimate I only quantify to be 60,000 or above.

6 : 0 4 P M 8 Q. Can I label that "best estimate"?

6 : 0 4 P M 9 A. Sure.

6 : 0 4 P M 10 Q. And what about your Top Hat calculation?

6 : 0 4 P M 11 A. The Top Hat calculation was also approximately 60,000. It

6 : 0 4 P M 12 was done on the last day, so that's a few days before we put in

6 : 0 4 P M 13 the -- put on the riser. It was also about 60,000 from there.

6 : 0 4 P M 14 Q. Do I have the right spot?

6 : 0 5 P M 15 A. Yes, I think so. Close enough for government work.

6 : 0 5 P M 16 Q. And can I call that a best estimate?

6 : 0 5 P M 17 A. Correct.

6 : 0 5 P M 18 Q. And can you tell me -- I believe you testified that you

6 : 0 5 P M 19 thought Dr. Zaldivar's calculations were off by a factor of 2.

6 : 0 5 P M 20 Is that right?

6 : 0 5 P M 21 A. Yes.

6 : 0 5 P M 22 Q. And if they were increased by a factor of 2, in what range

6 : 0 5 P M 23 would those be?

6 : 0 5 P M 24 A. Between 50,000 and 70,000, approximately in this range.

6 : 0 5 P M 25 Because you take 25 and double and get 50, and you take 35 and

RONALD DYKHUIZEN, PH.D. - REDIRECT

6:05 PM 1 double and get 70.

6:05 PM 2 Q. So is that about in this range?

6:05 PM 3 A. I think that's correct. That looks close. It's hard to
6:05 PM 4 find May 13th and May 16th on there. But we can slide that
6:06 PM 5 left to right and it still wouldn't make that much difference
6:06 PM 6 for your point.

6:06 PM 7 Q. Would it be fair to call that "Dr. Zaldivar corrected"?

6:06 PM 8 A. Sure.

6:06 PM 9 Q. And your best estimate for the Top Kill calculation, that
6:06 PM 10 has a range of plus or minus 20 percent and that goes in both
6:06 PM 11 directions; is that right?

6:06 PM 12 A. The Top Kill we put a minimum, a lower bound, at 43, and
6:06 PM 13 it could -- I use that to estimate an upper bound also. It's
6:06 PM 14 just an approximation of how far up this could go, yes. So we
6:07 PM 15 could put 17,000 down and 17,000 up to represent my Top Kill
6:07 PM 16 calculation, but you need a bell curve where the most probable
6:07 PM 17 is somewhere near 60,000.

6:07 PM 18 Q. And despite the inaccuracies you were asked about, is
6:07 PM 19 greater than 60,000 still your best estimate?

6:07 PM 20 A. Yes.

6:07 PM 21 Q. And does the same apply to the Top Hat calculation?

6:07 PM 22 A. Using the data of the Top Hat, my best estimate is
6:07 PM 23 approximately 60,000 on that day. Using the data of the
6:07 PM 24 capping stack, I get a different estimate for the flow on that
6:07 PM 25 day, a little lower.

RONALD DYKHUIZEN, PH.D. - REDIRECT

6:07 PM 1 Q. And the curve that's on this demonstrative, Dr. Dykhuizen,
6:07 PM 2 the red curve there, is that a fair representation of your
6:07 PM 3 work?

6:07 PM 4 A. No, it's not. I think that that flow linearly increasing
6:08 PM 5 over the entire time period is not a possible solution. We
6:08 PM 6 could have the flow starting at some low value and as we erode,
6:08 PM 7 we either go up above my line or we go up below my line, but we
6:08 PM 8 probably stay close to my line after May 14th, because that's
6:08 PM 9 where I have -- that's where Dr. Stewart Griffiths has his last
6:08 PM 10 firm data point.

6:08 PM 11 He also has some points in May 8th that he may want
6:08 PM 12 you to believe the data back to May 8th. But I think
6:08 PM 13 May 14th is a pretty -- pretty good estimate that this blue
6:08 PM 14 line is probably decreasing all the way back to May 14th and
6:08 PM 15 probably all the way back to May 8th.

6:09 PM 16 Q. I'm going to mark this as demonstrative D-21160.

6:09 PM 17 MR. CERNICH: Thank you, Dr. Dykhuizen. That's all I
6:09 PM 18 have.

6:09 PM 19 THE COURT: All right. Thank you, sir.

6:09 PM 20 THE WITNESS: Thank you.

6:09 PM 21 THE COURT: You're done. Are you on furlough?

6:09 PM 22 THE WITNESS: I get my salary whether I'm here or
6:09 PM 23 there, so it doesn't really...

6:09 PM 24 THE COURT: That's good. I can't say that for
6:09 PM 25 everyone.

6:09 PM 1 Okay. It's about almost 10 after 6:00.

6:09 PM 2 Obviously, we'll recess for the evening. We'll come back --
6:09 PM 3 well, before we do that, the witnesses tomorrow. Let's see,
6:10 PM 4 you're going to have Mr.-- is it Mr. Hsieh?

6:10 PM 5 **MS. HIMMELHOCH:** Hsieh, Your Honor.

6:10 PM 6 **THE COURT:** He's testifying as a fact witness, Your
6:10 PM 7 Honor.

6:10 PM 8 **MS. HIMMELHOCH:** That is correct, Your Honor.

6:10 PM 9 **THE COURT:** And then Dr. Griffiths?

6:10 PM 10 **THE WITNESS:** Yes, Your Honor.

6:10 PM 11 **THE COURT:** Will those two likely take up most of the
6:10 PM 12 day tomorrow, or will we get to Mr. Zick?

6:10 PM 13 **MS. HIMMELHOCH:** We hope to squeeze in at least a
6:10 PM 14 little bit of Dr. Zick tomorrow, Your Honor. Of course, it
6:10 PM 15 depends on how long the cross takes.

6:10 PM 16 **THE COURT:** All right. Anything else?

6:10 PM 17 **MS. HIMMELHOCH:** Your Honor, we have not yet received
6:10 PM 18 the order of witnesses from BP, which was due today.

6:10 PM 19 Can you gives us a guesstimate as to when we'll
6:10 PM 20 get it?

6:10 PM 21 **MR. BROCK:** Yes. There was an inquiry made earlier
6:10 PM 22 today. I said you would get it around 5:30 or 6:00. So I
6:11 PM 23 don't know why you're bringing that up.

6:11 PM 24 I promised to give it to them as soon as we get
6:11 PM 25 back.

6 : 1 1 P M 1 MS. HIMMELHOCH: I apologize.

6 : 1 1 P M 2 MR. CERNICH: Mike, it wasn't intended --

6 : 1 1 P M 3 MR. BROCK: We had a conversation about it. I've
6 : 1 1 P M 4 indicated the time we would get it --

6 : 1 1 P M 5 THE COURT: All right. Anything else?

6 : 1 1 P M 6 MS. KARIS: Your Honor, two quick carryover issues
6 : 1 1 P M 7 from last week's trial. The outstanding exhibit lists for both
6 : 1 1 P M 8 Dr. Ballard as well as Mr. Adams were circulated over the
6 : 1 1 P M 9 weekend.

6 : 1 1 P M 10 THE COURT: Did you say witness lists?

6 : 1 1 P M 11 MS. KARIS: I'm sorry. Exhibit lists.

6 : 1 1 P M 12 THE COURT: Exhibit lists.

6 : 1 1 P M 13 MS. KARIS: I'm sorry. I probably misspoke. It's
6 : 1 1 P M 14 been a long day.

6 : 1 1 P M 15 We have circulated those. Transocean -- or the
6 : 1 1 P M 16 aligned parties have asked me for additional time to review
6 : 1 1 P M 17 those. That is an open item from last week's case. I just
6 : 1 1 P M 18 don't want the Court to think that --

6 : 1 1 P M 19 THE COURT: Okay.

6 : 1 1 P M 20 MS. KARIS: And we are also working with the aligned
6 : 1 1 P M 21 parties with respect to redacting Mr. Ziegler's report, and we
6 : 1 1 P M 22 will have that resolved in short order.

6 : 1 1 P M 23 THE COURT: Okay. Very well. Everyone have a good
6 : 1 1 P M 24 evening. See you in the morning.

6 : 1 1 P M 25 THE DEPUTY CLERK: All rise.

6:11 PM 1
6:11 PM 2
6:11 PM 3
6:11 PM 4
6:11 PM 5
6:11 PM 6
6:11 PM 7
6:11 PM 8
6:11 PM 9
6:11 PM 10
6:11 PM 11
6:11 PM 12
6:11 PM 13
6:11 PM 14
15
16
17
18
19
20
21
22
23
24
25

(WHEREUPON, the proceedings were concluded.)

CERTIFICATE

I, Jodi Simcox, RMR, FCRR, Official Court Reporter
for the 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.

s/Jodi Simcox, RMR, FCRR
Jodi Simcox, RMR, FCRR
Official Court Reporter

'	1300 [1] 1313/12 1331 [1] 1313/9	1481/19 1487/4 1488/10 1497/14 1498/9
'reasonable' [1] 1398/16	13th [1] 1422/14	2011 [3] 1350/8 1351/12 1352/15
'the' [1] 1422/23	14 [2] 1465/17 1465/23	2013 [2] 1309/7 1315/2
'upper' [1] 1467/5	14 flow [1] 1464/23	2020 [1] 1313/16
.	14271 [1] 1311/7	20th [4] 1344/15 1348/25 1434/17 1493/12
.5 [1] 1457/10	14th [12] 1451/2 1474/8 1475/5 1475/11 1475/12 1475/13 1475/17 1475/18 1475/20 1475/20 1475/24 1503/8	21006.1 [1] 1322/4 21100.1 [2] 1367/18 1455/18
0	15 [4] 1325/12 1386/21 1386/24 1486/2 15,000 [1] 1485/23	21101 [1] 1368/12 21101.1 [1] 1456/6
02771 [1] 1309/7	15,000 barrels [2] 1405/17 1406/2	21102 [1] 1370/4
040 [1] 1439/1	15-minute [1] 1414/3	21103 [1] 1371/15
1	15th [15] 1325/10 1325/16 1344/12 1348/11 1348/24 1349/8 1434/17 1451/3 1451/19 1452/3 1462/18 1468/10 1468/15 1471/25 1484/24	21104 [1] 1374/3 21105 [1] 1373/12 21106 [1] 1374/20 21109 [1] 1403/21 21110 [1] 1405/8 21117 [1] 1391/14 21118 [1] 1393/20 21119 [1] 1408/4 21122 [2] 1366/24 1432/11 21123 [1] 1388/5 21124 [1] 1418/7 21125 [1] 1423/23 21140 [1] 1355/25 21141 [1] 1357/5 21142 [1] 1357/13 21143 [2] 1366/20 1433/2 21145 [1] 1354/25 21160 [1] 1503/16 2179 [1] 1309/4 220 [1] 1382/21 220 degrees [1] 1382/20 2216 [1] 1310/7 22nd [1] 1438/23 23 [1] 1493/15 23rd [2] 1438/23 1450/11 24 [3] 1335/9 1475/21 1493/17 24,900 [1] 1493/19 24368 [1] 1319/1 24369 [1] 1476/11 24370 [1] 1476/20 24401 [1] 1477/10 24406 [1] 1464/20 24407 [2] 1465/21 1466/5 24496 [1] 1494/10 25 [1] 1501/25 25 percent [1] 1498/24 25,000 [1] 1404/23 25,000 barrels [1] 1404/16 252 [1] 1386/23 25th [1] 1492/7 26 [1] 1327/24 26th [8] 1324/19 1327/10 1327/25 1328/3 1339/20 1451/7 1453/15 1454/11 26th of [1] 1324/17 27 [1] 1493/15 28th [3] 1329/14 1331/12 1332/5 28th of [1] 1329/7 29th [4] 1398/12 1442/10 1442/14 1445/7 2nd [6] 1341/4 1345/7 1349/20 1352/17 1464/3 1464/13
1 percent [3] 1384/5 1498/20 1498/22	15th of [1] 1321/1	
1 psi [2] 1326/10 1326/10	1600 psi [1] 1467/23	
1,000 [1] 1406/20	1615 [1] 1313/12	
1-peak [1] 1425/11	1665 [1] 1313/9	
1.1 psi [3] 1403/6 1403/17 1404/11	16th [3] 1425/24 1425/25 1426/10	
10 [15] 1338/16 1338/19 1341/17	17,000 [3] 1491/20 1502/15 1502/15	
1346/20 1400/18 1401/7 1405/16	1700 [1] 1313/5	
1406/2 1462/1 1463/23 1464/5 1464/6	17th [1] 1386/15	
1485/23 1486/2 1504/1	18,000 [1] 1404/19	
10 heads [1] 1385/11	18,000 barrels [1] 1404/13	
10 percent [26] 1338/18 1341/23	180 [1] 1382/22	
1342/10 1343/5 1345/3 1345/6 1345/12	180 degrees [4] 1363/5 1363/6 1382/17 1383/5	
1345/20 1345/22 1346/8 1346/9	1800 psi [1] 1467/23	
1346/10 1346/21 1346/24 1346/25	188 [1] 1310/16	
1347/5 1347/13 1347/16 1399/10	1885 [1] 1310/23	
1429/13 1461/21 1462/4 1463/7	1979 [1] 1358/5	
1463/14 1463/22 1464/8	19th [1] 1475/25	
10,000 [2] 1441/6 1441/17		
10,050 [1] 1408/1	2	
10,600 [1] 1408/2	2 percent [4] 1382/18 1382/20 1407/20 1407/21	
10-CV-02771 [1] 1309/7	2 psi [1] 1403/17	
10-CV-4536 [1] 1309/9	2-peak [1] 1425/10	
10-MD-2179 [1] 1309/4	20 [6] 1309/5 1436/23 1437/8 1437/18 1485/1 1486/4	
100 [1] 1406/20	20 degrees [2] 1407/20 1407/21	
100 percent [1] 1435/3	20 percent [31] 1338/16 1338/19 1341/17 1376/3 1384/14 1385/5 1385/13 1411/13 1411/15 1411/15 1411/16 1411/16 1411/17 1412/1 1412/2 1412/3 1414/20 1414/21 1433/25 1434/6 1434/12 1435/14 1461/14 1461/18 1461/24 1466/25 1467/1 1472/5 1498/23 1499/11 1502/10	
100,000 barrels [1] 1453/21	20,000 [8] 1406/2 1406/5 1406/6 1441/17 1485/21 1486/1 1486/2 1487/2	
10003 [1] 1310/11	20,000 barrels [1] 1485/16	
1001 [1] 1312/16	20,000's [1] 1406/7	
104 [1] 1452/17	200 degrees [3] 1382/17 1383/7 1383/8	
104,000 [1] 1325/14	20004 [1] 1312/11	
104,900 [1] 1451/22	20005 [1] 1312/7	
105 [2] 1452/18 1452/18	20006 [1] 1313/16	
105,000 barrels [2] 1452/19 1452/20	20044 [2] 1311/8 1311/16	
10650 [2] 1427/3 1427/3	2010 [49] 1309/5 1316/25 1318/9 1321/9 1321/16 1323/2 1332/17 1335/6 1339/12 1349/23 1350/15 1352/18 1362/7 1362/14 1375/12 1386/15 1395/18 1398/12 1401/19 1403/15 1412/19 1412/20 1413/2 1434/25 1442/8 1442/10 1445/7 1450/11 1451/19 1455/12 1460/1 1460/17 1461/6 1464/3 1470/16 1474/12 1478/21 1479/6 1479/8 1479/11 1479/16 1480/1 1480/10 1481/8	
10650.1.1.US [1] 1427/7		
10650.2.1 [1] 1489/13		
11 [1] 1395/18		
11,000 [1] 1427/12		
11,850 psi [1] 1445/24		
11,850 to [1] 1472/21		
1100 [1] 1312/13		
11087 [1] 1376/25		
11191 [1] 1389/11		
11191.1.US [1] 1389/12		
11352 [2] 1377/17 1379/7		
11435.1.1 [1] 1479/13		
11436.2.1 [1] 1480/7		
11452 [2] 1365/5 1365/18		
11453.12.1 [1] 1474/17		
11456.1.1 [1] 1454/25		
11463-R [2] 1365/10 1365/18		
115 [1] 1335/10		
11534.1 [1] 1452/21		
11534.16 [1] 1453/2		
11th of [2] 1329/16 1332/3		
1201 [2] 1312/10 1313/5		
12308 [1] 1310/4		
12th [2] 1451/1 1475/19		
13 [2] 1441/6 1441/6		
		3
		3 percent [3] 1408/2 1408/3 1472/25 3 psi [1] 1326/14 3-K [4] 1390/5 1390/6 1390/7 1390/9 3-ram [2] 1336/25 1387/5 3.5 [2] 1437/15 1438/2 3.5 million [4] 1439/7 1439/8 1440/12

3	48-hour [1] 1328/21 49 [2] 1335/9 1450/14 4:00 p.m [1] 1329/7	1491/16 1500/25 1501/5 1501/7 1501/11 1501/13 1502/17 1502/19 1502/23
3.5 million... [1] 1440/23 3.5 million barrels [3] 1437/10 1440/7 1441/3	5	60,000 barrels [17] 1366/11 1366/14 1389/3 1390/24 1394/17 1394/19 1401/3 1481/23 1481/25 1482/25 1484/18 1485/11 1486/13 1486/16 1486/18 1486/25 1491/23
30 [11] 1342/24 1356/23 1412/14 1414/1 1436/23 1437/3 1437/8 1437/19 1441/3 1486/5 1493/24	5 million [18] 1366/16 1434/16 1434/24 1435/11 1436/2 1436/4 1436/7 1436/12 1436/21 1437/1 1437/6 1438/2 1439/5 1440/5 1440/14 1486/19 1486/22 1493/25	60,000-barrels-a-day [1] 1482/23 600 [1] 1310/4 60654 [1] 1311/24 6196 [1] 1386/10 6196.4.1.US [1] 1386/18 63 [3] 1335/10 1385/8 1499/15 63,000 [4] 1348/11 1385/6 1439/21 1441/21
30 percent [22] 1411/8 1411/10 1411/11 1414/20 1414/22 1435/10 1435/13 1436/8 1436/15 1436/21 1437/1 1437/3 1439/8 1440/12 1462/6 1462/9 1462/18 1462/20 1462/21 1493/25 1498/25 1499/11	5 million barrels [4] 1407/8 1411/11 1414/18 1499/14 5 percent [2] 1461/23 1461/24 5,000 barrels [3] 1338/14 1363/25 1449/24 5,000 feet [1] 1326/22 5-million-barrel [2] 1412/5 1438/24	64 [2] 1335/11 1394/13 64 1/2 [2] 1394/13 1394/14 65 [1] 1394/13 655 [1] 1312/7 6:00 [2] 1504/1 1504/22
30,000 [1] 1486/2 300 [1] 1311/23 30th [16] 1331/13 1333/25 1335/6 1336/22 1339/12 1339/23 1340/22 1340/23 1341/9 1341/15 1342/7 1454/12 1460/1 1460/17 1461/6 1464/13	50 [5] 1400/16 1400/20 1481/11 1481/13 1501/25 50 percent [1] 1453/11 50,000 [1] 1501/24 50,000 barrels [1] 1500/11 500 [3] 1309/23 1310/20 1313/18 5000 [1] 1311/18 501 [1] 1310/13 504 [1] 1313/19 5066 [1] 1395/12 5066.1.1.US [1] 1395/16 5066.1.2.US [1] 1396/7 5066.3.1.US [1] 1396/23	7
30th of [1] 1332/3 30th, they [1] 1339/21 31 [2] 1467/16 1467/25 316 [1] 1310/4 31st [6] 1341/11 1342/1 1342/5 1342/8 1346/19 1461/7 31st of [1] 1343/4 31st to [1] 1464/13 32591 [1] 1310/5 33 [1] 1335/10 333 [1] 1312/3 35 [5] 1355/13 1486/5 1493/17 1493/20 1501/25	51 [4] 1389/8 1390/4 1390/13 1467/22 51,000 [1] 1325/14 51,500 [1] 1388/25 51,900 [1] 1451/22 51-60 [1] 1335/11 51K [2] 1467/14 1467/18 52 [2] 1335/10 1452/17 53 [7] 1335/14 1344/19 1345/1 1346/2 1346/5 1346/22 1467/22 53,000 [37] 1341/3 1344/12 1344/13 1345/22 1346/18 1348/10 1385/6 1385/7 1434/20 1436/1 1438/18 1439/11 1440/4 1440/11 1440/22 1441/13 1441/18 1441/20 1441/22 1462/5 1462/9 1465/3 1465/16 1465/19 1465/24 1466/17 1466/18 1467/2 1468/3 1468/9 1468/10 1468/14 1472/5 1472/13 1472/16 1472/22 1495/9	70 [3] 1394/8 1491/22 1502/1 70,000 [1] 1501/24 700 [1] 1310/10 701 [2] 1311/4 1311/18 70112 [1] 1313/13 70113 [1] 1309/20 70130 [3] 1310/8 1311/4 1313/19 70139 [1] 1311/19 70163 [1] 1312/14 703 [1] 1378/10 70502 [1] 1309/24 70601 [1] 1310/14 70804 [1] 1310/24 72,000 [1] 1325/13 72,700 [3] 1451/22 1452/3 1453/5 73,000 [1] 1452/14 75270 [1] 1313/6 7611 [1] 1311/15 77,000 [1] 1399/16 77,000 barrels [1] 1399/4 77002 [1] 1312/17 77010 [1] 1313/9 777 [1] 1310/16 7780 [1] 1313/19
35 million [1] 1440/23 35,000 [1] 1493/20 355 [1] 1312/21 35th [1] 1312/21 36,000 [1] 1493/20 36130 [1] 1310/20 3668 [1] 1309/23 37 [1] 1414/4 3700 [2] 1312/13 1312/16 39201 [1] 1310/17 3:35 [1] 1414/4 3rd [1] 1470/16	53,000 barrels [8] 1338/13 1366/7 1367/13 1375/9 1385/1 1385/14 1433/1 1433/22 53-64 [1] 1335/11 53K [2] 1467/15 1467/18 53K-bopd [1] 1467/14 54 [1] 1390/13 54,000 barrels [2] 1389/9 1390/4 55,300 [3] 1466/2 1466/4 1466/12 556 [1] 1309/23 56,000 barrels [1] 1388/14 589-7780 [1] 1313/19 59 [1] 1491/17 59,200 [1] 1335/11 5:30 [1] 1504/22	8
4	6	8,200 barrels [1] 1427/25 80 [3] 1451/24 1452/17 1480/5 800,000 barrels [1] 1352/24 810,000 [1] 1353/2 82,000 [1] 1427/24 820 [1] 1309/19 83,000 [5] 1325/14 1451/22 1452/4 1452/15 1453/6 85 [1] 1468/20 85 days [1] 1470/22 86 [3] 1347/7 1347/15 1478/17 86-day [2] 1347/2 1474/1 8628.58.1 [1] 1342/1 8635.96.1 [1] 1339/11 8635.96.3 [1] 1460/10 8635.97.1 [1] 1338/5 87 [7] 1316/14 1342/17 1344/13 1344/20 1346/2 1346/7 1346/13 8809 [1] 1462/25 8809.1.1 [1] 1463/19 8th [4] 1409/6 1409/7 1503/12 1503/15
4 percent [5] 1376/2 1376/2 1408/21 1471/9 1471/12 4,200 [1] 1428/2 4,900 [1] 1428/2 4.1 [1] 1353/4 4.9 [4] 1352/22 1353/1 1434/25 1439/1 4.9 million [9] 1345/7 1345/12 1347/1 1347/20 1352/18 1407/14 1435/4 1435/6 1463/3 4.9 million-barrel [1] 1344/15 40 [2] 1335/9 1406/8 406 [1] 1313/18 42 [1] 1335/9 42,400 [2] 1434/3 1472/6 43 [3] 1385/7 1499/15 1502/12 43,000 [12] 1385/5 1393/7 1393/18 1404/21 1405/2 1405/4 1406/6 1406/7 1441/21 1482/6 1492/21 1493/7 43,000 barrels [4] 1391/5 1393/15 1405/7 1492/11 44,000 [2] 1399/4 1399/15 45 [2] 1451/24 1452/17 4536 [1] 1309/9 46 [1] 1348/6 48 hours [1] 1328/16	6 million barrels [1] 1437/9 6.0 [1] 1438/3 6.5 [1] 1437/15 60 [5] 1335/11 1394/8 1394/10 1394/11 1501/1 60,000 [20] 1391/2 1394/5 1394/6 1406/7 1432/19 1432/23 1439/11 1439/13 1482/8 1482/10 1486/17	9
		90071 [2] 1312/4 1312/22

<p>9</p> <p>9361 [1] 1464/23 9361.1 [1] 1464/11 9361.24.1 [1] 1456/24 9361.46 [1] 1348/3 9361.49.1 [1] 1450/2 9361.71 [1] 1469/4 9379.1.2 [1] 1467/8 9388 [1] 1442/15 9388.1.1 [1] 1442/9 9389.1.1 [1] 1443/5 9389.2.1 [2] 1442/23 1445/15 94005 [1] 1310/23 94512.1.1.US [1] 1398/7 9452 [1] 1398/3 9452.2.1.US [1] 1398/20 9452.9.1.US [1] 1399/12 9671.1.1 [1] 1351/17 9671.2.1 [1] 1350/5 9692.3.2 [1] 1316/20 9706 [2] 1327/24 1451/12 9706.1 [1] 1324/20 9706.26.1 [1] 1327/24 9706.4 [2] 1325/3 1451/13 9706.5 [2] 1325/20 1453/13 9710.3.1 [1] 1350/18 9718.1.1 [1] 1328/22 9718.1.2 [1] 1329/23 9725.2.1 [1] 1341/14 9906.3.3 [1] 1336/10 9908 [1] 1332/9 9908.2.2 [1] 1332/22 9924.1.1 [2] 1470/15 1470/17 9924.3.2 [1] 1470/17 9929 [1] 1334/19 9929.95 [1] 1334/17</p>	<p>1337/1 1392/13 1396/12 1439/11 1444/3 1453/17 1469/16 1476/22 1477/5 1500/25 1501/7 1503/7 1506/9 above-entitled [1] 1506/9 absolutely [1] 1330/19 accept [3] 1364/22 1409/1 1440/12 accepting [1] 1425/15 accepts [1] 1400/12 accident [12] 1316/10 1329/10 1333/8 1355/11 1359/3 1391/23 1440/3 1445/24 1450/15 1475/21 1480/13 1481/20 accommodation [1] 1474/13 account [17] 1317/10 1345/8 1345/13 1347/10 1370/23 1399/22 1408/10 1409/2 1411/20 1443/12 1446/3 1447/8 1447/9 1447/10 1471/8 1471/18 1471/20 accounted [2] 1352/19 1436/3 accuracy [5] 1330/15 1340/15 1419/15 1478/15 1487/2 accurate [27] 1316/19 1320/19 1322/19 1323/3 1323/25 1343/8 1343/15 1381/20 1381/23 1382/1 1383/19 1384/17 1384/24 1390/7 1394/10 1403/19 1452/16 1466/12 1482/9 1484/24 1485/3 1485/7 1485/8 1485/9 1498/16 1498/17 1498/18 accurately [2] 1331/19 1332/19 achieve [2] 1392/18 1392/20 across [2] 1396/12 1481/5 activated [1] 1451/2 activities [2] 1450/10 1464/12 actual [4] 1327/25 1428/22 1429/6 1472/3 actually [24] 1317/3 1320/14 1322/20 1322/25 1323/10 1335/3 1340/18 1342/3 1343/20 1346/5 1346/7 1347/19 1349/18 1374/25 1378/12 1380/8 1394/6 1424/15 1430/20 1441/12 1443/4 1457/8 1458/22 1492/8 ad [1] 1422/25 Adam [1] 1387/22 Adams [1] 1505/8 add [7] 1370/18 1404/20 1405/11 1405/12 1406/6 1486/1 1486/2 added [5] 1317/7 1331/6 1378/7 1400/1 1468/8 adding [3] 1342/17 1434/21 1446/13 addition [1] 1365/16 additional [6] 1325/21 1326/20 1341/15 1401/5 1401/25 1505/16 address [2] 1329/1 1422/17 addressed [4] 1413/13 1418/22 1496/8 1498/7 addresses [1] 1425/20 addressing [1] 1479/10 adds [2] 1408/14 1439/4 adequate [1] 1360/23 adjust [3] 1403/1 1472/7 1495/16 adjusted [1] 1472/5 adjustments [2] 1330/10 1348/21 administration [2] 1328/15 1346/20 admits [1] 1422/13 admitted [2] 1365/21 1377/24 adopt [1] 1365/13 affect [4] 1349/12 1419/15 1443/12 1443/13 affects [1] 1350/24 after [28] 1336/5 1350/1 1378/12 1378/12 1383/21 1388/10 1388/12 1395/5 1395/11 1396/21 1397/14 1397/17 1405/22 1430/14 1430/15</p>	<p>1436/17 1436/17 1436/18 1436/19 1439/25 1461/19 1473/17 1473/22 1482/15 1483/10 1485/15 1503/8 1504/1 afternoon [4] 1309/14 1315/1 1315/17 1315/18 afterwards [1] 1450/8 again [19] 1318/23 1325/25 1338/6 1354/17 1363/7 1377/9 1417/4 1417/5 1422/11 1439/3 1445/11 1446/6 1453/7 1457/2 1464/12 1469/4 1477/17 1482/23 1500/19 against [3] 1387/4 1402/17 1402/18 age [3] 1400/16 1400/17 1400/20 ago [4] 1412/14 1462/3 1463/22 1500/16 agree [25] 1322/17 1348/23 1363/21 1382/21 1408/24 1437/12 1439/8 1439/10 1440/6 1449/16 1449/17 1454/17 1454/18 1465/16 1465/24 1471/24 1472/19 1476/4 1476/7 1476/21 1482/8 1484/15 1485/18 1486/7 1493/23 agreed [6] 1326/5 1333/12 1363/16 1378/6 1410/1 1437/16 agreeing [1] 1436/10 agreement [3] 1396/19 1474/21 1475/2 ahead [5] 1354/22 1364/22 1380/6 1414/3 1452/11 aided [1] 1313/24 al [2] 1309/8 1309/11 Alabama [1] 1310/20 ALAN [1] 1313/8 Albuquerque [1] 1442/12 alert [1] 1377/1 alerted [1] 1350/15 aligned [2] 1505/16 1505/20 all [95] 1315/4 1315/5 1319/19 1321/21 1325/1 1330/6 1331/25 1333/6 1333/11 1333/21 1336/6 1337/1 1338/1 1338/4 1341/18 1342/17 1343/2 1343/14 1346/22 1346/24 1351/11 1351/15 1352/3 1354/21 1358/1 1359/4 1360/4 1364/5 1364/17 1365/21 1370/14 1370/25 1372/2 1372/8 1373/20 1375/1 1375/7 1375/22 1375/22 1378/25 1382/5 1382/10 1384/16 1384/22 1384/22 1385/10 1386/7 1388/10 1388/12 1389/4 1392/2 1392/9 1394/2 1395/21 1411/23 1414/5 1414/7 1414/8 1418/24 1419/14 1419/19 1420/14 1421/20 1422/4 1432/4 1442/24 1450/7 1456/13 1456/18 1458/16 1458/17 1459/14 1463/16 1463/16 1473/12 1473/16 1475/12 1478/23 1483/1 1483/10 1496/8 1496/9 1498/7 1498/8 1499/6 1499/24 1500/8 1500/10 1503/14 1503/15 1503/17 1503/19 1504/16 1505/5 1505/25 ALLAN [1] 1311/3 ALLEN [1] 1312/21 allow [5] 1346/8 1367/23 1391/4 1416/5 1468/22 allowed [3] 1333/2 1333/9 1367/25 allows [4] 1368/3 1371/23 1374/1 1473/4 almost [1] 1504/1 along [3] 1401/7 1417/3 1441/2 already [5] 1331/8 1342/25 1398/13 1401/4 1403/24 also [93] 1316/10 1317/21 1318/22 1320/10 1323/8 1324/12 1330/17 1336/18 1336/20 1339/11 1339/20</p>
<p>A</p> <p>ability [2] 1403/1 1506/7 able [7] 1331/14 1363/17 1378/20 1380/20 1402/12 1410/12 1424/20 about [121] 1316/16 1317/1 1318/1 1318/8 1318/13 1320/7 1320/14 1320/15 1322/2 1322/3 1322/8 1322/19 1324/15 1324/16 1325/21 1326/15 1329/18 1331/5 1332/17 1332/17 1337/23 1338/1 1341/7 1342/24 1342/25 1343/15 1343/18 1344/19 1344/21 1345/17 1348/1 1351/24 1355/13 1364/9 1369/18 1372/10 1376/19 1378/15 1380/15 1380/15 1380/16 1389/23 1403/6 1403/19 1403/24 1405/25 1407/23 1410/11 1410/17 1410/24 1411/18 1412/7 1414/4 1414/13 1416/11 1421/4 1423/12 1423/20 1429/23 1430/2 1430/18 1431/4 1431/9 1431/23 1431/24 1436/19 1437/16 1439/11 1441/12 1441/25 1442/12 1443/4 1444/2 1445/21 1446/22 1446/23 1449/4 1449/7 1453/11 1455/16 1459/3 1459/7 1459/22 1461/11 1468/18 1469/2 1470/19 1472/9 1476/24 1477/19 1478/13 1478/15 1478/18 1478/24 1479/1 1479/12 1480/10 1480/20 1480/22 1481/7 1481/17 1485/5 1487/3 1489/9 1493/9 1493/15 1494/22 1496/3 1496/11 1497/16 1497/22 1498/16 1499/18 1501/2 1501/3 1501/10 1501/13 1502/2 1502/18 1504/1 1505/3 above [16] 1319/21 1319/25 1327/8</p>	<p>ad [1] 1422/25 Adam [1] 1387/22 Adams [1] 1505/8 add [7] 1370/18 1404/20 1405/11 1405/12 1406/6 1486/1 1486/2 added [5] 1317/7 1331/6 1378/7 1400/1 1468/8 adding [3] 1342/17 1434/21 1446/13 addition [1] 1365/16 additional [6] 1325/21 1326/20 1341/15 1401/5 1401/25 1505/16 address [2] 1329/1 1422/17 addressed [4] 1413/13 1418/22 1496/8 1498/7 addresses [1] 1425/20 addressing [1] 1479/10 adds [2] 1408/14 1439/4 adequate [1] 1360/23 adjust [3] 1403/1 1472/7 1495/16 adjusted [1] 1472/5 adjustments [2] 1330/10 1348/21 administration [2] 1328/15 1346/20 admits [1] 1422/13 admitted [2] 1365/21 1377/24 adopt [1] 1365/13 affect [4] 1349/12 1419/15 1443/12 1443/13 affects [1] 1350/24 after [28] 1336/5 1350/1 1378/12 1378/12 1383/21 1388/10 1388/12 1395/5 1395/11 1396/21 1397/14 1397/17 1405/22 1430/14 1430/15</p>	<p>ad [1] 1422/25 Adam [1] 1387/22 Adams [1] 1505/8 add [7] 1370/18 1404/20 1405/11 1405/12 1406/6 1486/1 1486/2 added [5] 1317/7 1331/6 1378/7 1400/1 1468/8 adding [3] 1342/17 1434/21 1446/13 addition [1] 1365/16 additional [6] 1325/21 1326/20 1341/15 1401/5 1401/25 1505/16 address [2] 1329/1 1422/17 addressed [4] 1413/13 1418/22 1496/8 1498/7 addresses [1] 1425/20 addressing [1] 1479/10 adds [2] 1408/14 1439/4 adequate [1] 1360/23 adjust [3] 1403/1 1472/7 1495/16 adjusted [1] 1472/5 adjustments [2] 1330/10 1348/21 administration [2] 1328/15 1346/20 admits [1] 1422/13 admitted [2] 1365/21 1377/24 adopt [1] 1365/13 affect [4] 1349/12 1419/15 1443/12 1443/13 affects [1] 1350/24 after [28] 1336/5 1350/1 1378/12 1378/12 1383/21 1388/10 1388/12 1395/5 1395/11 1396/21 1397/14 1397/17 1405/22 1430/14 1430/15</p>

<p>A</p> <p>also... [82] 1340/19 1341/16 1342/8 1343/6 1346/2 1353/21 1355/11 1357/25 1359/21 1359/23 1360/1 1361/16 1366/3 1371/7 1371/12 1372/15 1373/8 1373/11 1373/24 1376/6 1376/8 1376/20 1382/15 1382/20 1383/6 1383/16 1390/25 1392/25 1397/10 1398/23 1400/2 1400/9 1404/11 1404/15 1405/12 1406/12 1407/1 1407/24 1412/3 1412/21 1415/17 1417/2 1419/10 1423/20 1423/22 1425/11 1426/12 1430/6 1439/12 1443/17 1444/8 1448/7 1449/10 1454/17 1457/17 1457/23 1458/6 1462/4 1462/17 1463/22 1464/5 1466/2 1466/2 1467/13 1471/24 1478/11 1479/7 1480/4 1481/15 1482/2 1484/18 1490/3 1490/7 1492/2 1495/11 1498/6 1499/5 1501/11 1501/13 1502/13 1503/11 1505/20 alternate [15] 1373/9 1373/15 1373/16 1374/5 1375/4 1375/5 1375/6 1376/18 1383/15 1387/7 1389/2 1394/21 1394/24 1457/17 1459/5 alternated [1] 1416/21 alternating [1] 1361/13 although [4] 1360/7 1382/21 1436/22 1437/23 always [8] 1353/3 1382/24 1402/10 1402/25 1403/3 1403/5 1403/7 1447/2 am [2] 1377/25 1482/22 ambient [3] 1319/4 1319/12 1393/11 AMERICA [8] 1309/10 1311/6 1311/10 1311/18 1311/21 1312/3 1312/6 1312/10 Ammerman [2] 1344/1 1344/2 amongst [2] 1339/23 1464/16 amount [14] 1329/9 1345/5 1346/2 1358/13 1358/16 1358/19 1366/4 1370/10 1370/19 1392/7 1401/13 1405/20 1472/20 1485/21 Anadarko [4] 1313/11 1313/11 1313/14 1313/15 anaerobic [1] 1415/11 analogy [1] 1447/13 analyses [4] 1339/3 1350/14 1447/7 1467/13 analysis [37] 1318/4 1334/7 1338/20 1339/13 1341/8 1358/2 1362/6 1372/2 1372/3 1378/7 1378/8 1378/9 1378/11 1379/9 1379/11 1379/17 1379/19 1380/17 1380/18 1381/8 1425/16 1443/11 1444/17 1445/20 1454/3 1460/5 1460/18 1462/14 1476/9 1479/4 1480/12 1481/8 1488/8 1488/12 1488/15 1494/22 1495/7 analysts [1] 1331/5 analyze [3] 1400/6 1400/11 1483/21 analyzed [5] 1330/2 1331/11 1400/7 1400/9 1484/1 analyzing [4] 1337/24 1355/10 1356/14 1485/12 and/or [1] 1454/3 ANDREW [1] 1311/21 Angeles [2] 1312/4 1312/22 angle [4] 1322/21 1322/22 1323/2 1402/10 ANNA [1] 1311/13 announce [1] 1454/13 annulars [1] 1317/15 anomalous [1] 1373/4</p>	<p>anomaly [3] 1339/8 1466/8 1466/10 another [18] 1315/25 1320/23 1341/11 1344/18 1352/7 1371/7 1371/24 1376/15 1378/7 1379/13 1382/20 1412/12 1425/12 1425/13 1444/21 1445/16 1480/9 1486/9 answer [6] 1316/13 1322/1 1385/20 1388/12 1388/17 1423/16 answering [1] 1423/9 ANTHONY [1] 1310/7 any [65] 1316/10 1321/13 1321/21 1338/2 1345/8 1345/13 1347/6 1347/10 1347/19 1351/2 1352/19 1354/17 1360/2 1360/5 1364/5 1364/17 1366/2 1367/8 1367/15 1372/2 1379/8 1379/11 1382/7 1384/6 1384/20 1384/20 1386/6 1387/14 1387/15 1387/16 1387/17 1388/15 1390/15 1391/11 1399/25 1404/25 1405/2 1405/3 1406/21 1413/1 1418/4 1420/17 1426/20 1434/15 1434/25 1446/1 1448/17 1457/18 1462/14 1466/11 1467/21 1469/25 1479/23 1480/13 1481/1 1483/10 1485/24 1486/2 1488/1 1488/8 1488/12 1488/15 1488/17 1495/16 1497/2 anybody [2] 1400/18 1480/25 anybody's [1] 1384/22 anyone [4] 1351/2 1364/9 1401/21 1495/15 anything [7] 1323/22 1375/12 1377/20 1440/8 1476/22 1504/16 1505/5 apart [3] 1372/12 1379/25 1380/3 APLC [1] 1311/17 apologize [2] 1437/4 1505/1 apology [1] 1437/5 appeal [1] 1376/23 appealed [1] 1377/5 appear [1] 1438/18 appearance [1] 1476/4 Appearances [5] 1309/17 1310/1 1311/1 1312/1 1313/1 appeared [1] 1475/25 appears [1] 1325/2 applicable [1] 1375/20 application [1] 1359/15 applied [4] 1358/24 1376/3 1435/1 1464/9 applies [5] 1309/6 1429/5 1463/15 1463/16 1463/17 apply [10] 1358/20 1395/3 1412/7 1412/10 1414/16 1484/3 1491/19 1492/5 1499/6 1502/21 applying [2] 1395/3 1491/17 appreciate [1] 1476/21 appreciated [1] 1318/9 approach [4] 1379/6 1440/5 1440/13 1479/17 appropriate [4] 1343/18 1369/3 1461/3 1462/8 approximate [1] 1394/15 approximately [35] 1348/11 1356/23 1366/13 1375/8 1376/2 1384/14 1395/5 1399/10 1401/3 1403/16 1404/16 1408/2 1426/18 1427/12 1428/1 1428/2 1429/7 1432/23 1433/1 1434/5 1438/25 1439/5 1439/13 1441/3 1457/20 1457/21 1463/7 1476/3 1483/19 1492/21 1493/7 1499/16 1501/11 1501/24 1502/23 approximation [3] 1376/16 1424/17 1502/14 approximations [2] 1421/18 1422/11 APRIL [6] 1309/5 1344/15 1348/25</p>	<p>1434/17 1434/21 1438/23 April 20th [2] 1344/15 1348/25 April 20th and [1] 1434/21 April 22nd [1] 1438/23 arbitrarily [1] 1481/11 are [123] 1317/9 1319/20 1319/21 1330/1 1331/10 1332/4 1335/1 1335/19 1336/12 1337/7 1339/16 1339/16 1339/17 1340/22 1341/14 1341/22 1343/20 1343/25 1349/1 1349/4 1353/15 1354/17 1356/17 1358/23 1359/16 1360/19 1365/18 1367/3 1369/6 1369/7 1370/10 1371/2 1371/3 1371/8 1374/7 1376/19 1376/20 1378/13 1381/4 1381/20 1384/16 1384/18 1384/19 1384/24 1390/10 1390/11 1394/23 1394/25 1396/13 1396/19 1397/3 1397/15 1398/15 1405/13 1410/14 1410/19 1411/14 1413/25 1414/25 1416/1 1419/8 1419/14 1419/21 1421/17 1421/25 1422/11 1422/21 1423/25 1424/1 1424/14 1425/1 1425/1 1425/8 1425/14 1427/5 1427/6 1427/9 1427/9 1427/11 1433/7 1433/8 1433/19 1438/12 1441/24 1443/6 1445/1 1446/13 1446/15 1447/4 1447/6 1447/16 1456/5 1456/7 1459/1 1461/5 1464/23 1465/1 1465/3 1465/5 1466/22 1467/21 1467/22 1470/23 1473/8 1476/17 1476/25 1484/7 1486/11 1487/1 1487/13 1490/18 1490/19 1490/21 1494/1 1494/5 1494/11 1496/8 1496/10 1498/22 1498/22 1499/15 1503/21 1505/20 area [19] 1318/1 1323/5 1337/19 1350/22 1361/5 1369/3 1369/4 1426/23 1428/23 1429/3 1429/6 1429/6 1429/14 1434/21 1439/3 1452/8 1490/22 1490/24 1495/21 areas [5] 1319/23 1322/16 1490/1 1490/1 1490/5 aren't [3] 1323/16 1397/10 1399/9 argued [1] 1378/3 argues [1] 1400/9 arithmetic [1] 1345/2 around [16] 1319/13 1381/17 1389/3 1394/8 1394/10 1394/13 1394/14 1402/17 1404/3 1439/17 1456/13 1467/24 1491/22 1492/23 1493/15 1504/22 arrival [1] 1450/9 arrive [7] 1405/10 1436/20 1449/19 1464/13 1485/15 1486/12 1486/15 arrived [2] 1412/23 1442/6 arriving [4] 1320/16 1340/4 1340/9 1340/15 arrow [1] 1501/6 Art [2] 1351/22 1351/22 article [1] 1413/9 articulate [1] 1410/10 articulated [1] 1461/19 as [209] Asbill [1] 1312/15 ascribed [2] 1385/4 1411/7 ask [9] 1346/11 1361/23 1363/24 1378/17 1387/9 1411/3 1431/12 1492/9 1495/15 asked [23] 1331/1 1333/16 1361/10 1361/25 1363/9 1365/25 1366/1 1366/3 1378/15 1382/25 1387/12 1431/14 1431/19 1468/8 1494/21 1496/3 1496/11 1497/8 1497/19 1499/5</p>
---	--	--

A	away [7] 1348/23 1349/7 1349/16 1373/25 1412/24 1471/24 1472/1	1338/18 1338/19 1339/25 1340/20 1341/1 1345/15 1345/18 1346/9
<p>asked... [3] 1499/18 1502/18 1505/16 asking [5] 1410/9 1423/5 1423/6 1423/14 1498/15 asks [1] 1351/2 assembled [2] 1328/5 1460/17 assess [1] 1324/2 assessment [6] 1316/5 1317/25 1318/11 1343/8 1448/20 1453/16 asset [2] 1309/8 1455/11 assign [7] 1348/2 1384/13 1384/14 1409/8 1419/22 1439/24 1439/24 assigned [7] 1336/16 1384/8 1406/5 1406/16 1408/11 1409/7 1411/15 assigning [1] 1471/21 assigns [1] 1404/21 assist [3] 1367/15 1368/14 1391/11 assume [15] 1363/24 1387/11 1400/12 1407/3 1444/2 1446/2 1447/20 1452/8 1452/13 1458/25 1462/13 1463/10 1483/8 1492/14 1500/6 assumed [8] 1392/2 1399/24 1446/4 1470/21 1475/1 1481/10 1483/1 1483/3 assumes [1] 1415/17 assuming [4] 1380/2 1392/18 1392/23 1473/2 assumption [16] 1317/25 1330/10 1348/18 1352/2 1376/18 1380/22 1383/3 1392/3 1393/19 1445/21 1449/4 1449/7 1459/3 1459/6 1482/16 1493/3 assumptions [9] 1375/15 1375/16 1383/3 1391/1 1391/4 1403/19 1449/9 1482/19 1494/8 assure [1] 1330/13 attached [5] 1396/9 1398/16 1416/20 1442/3 1452/25 attaches [2] 1441/7 1470/16 attachment [3] 1396/2 1397/1 1470/17 attachments [1] 1396/5 attack [1] 1376/16 attempt [3] 1390/7 1398/25 1455/5 attempted [2] 1374/24 1374/25 attempting [1] 1458/16 attempts [4] 1325/9 1389/2 1450/15 1450/18 attended [2] 1342/2 1460/2 attending [1] 1461/25 attention [1] 1469/11 Attorney [2] 1310/18 1310/22 August [14] 1341/4 1345/7 1349/20 1352/17 1386/15 1412/18 1434/25 1450/11 1463/2 1464/3 1464/13 1470/16 1479/15 1480/1 August 17th [1] 1386/15 August 23rd [1] 1450/11 August 2nd [6] 1341/4 1345/7 1349/20 1352/17 1464/3 1464/13 August 2nd press [1] 1463/2 August 3rd [1] 1470/16 Austin [3] 1489/4 1489/10 1491/6 author [1] 1464/1 available [4] 1316/7 1318/21 1321/8 1498/3 Avenue [4] 1309/19 1310/20 1312/10 1312/21 average [12] 1346/10 1381/19 1407/23 1419/25 1420/5 1437/20 1465/5 1465/7 1465/20 1466/17 1477/6 1477/7 averaged [1] 1375/9 averaging [1] 1420/14 aware [5] 1345/20 1467/21 1475/25 1476/2 1493/11</p>	<p>B</p> <p>B.S [1] 1356/8 back [39] 1329/16 1332/1 1344/15 1344/17 1348/11 1349/7 1361/14 1361/17 1361/21 1363/6 1363/6 1380/12 1392/16 1392/17 1394/11 1406/24 1407/4 1416/21 1416/22 1417/4 1417/4 1422/9 1429/1 1438/22 1440/22 1453/13 1464/11 1470/19 1471/3 1471/5 1471/14 1471/17 1471/22 1497/13 1503/12 1503/14 1503/15 1504/2 1504/25 background [3] 1356/3 1356/6 1356/12 backpedaling [1] 1467/21 backwards [9] 1345/1 1348/24 1434/20 1471/10 1471/25 1492/6 1492/18 1493/2 1493/4 bad [1] 1479/23 balance [1] 1472/10 Ballard [4] 1387/22 1389/1 1395/1 1505/8 bar [11] 1376/3 1411/22 1433/25 1435/1 1435/3 1435/6 1435/10 1440/12 1442/3 1454/9 1482/4 BARBIER [5] 1309/15 1355/15 1381/11 1391/16 1393/22 BARR [1] 1310/3 barrel [4] 1344/15 1412/5 1438/24 1469/20 barrels [75] 1338/13 1338/14 1352/24 1363/25 1366/7 1366/11 1366/14 1366/16 1367/13 1369/5 1375/9 1385/1 1385/14 1388/14 1388/25 1389/3 1389/9 1390/4 1390/24 1391/2 1391/5 1393/7 1393/15 1394/5 1394/6 1394/17 1394/19 1399/4 1401/3 1404/13 1404/16 1405/4 1405/7 1405/17 1406/2 1407/8 1407/14 1411/11 1414/18 1427/12 1427/25 1429/12 1432/19 1432/23 1433/1 1433/22 1434/16 1437/9 1437/10 1440/7 1441/3 1449/24 1452/19 1452/20 1453/21 1469/1 1481/23 1481/25 1482/23 1482/25 1484/18 1485/11 1485/16 1486/13 1486/16 1486/18 1486/25 1491/23 1492/11 1493/7 1496/22 1496/25 1497/7 1499/14 1500/11 BARRY [1] 1311/23 bars [1] 1496/8 base [3] 1382/16 1383/6 1434/19 based [31] 1321/1 1325/5 1326/1 1360/25 1368/10 1379/24 1380/22 1384/8 1390/5 1392/14 1393/19 1397/18 1399/8 1401/12 1402/5 1402/7 1402/13 1409/5 1417/18 1431/19 1433/22 1434/6 1452/16 1457/7 1462/12 1462/13 1467/15 1467/24 1469/15 1496/16 1498/5 baseline [3] 1452/6 1452/7 1453/7 basically [6] 1319/8 1322/7 1335/20 1345/3 1345/19 1350/3 basing [1] 1486/10 basis [5] 1333/6 1333/9 1382/8 1395/8 1495/9 Baton [1] 1310/24 Baylen [1] 1310/4 be [144] 1315/5 1320/5 1320/19 1325/2 1325/15 1327/3 1327/25 1330/6 1330/21 1331/6 1333/3 1333/6 1333/17 1334/14 1337/3 1338/3 1338/17</p>	<p>1338/18 1338/19 1339/25 1340/20 1341/1 1345/15 1345/18 1346/9 1348/21 1349/15 1349/18 1351/11 1351/21 1351/25 1352/2 1352/6 1353/1 1355/3 1355/17 1355/18 1357/25 1359/11 1359/16 1361/20 1362/13 1363/2 1363/8 1365/21 1368/17 1369/11 1369/22 1370/15 1372/11 1372/17 1377/19 1377/21 1377/24 1379/1 1385/6 1385/8 1385/13 1385/14 1386/23 1387/3 1390/7 1392/10 1395/20 1396/11 1399/10 1400/4 1402/3 1402/7 1403/4 1403/6 1403/10 1405/1 1405/25 1406/1 1406/3 1406/14 1408/20 1411/10 1411/11 1411/15 1411/17 1412/11 1413/25 1414/8 1419/23 1419/25 1420/6 1421/5 1421/17 1424/19 1425/20 1434/3 1435/1 1436/7 1436/15 1437/9 1437/12 1437/17 1437/19 1438/18 1439/14 1441/18 1441/21 1441/22 1441/25 1444/11 1451/2 1452/5 1455/11 1457/7 1461/13 1461/21 1463/6 1464/4 1466/12 1466/25 1467/1 1467/17 1467/23 1469/9 1472/11 1473/5 1473/25 1477/12 1477/20 1484/13 1486/25 1487/19 1488/22 1490/14 1491/4 1491/22 1492/7 1492/7 1493/1 1494/3 1498/21 1499/8 1499/11 1499/25 1501/7 1501/23 1502/7 beat [1] 1423/17 became [2] 1478/8 1478/9 because [82] 1316/13 1323/5 1323/8 1323/9 1324/1 1326/6 1326/12 1326/15 1326/20 1328/18 1329/4 1331/1 1332/18 1337/12 1339/4 1339/7 1339/8 1341/18 1352/2 1358/1 1359/24 1368/1 1368/23 1369/21 1371/21 1373/4 1373/17 1377/15 1380/23 1392/4 1392/13 1392/15 1392/17 1392/20 1393/4 1393/24 1397/4 1397/6 1402/20 1405/12 1406/2 1408/13 1408/16 1409/23 1414/20 1416/16 1417/23 1418/2 1420/16 1422/5 1424/22 1425/16 1426/8 1429/11 1441/18 1441/19 1443/12 1450/19 1452/18 1453/22 1454/8 1461/24 1463/9 1464/9 1466/10 1466/22 1474/3 1478/15 1485/23 1486/1 1486/8 1486/9 1487/17 1488/24 1492/6 1492/14 1492/16 1492/18 1494/5 1497/5 1501/25 1503/8 becomes [1] 1479/21 been [41] 1315/6 1328/4 1328/5 1328/13 1329/19 1330/7 1333/16 1335/17 1345/21 1347/2 1350/14 1350/15 1354/1 1355/11 1356/22 1358/3 1377/12 1387/19 1406/20 1409/18 1413/15 1421/6 1421/16 1421/18 1431/1 1431/2 1442/10 1449/19 1450/15 1451/8 1473/9 1473/10 1474/7 1475/23 1478/22 1487/18 1487/22 1487/24 1491/10 1499/22 1505/14 before [36] 1309/14 1318/17 1319/8 1319/10 1369/12 1376/25 1377/17 1380/11 1386/12 1389/14 1395/5 1395/11 1395/14 1396/20 1397/15 1409/7 1412/23 1415/9 1421/25 1431/3 1445/24 1449/25 1450/5 1451/7 1475/11 1475/17 1475/19 1475/20 1475/23 1483/9 1485/25 1491/10 1500/24 1500/25 1501/12 1504/3 beginning [7] 1329/10 1330/3 1439/19</p>

B		
beginning... [4] 1439/20 1441/16 1471/3 1483/15	blindly [1] 1363/14	1363/14 1363/17 1363/18 1363/21
begun [2] 1329/16 1332/1	blocked [2] 1368/10 1368/10	1363/24 1364/3 1364/6 1364/9 1378/3
behalf [4] 1315/16 1354/12 1354/24 1433/17	blocking [3] 1349/15 1349/17 1349/19	1382/25 1383/5 1383/7 1383/12
behave [1] 1459/4	blow [2] 1326/16 1372/11	1383/13 1383/14 1383/16 1383/18
behavior [4] 1420/12 1420/12 1421/14 1488/9	blowout [5] 1319/8 1319/10 1415/1 1473/13 1473/17	1383/19 1385/23 1386/2 1387/9
behind [1] 1435/6	blue [4] 1424/9 1438/18 1439/4 1503/13	1387/14 1387/21 1387/25 1389/7
being [19] 1321/1 1322/20 1323/1 1339/6 1345/20 1367/3 1370/14 1372/16 1390/4 1410/12 1414/21 1414/22 1431/7 1456/2 1460/21 1467/2 1470/24 1498/16 1498/21	blush [1] 1350/23	1389/10 1390/15 1391/10 1395/22
belief [1] 1343/8	board [1] 1466/5	1397/16 1401/19 1401/21 1402/23
believable [9] 1327/9 1416/7 1416/8 1416/9 1442/2 1453/18 1453/20 1453/22 1453/23	body [1] 1350/19	1404/6 1406/10 1408/22 1408/24
believe [37] 1317/3 1320/21 1324/9 1324/11 1324/19 1328/11 1331/8 1334/6 1335/19 1338/17 1339/18 1342/7 1342/8 1342/16 1347/24 1349/4 1350/4 1352/14 1380/15 1388/11 1388/13 1404/22 1409/12 1412/5 1418/15 1430/6 1434/25 1455/18 1467/19 1473/25 1475/8 1485/25 1497/13 1497/24 1498/19 1501/18 1503/12	boiling [1] 1355/19	1409/21 1409/22 1410/15 1410/15 1410/21 1410/24 1413/24 1414/24 1421/12 1426/20 1426/22 1431/12 1433/17 1489/4 1500/9 1504/18
believed [6] 1330/18 1461/12 1461/20 1462/8 1473/11 1473/15	boils [1] 1357/22	BP's [9] 1362/4 1362/15 1362/24 1387/17 1388/2 1399/18 1414/23 1416/12 1500/22
bell [11] 1385/7 1414/14 1414/19 1437/21 1494/5 1499/6 1499/8 1499/9 1499/12 1499/14 1502/16	BOLES [1] 1312/3	BRAD [1] 1312/19
below [16] 1317/18 1319/20 1319/24 1369/17 1370/17 1373/18 1392/13 1405/4 1405/6 1444/2 1444/4 1476/17 1476/18 1477/4 1490/4 1503/7	boost [1] 1320/10	Branch [1] 1311/6
bends [1] 1370/24	BOP [56] 1317/14 1319/13 1319/16 1337/1 1337/4 1347/1 1347/22 1349/21 1350/8 1350/14 1352/17 1352/19 1373/18 1391/18 1392/5 1392/12 1392/14 1393/9 1395/4 1395/9 1395/10 1396/1 1396/2 1396/10 1396/12 1397/2 1397/6 1409/5 1409/6 1409/14 1409/16 1415/4 1415/19 1415/22 1416/2 1416/2 1416/3 1416/20 1443/19 1445/2 1445/6 1445/11 1445/13 1446/5 1450/19 1468/11 1468/16 1476/13 1476/22 1476/22 1477/13 1478/1 1478/4 1478/9 1482/16 1483/2	Brennan [1] 1312/15
benefit [1] 1316/23	bopd [1] 1467/14	BRIAN [2] 1310/3 1312/19
benefits [1] 1318/14	borrowed [2] 1317/4 1317/5	BRIDGET [1] 1312/10
BENSON [1] 1311/11	both [25] 1315/21 1321/24 1329/18 1339/16 1342/3 1343/5 1346/3 1361/10 1373/22 1374/15 1389/2 1420/2 1426/3 1426/7 1441/24 1467/21 1472/12 1472/12 1485/10 1486/11 1486/12 1487/1 1487/2 1502/10 1505/7	briefed [1] 1377/17
best [30] 1315/20 1333/22 1334/21 1336/6 1366/18 1375/10 1385/1 1385/6 1393/22 1393/24 1394/18 1395/6 1405/10 1405/11 1414/19 1433/7 1479/20 1481/1 1481/23 1482/22 1482/23 1485/11 1499/4 1501/6 1501/8 1501/16 1502/9 1502/19 1502/22 1506/7	bottom [28] 1318/5 1319/16 1323/5 1323/13 1345/4 1352/11 1357/20 1363/12 1368/2 1387/8 1390/12 1391/19 1393/9 1395/9 1402/17 1404/10 1415/20 1416/4 1417/3 1417/11 1425/1 1447/12 1465/5 1465/20 1476/13 1481/17 1486/6 1491/5	briefly [2] 1322/2 1362/23
BETHANY [1] 1311/13	bound [51] 1390/25 1391/5 1391/6 1391/17 1393/6 1393/18 1400/14 1400/15 1400/16 1400/18 1400/19 1400/21 1400/22 1403/23 1404/13 1404/25 1405/1 1405/2 1405/2 1405/7 1405/13 1454/7 1466/20 1467/3 1467/14 1467/19 1468/4 1468/6 1468/9 1482/5 1482/6 1482/6 1483/20 1484/4 1484/8 1484/8 1484/11 1484/12 1484/12 1484/14 1484/16 1492/8 1492/11 1492/14 1492/16 1492/20 1493/1 1493/5 1494/6 1502/12 1502/13	bright [1] 1462/20
better [12] 1316/2 1346/7 1354/9 1354/10 1360/12 1363/20 1363/22 1411/4 1412/9 1434/11 1434/15 1491/25	bound,' [1] 1467/5	bring [8] 1333/23 1346/16 1430/1 1430/22 1431/8 1435/22 1436/3 1476/11
between [26] 1315/25 1317/25 1326/14 1326/18 1327/16 1333/7 1337/21 1338/2 1344/22 1345/6 1348/20 1360/14 1370/12 1399/4 1405/24 1416/21 1419/19 1419/24 1424/15 1426/10 1437/13 1439/1 1474/5 1476/25 1486/4 1501/24	boundaries [2] 1424/18 1425/21	bringing [4] 1333/11 1379/13 1421/9 1504/23
beyond [2] 1432/5 1479/24	boundary [5] 1363/11 1364/1 1460/24 1487/9 1487/13	brings [2] 1472/6 1472/7
Bickel [1] 1361/10	bounds [3] 1440/19 1484/7 1494/5	Broad [1] 1310/13
big [1] 1411/19	bouyant [4] 1417/3 1417/13 1488/13 1488/16	broadly [2] 1396/13 1447/6
bigger [2] 1324/9 1480/18	BOWMAN [1] 1313/4	Broadway [1] 1310/10
biggest [1] 1411/19	Box [5] 1309/23 1310/4 1310/23 1311/7 1311/15	BROCK [1] 1312/9
Bingham [1] 1313/14	BP [85] 1309/10 1311/17 1311/18 1311/19 1311/20 1311/21 1311/22 1312/2 1312/3 1312/4 1312/5 1312/6 1312/7 1312/9 1312/10 1312/10 1315/16 1317/3 1340/10 1340/15 1353/16 1354/12 1360/25 1361/1 1361/2 1361/11 1361/22 1362/11 1362/12 1362/17 1362/22 1362/25	broke [1] 1404/4
bit [8] 1318/13 1391/24 1436/24 1455/16 1476/10 1488/20 1497/22 1504/14		brought [2] 1340/12 1340/12
blacked [1] 1328/24		BRUCE [1] 1313/4
		budget [1] 1340/5
		bullet [2] 1386/22 1469/12
		bump [4] 1425/3 1425/4 1425/4 1425/5
		bunch [1] 1381/14
		buoyancy [1] 1404/13
		buried [4] 1488/20 1488/21 1488/22 1489/3
		Burling [1] 1312/9
		burst [1] 1391/25
		Bushnell [14] 1377/5 1377/11 1378/3 1378/5 1378/16 1378/19 1378/20 1379/10 1379/17 1380/1 1380/16 1380/17 1381/1 1382/4
		Bushnell's [4] 1378/8 1379/5 1379/10 1381/10
		C
		cabinet [3] 1331/17 1343/12 1343/16
		calculate [51] 1321/4 1321/8 1325/21 1326/1 1344/15 1346/15 1363/1 1363/11 1366/1 1366/5 1366/9 1366/12 1366/15 1367/23 1367/25 1369/23 1370/12 1370/25 1371/12 1372/3 1372/15 1373/9 1374/2 1374/16 1388/24 1389/1 1390/25 1391/4 1392/12 1400/25 1401/9 1403/12 1404/13 1407/4 1419/2 1424/20 1425/22 1427/23 1428/1 1429/4 1443/14 1447/8 1451/9 1454/22 1481/1 1481/2 1481/4 1487/25 1488/3 1495/22 1498/20
		calculated [28] 1328/4 1329/13 1329/15 1361/4 1366/7 1367/12 1368/15 1373/3 1387/9 1388/14 1388/25 1390/5 1391/16 1393/19 1399/6 1401/2 1403/4 1406/25 1407/2 1407/3 1427/24 1432/8

<p>C</p> <p>calculated... [6] 1438/23 1465/6 1469/16 1486/24 1492/7 1496/25</p> <p>calculates [3] 1376/19 1427/14 1453/21</p> <p>calculating [7] 1358/6 1359/19 1360/14 1371/24 1397/23 1434/7 1487/21</p> <p>calculation [75] 1318/3 1320/17 1328/6 1328/20 1332/20 1332/24 1333/2 1347/8 1347/19 1363/10 1364/5 1369/13 1371/18 1373/4 1373/15 1378/21 1382/17 1382/25 1385/19 1387/5 1387/12 1388/16 1388/17 1389/16 1390/16 1390/17 1390/19 1390/20 1390/21 1391/9 1391/12 1398/24 1401/18 1406/17 1407/17 1407/19 1408/18 1408/22 1409/2 1420/3 1426/17 1432/16 1435/22 1439/23 1444/18 1446/7 1447/5 1449/22 1451/17 1452/10 1454/8 1454/9 1459/23 1461/4 1466/23 1470/5 1472/1 1472/3 1472/23 1480/12 1482/4 1483/5 1484/6 1484/9 1484/23 1488/18 1491/1 1492/17 1499/1 1500/23 1501/10 1501/11 1502/9 1502/16 1502/21</p> <p>calculational [1] 1362/22</p> <p>calculations [122] 1324/9 1326/11 1327/12 1329/16 1332/2 1333/16 1338/6 1343/10 1356/15 1359/1 1359/7 1359/9 1359/14 1361/20 1362/14 1363/19 1363/21 1364/7 1364/10 1364/13 1367/1 1367/10 1367/16 1369/10 1369/15 1370/7 1370/13 1373/5 1375/13 1375/14 1381/19 1381/20 1382/14 1382/23 1383/1 1383/4 1383/11 1384/1 1384/3 1384/7 1386/6 1386/7 1386/8 1387/18 1387/21 1388/3 1393/12 1395/1 1399/19 1399/21 1400/25 1401/12 1401/14 1401/19 1401/22 1402/1 1402/2 1402/5 1403/15 1406/10 1406/12 1409/1 1414/15 1420/10 1426/9 1426/10 1426/13 1426/16 1426/20 1426/22 1426/25 1427/5 1429/9 1429/19 1430/12 1430/24 1431/13 1432/14 1449/25 1451/5 1452/8 1452/11 1452/16 1453/24 1454/1 1454/4 1454/16 1454/19 1454/19 1455/17 1456/5 1456/7 1456/8 1456/10 1457/16 1457/22 1458/3 1458/20 1465/8 1465/12 1471/14 1487/16 1490/2 1490/12 1495/3 1495/4 1495/16 1495/20 1495/25 1496/9 1496/12 1497/4 1498/16 1498/21 1498/22 1499/7 1499/21 1499/22 1500/8 1500/9 1500/10 1501/19</p> <p>CALDWELL [1] 1310/22</p> <p>calibrated [1] 1455/24</p> <p>California [2] 1312/4 1312/22</p> <p>call [14] 1318/4 1319/11 1339/7 1344/17 1345/17 1353/12 1353/15 1361/9 1386/17 1389/12 1442/14 1443/5 1501/16 1502/7</p> <p>call-out [2] 1386/17 1389/12</p> <p>called [10] 1322/10 1325/5 1370/23 1371/7 1371/14 1373/8 1381/1 1417/12 1486/7 1499/18</p> <p>calling [5] 1377/11 1429/24 1430/19 1431/9 1467/19</p> <p>came [11] 1323/6 1331/3 1331/16 1352/23 1379/21 1380/23 1386/2 1394/5 1406/24 1407/8 1458/3</p>	<p>camera [2] 1402/7 1402/9</p> <p>Camp [1] 1311/4</p> <p>can [110] 1319/1 1322/23 1323/18 1330/2 1330/7 1330/22 1331/5 1331/10 1332/9 1334/22 1337/24 1341/1 1344/8 1350/19 1352/22 1353/12 1354/7 1354/18 1355/14 1358/1 1359/16 1368/5 1368/5 1369/2 1369/5 1371/15 1373/22 1373/23 1373/24 1374/13 1376/16 1376/21 1381/11 1384/10 1391/14 1391/16 1391/18 1392/12 1392/16 1393/6 1395/9 1396/11 1396/23 1398/3 1398/20 1403/23 1404/22 1404/25 1405/1 1405/12 1406/7 1408/4 1411/13 1412/10 1417/24 1418/1 1418/19 1418/20 1419/14 1421/15 1421/17 1423/23 1424/5 1427/3 1427/7 1428/9 1433/2 1436/20 1438/14 1441/5 1443/12 1443/13 1443/14 1443/19 1444/18 1449/16 1455/16 1455/18 1469/6 1469/8 1475/14 1475/15 1479/4 1479/23 1480/17 1480/23 1481/2 1481/3 1482/6 1486/4 1487/9 1487/12 1487/12 1487/19 1489/1 1492/5 1492/18 1493/17 1494/9 1497/23 1498/13 1498/17 1498/19 1500/21 1500/22 1501/8 1501/16 1501/18 1502/4 1504/19</p> <p>can't [15] 1316/13 1328/6 1328/17 1328/17 1339/19 1405/23 1406/2 1453/22 1457/9 1461/15 1468/17 1475/18 1475/18 1493/1 1503/24</p> <p>cannot [5] 1439/9 1447/14 1452/18 1485/22 1493/4</p> <p>cants [1] 1323/4</p> <p>cap [2] 1330/8 1330/8</p> <p>capability [3] 1424/21 1424/23 1430/16</p> <p>Capital [1] 1310/16</p> <p>capping [110] 1316/16 1316/17 1318/14 1318/17 1321/2 1321/19 1324/15 1325/6 1325/22 1327/12 1327/13 1331/3 1333/1 1335/23 1336/1 1336/24 1336/25 1338/7 1345/9 1348/16 1348/22 1348/24 1366/5 1366/7 1367/11 1367/13 1367/20 1367/21 1367/23 1367/25 1368/2 1369/9 1369/11 1369/12 1369/24 1370/2 1371/12 1372/12 1373/9 1373/17 1373/19 1373/21 1376/7 1383/11 1383/17 1383/18 1383/21 1383/23 1383/24 1384/6 1385/12 1387/10 1387/15 1387/18 1387/21 1388/3 1389/8 1390/16 1390/17 1394/22 1395/1 1395/3 1408/13 1409/23 1412/2 1414/14 1432/25 1433/23 1438/19 1447/23 1449/18 1449/25 1451/1 1451/6 1451/9 1454/20 1455/16 1455/21 1456/2 1457/15 1458/17 1458/22 1459/2 1459/12 1459/23 1461/3 1461/13 1464/17 1464/24 1465/8 1465/18 1466/1 1466/20 1468/12 1468/16 1468/18 1468/21 1468/23 1471/3 1471/10 1471/11 1472/1 1473/4 1484/24 1485/8 1500/4 1500/5 1500/8 1500/9 1502/24</p> <p>career [1] 1355/23</p> <p>carefully [2] 1330/7 1351/8</p> <p>CARL [1] 1309/15</p> <p>CARRIE [1] 1311/21</p> <p>carryover [1] 1505/6</p> <p>case [42] 1323/16 1342/16 1349/14 1353/18 1355/8 1356/7 1356/13</p>	<p>1357/11 1358/5 1358/24 1359/7 1360/1 1360/3 1363/19 1363/22 1365/3 1365/8 1365/14 1365/24 1366/22 1367/4 1372/9 1375/3 1375/5 1375/5 1375/7 1375/7 1378/16 1378/22 1382/16 1383/6 1390/15 1395/24 1402/1 1412/8 1412/13 1421/9 1433/5 1435/9 1453/7 1469/25 1505/17</p> <p>cases [6] 1375/7 1375/9 1448/21 1448/21 1498/23 1498/23</p> <p>category [1] 1377/14</p> <p>cause [1] 1496/3</p> <p>caused [3] 1317/15 1477/12 1477/20</p> <p>causes [2] 1351/9 1351/10</p> <p>causing [2] 1416/2 1425/14</p> <p>caution [1] 1351/19</p> <p>cautioned [1] 1352/5</p> <p>cautious [1] 1352/6</p> <p>cells [2] 1419/9 1500/4</p> <p>cement [1] 1317/20</p> <p>center [2] 1419/23 1444/20</p> <p>centered [1] 1385/7</p> <p>CERNICH [4] 1311/12 1354/23 1414/9 1494/19</p> <p>certain [11] 1358/19 1370/10 1382/3 1384/20 1404/7 1421/3 1461/9 1464/8 1484/6 1485/21 1487/9</p> <p>certainly [11] 1323/23 1328/20 1329/6 1339/20 1340/1 1341/21 1342/7 1345/15 1347/9 1404/7 1428/16</p> <p>certainty [2] 1348/25 1495/20</p> <p>CERTIFICATE [1] 1506/3</p> <p>certify [1] 1506/6</p> <p>cetera [1] 1496/6</p> <p>CFD [1] 1380/17</p> <p>CHAKERES [1] 1311/12</p> <p>challenge [1] 1360/6</p> <p>challenged [1] 1480/4</p> <p>challenges [5] 1318/9 1320/2 1360/5 1442/25 1448/2</p> <p>chance [1] 1385/10</p> <p>change [29] 1345/3 1359/12 1368/21 1368/25 1384/5 1406/3 1406/3 1407/20 1407/21 1408/1 1408/2 1408/21 1409/16 1416/24 1417/14 1420/12 1422/19 1424/18 1446/10 1468/8 1470/21 1473/3 1483/11 1483/15 1485/24 1486/3 1486/4 1490/7 1495/15</p> <p>changed [13] 1333/5 1347/2 1347/4 1359/13 1396/15 1396/20 1405/16 1420/14 1420/15 1446/15 1471/7 1486/1 1494/16</p> <p>changes [23] 1316/11 1345/8 1345/13 1345/16 1345/19 1345/21 1347/10 1347/12 1347/22 1347/22 1347/22 1347/23 1352/19 1357/21 1397/2 1408/8 1421/4 1422/19 1448/17 1470/22 1471/9 1485/23 1485/24</p> <p>changing [7] 1375/16 1383/1 1397/10 1416/3 1416/4 1417/5 1466/13</p> <p>channel [2] 1417/22 1417/23</p> <p>channels [1] 1409/14</p> <p>chaotic [1] 1421/14</p> <p>characterization [1] 1496/24</p> <p>characterize [1] 1482/2</p> <p>characterized [1] 1481/25</p> <p>charged [2] 1340/9 1340/15</p> <p>Charles [6] 1310/14 1360/9 1360/24 1361/13 1361/20 1465/15</p> <p>Charlie [9] 1336/18 1361/3 1455/4 1455/6 1456/15 1462/3 1462/7 1462/16 1465/14</p> <p>Charlie's [1] 1361/4</p>
--	---	--

C	1405/14	concerned [12] 1343/14 1358/8 1362/25
chart [12] 1316/25 1317/3 1348/5	collection [17] 1322/9 1323/15 1326/2	1363/2 1363/8 1372/10 1376/9 1379/1
1396/9 1396/25 1397/1 1438/17 1458/4	1327/20 1352/25 1370/19 1372/2	1402/19 1410/4 1410/23 1479/12
1465/20 1466/4 1474/11 1492/4	1383/14 1383/15 1387/4 1405/16	concerns [9] 1338/22 1373/2 1410/10
cheaper [1] 1359/24	1405/20 1405/22 1405/24 1405/24	1420/20 1479/10 1482/3 1488/19
check [2] 1381/9 1381/9	1475/4 1485/24	1498/7 1498/8
Chicago [1] 1311/24	collective [1] 1477/4	conclude [1] 1483/11
chief [1] 1353/19	COLLIER [1] 1311/22	concluded [4] 1399/2 1399/4 1417/6
Chisholm [1] 1375/23	color [1] 1416/25	1506/1
choice [1] 1419/24	colors [3] 1417/5 1444/25 1444/25	conclusion [5] 1327/7 1327/9 1339/22
choices [4] 1419/7 1419/8 1420/2	column [1] 1457/23	1468/19 1475/16
1420/4	combination [3] 1319/20 1319/22	Conclusions [1] 1450/14
choke [18] 1327/21 1339/3 1339/4	1354/14	conclusively [1] 1498/13
1339/8 1367/22 1371/13 1372/5 1372/7	combine [2] 1374/14 1375/6	concrete [2] 1481/5 1481/17
1372/15 1372/18 1372/20 1372/23	combined [2] 1465/7 1465/10	condition [2] 1355/20 1468/20
1459/8 1459/9 1459/11 1459/16 1466/5	combining [1] 1375/4	conditions [16] 1359/13 1362/2 1363/1
1467/20	come [14] 1317/25 1380/20 1394/1	1363/11 1364/1 1373/23 1373/24
choosing [1] 1336/3	1437/21 1441/2 1441/5 1445/20	1374/9 1374/13 1390/10 1397/10
chose [5] 1321/19 1372/1 1372/3	1448/20 1456/6 1466/16 1481/20	1460/25 1468/11 1468/15 1487/10
1400/6 1400/11	1482/6 1497/10 1504/2	1487/13
Chu [14] 1328/9 1328/14 1328/18	comes [4] 1353/3 1385/16 1440/18	conducted [1] 1342/3
1331/6 1331/16 1336/25 1339/24	1440/22	conducting [1] 1350/21
1340/1 1340/12 1341/16 1342/5 1460/2	coming [21] 1321/22 1322/13 1324/6	confidence [11] 1318/18 1373/3 1379/5
1461/20 1461/25	1336/12 1369/21 1370/16 1377/8	1379/14 1413/8 1472/2 1487/23 1488/4
Chu's [1] 1340/14	1390/21 1404/14 1405/19 1406/1	1495/3 1495/24 1495/25
circulated [2] 1505/8 1505/15	1406/4 1416/19 1425/3 1429/5 1429/8	confirm [1] 1379/21
circumstances [1] 1443/1	1455/21 1466/15 1482/5 1485/16	confirmed [1] 1390/3
cite [1] 1489/4	1486/6	conflict [1] 1426/9
Civil [1] 1311/6	comment [2] 1351/24 1500/4	confusion [1] 1489/15
claim [1] 1333/12	commenting [1] 1500/1	conservative [9] 1385/16 1391/3
claimed [1] 1487/17	comments [2] 1498/5 1500/3	1392/17 1392/24 1393/1 1393/6
claims [2] 1416/3 1422/22	commission [4] 1332/16 1332/18 1359/2	1393/19 1402/3 1402/4
clarified [1] 1316/2	1359/5	consider [9] 1351/7 1376/6 1381/22
clarify [1] 1321/23	common [3] 1328/5 1457/2 1495/21	1382/13 1384/6 1385/16 1400/2
clarity [1] 1437/5	Company [7] 1311/19 1311/22 1312/4	1407/16 1499/8
classic [1] 1375/21	1312/7 1312/10 1313/12 1313/15	considered [4] 1359/9 1365/20 1376/2
clean [2] 1343/13 1499/25	compare [6] 1374/18 1383/25 1422/1	1376/4
clear [7] 1331/14 1336/1 1340/19	1423/4 1423/8 1488/2	consistent [16] 1330/14 1331/20
1413/6 1419/18 1441/14 1452/5	compared [8] 1321/18 1358/12 1360/25	1335/20 1395/10 1397/10 1397/11
clearly [1] 1495/8	1376/3 1406/3 1435/14 1449/23	1399/9 1399/11 1441/24 1442/1 1442/2
clog [1] 1402/21	1487/22	1442/3 1444/25 1460/16 1467/17
close [16] 1371/10 1372/23 1379/2	comparison [3] 1338/9 1374/22 1423/15	1493/20
1380/2 1384/2 1394/8 1413/20 1457/8	compensated [1] 1367/3	constant [3] 1392/6 1392/8 1473/2
1457/9 1470/3 1486/20 1486/21	competing [1] 1351/8	constitutes [1] 1375/10
1493/19 1501/15 1502/3 1503/8	competition [1] 1334/24	constructed [1] 1379/9
closed [18] 1339/6 1339/8 1368/5	complain [1] 1364/9	contact [2] 1412/15 1412/17
1369/18 1372/9 1372/14 1372/16	COMPLAINT [1] 1309/7	contacted [1] 1387/19
1372/20 1373/20 1393/4 1396/13	complaints [1] 1418/14	contend [1] 1414/25
1399/7 1404/8 1404/9 1409/24 1459/8	complete [8] 1318/4 1318/11 1320/5	contended [1] 1406/14
1459/15 1483/9	1454/16 1471/5 1473/12 1473/16	contends [1] 1399/22
closely [5] 1361/2 1376/14 1376/14	1473/22	context [2] 1345/18 1471/2
1378/23 1455/7	completely [4] 1323/25 1358/18 1399/9	continually [1] 1467/22
closer [4] 1354/8 1361/3 1361/3	1483/17	continue [1] 1351/25
1426/23	complex [1] 1459/11	continued [2] 1372/23 1474/25
closing [6] 1372/18 1393/4 1403/2	complexity [2] 1337/2 1337/4	continues [1] 1441/7
1459/10 1466/9 1466/14	component [3] 1324/13 1346/12 1453/8	continuing [3] 1467/24 1476/5 1476/6
closure [2] 1339/4 1466/5	components [3] 1323/13 1324/10	contractions [2] 1370/24 1376/7
CO2 [2] 1357/24 1358/1	1408/7	contribute [2] 1349/4 1361/11
cocked [1] 1404/2	composite [1] 1347/24	control [2] 1362/4 1395/24
code [19] 1363/2 1363/18 1397/23	compromise [1] 1462/2	converged [1] 1394/14
1420/16 1420/16 1420/17 1422/4	computational [7] 1379/9 1381/1 1381/4	conversation [5] 1332/20 1340/12
1422/6 1424/11 1424/12 1424/13	1381/5 1381/7 1381/12 1488/7	1340/13 1410/11 1505/3
1424/19 1424/21 1424/22 1425/1	computer [8] 1313/24 1419/15 1422/2	conversation people [1] 1340/12
1426/18 1470/8 1470/8 1470/10	1422/4 1423/4 1423/8 1426/18 1469/12	conversations [4] 1328/18 1331/4
codes [1] 1363/1	computer-aided [1] 1313/24	1410/14 1410/19
coefficient [1] 1337/20	conceded [1] 1406/24	Conversely [1] 1477/16
coefficients [2] 1447/3 1447/3	concept [10] 1414/14 1414/16 1418/22	conversion [1] 1469/1
coin [1] 1385/9	1427/20 1428/23 1429/16 1460/20	convert [3] 1469/20 1496/22 1497/6
collected [4] 1326/24 1374/11 1374/12	1474/16 1481/14 1499/6	converts [1] 1429/12
1404/16	concepts [2] 1360/7 1360/8	convince [1] 1363/18
collecting [8] 1316/3 1370/17 1373/18	concern [10] 1376/8 1382/15 1400/4	cool [1] 1358/17
1404/5 1404/17 1404/19 1405/14	1407/24 1461/10 1461/11 1474/2	coordinated [4] 1415/20 1415/24 1416/1
	1478/18 1488/23 1497/7	1452/7

C	covered [1] 1346/21 covering [2] 1355/3 1432/1 Covington [1] 1312/9 coworker [1] 1462/3 Crane [1] 1371/6 create [1] 1369/20 created [1] 1469/12 credible [1] 1455/11 critical [5] 1331/24 1333/8 1333/10 1333/20 1349/18 critically [1] 1332/4 criticism [3] 1379/23 1382/19 1407/4 criticisms [9] 1375/18 1399/20 1413/4 1413/5 1413/12 1413/13 1413/16 1418/19 1431/13 criticize [1] 1399/18 criticized [4] 1406/10 1406/12 1406/13 1487/17 criticizes [2] 1421/1 1421/1 critique [1] 1498/1 critiques [2] 1423/1 1498/2 cross [12] 1311/13 1315/14 1315/17 1350/22 1364/20 1433/13 1433/18 1493/25 1496/4 1498/15 1500/16 1504/15 cross-exam [1] 1496/4 cross-examination [7] 1315/14 1315/17 1364/20 1433/13 1433/18 1498/15 1500/16 cross-sectional [1] 1350/22 crosses [1] 1381/14 crude [2] 1448/10 1469/14 cubes [1] 1381/15 culminated [1] 1333/11 cumulative [42] 1343/5 1344/16 1345/12 1346/12 1346/16 1346/19 1346/25 1347/5 1347/13 1347/21 1349/13 1366/4 1366/15 1407/6 1408/7 1411/10 1412/3 1414/12 1414/16 1434/19 1435/4 1435/6 1435/11 1436/12 1437/7 1439/7 1441/25 1442/1 1462/16 1462/17 1463/3 1463/24 1464/6 1472/13 1472/16 1486/19 1486/22 1487/21 1488/3 1493/24 1499/3 1499/10 current [3] 1383/3 1444/12 1444/23 currently [1] 1356/17 Curt [3] 1344/1 1344/2 1344/3 curve [18] 1351/6 1351/11 1385/7 1414/14 1437/21 1439/3 1472/6 1472/8 1479/22 1494/5 1494/9 1499/6 1499/8 1499/12 1499/14 1502/16 1503/1 1503/2 curve-fitting [1] 1479/22 cut [8] 1320/13 1408/16 1408/18 1444/24 1470/24 1471/13 1473/3 1500/24 cut-off [2] 1408/18 1444/24 cutoff [1] 1408/20 cutting [3] 1345/10 1348/21 1471/13 CV [3] 1309/7 1309/9 1365/18	D-21117 [1] 1391/14 D-21118 [1] 1393/20 D-21119 [1] 1408/4 D-21122 [2] 1366/24 1432/11 D-21123 [1] 1388/5 D-21124 [1] 1418/7 D-21125 [1] 1423/23 D-21140 [1] 1355/25 D-21141 [1] 1357/5 D-21142 [1] 1357/13 D-21143 [2] 1366/20 1433/2 D-21145 [1] 1354/25 D-21160 [1] 1503/16 D-23996-A [4] 1438/14 1471/22 1491/10 1500/22 D-24368 [1] 1319/1 D-24369 [1] 1476/11 D-24388-2 [1] 1322/23 D-24401 [1] 1477/10 D-24407 [1] 1465/21 D-24496 [1] 1494/10 D-Y-K-H-U-I-Z-E-N [1] 1354/6 D.C [5] 1311/8 1311/16 1312/7 1312/11 1313/16 daily [2] 1342/10 1349/1 Dallas [1] 1313/6 damaged [2] 1402/18 1481/5 damages [3] 1340/9 1340/15 1341/17 dark [3] 1416/21 1416/22 1425/7 Darvish [1] 1436/14 Darvish's [1] 1436/18 data [54] 1321/7 1321/15 1321/18 1321/19 1327/14 1331/3 1343/9 1352/12 1362/13 1366/2 1369/14 1383/12 1383/13 1383/19 1391/7 1391/8 1398/22 1398/23 1398/25 1418/3 1420/8 1420/17 1422/14 1425/8 1425/16 1425/18 1426/5 1426/7 1426/7 1439/16 1441/16 1454/3 1457/18 1457/19 1459/18 1466/11 1468/21 1474/21 1474/24 1475/3 1475/15 1479/20 1479/23 1479/24 1481/13 1483/20 1487/22 1488/3 1498/13 1499/4 1502/22 1502/23 1503/10 1503/12 date [7] 1324/19 1325/15 1329/24 1349/24 1463/23 1468/12 1476/2 dated [4] 1386/15 1395/18 1398/12 1470/16 dates [1] 1425/23 Daubert [3] 1354/13 1364/18 1364/19 DAVIS [1] 1312/20 DAVIS-DENNY [1] 1312/20 day [130] 1309/14 1316/14 1316/15 1319/11 1328/2 1328/19 1329/18 1338/13 1338/14 1340/5 1340/9 1340/20 1342/17 1342/17 1343/6 1344/13 1344/18 1344/18 1344/20 1345/5 1345/23 1346/2 1346/3 1346/7 1346/11 1346/13 1346/15 1347/2 1348/12 1349/12 1363/25 1366/7 1366/11 1366/14 1367/13 1369/5 1375/10 1385/1 1385/14 1388/14 1388/25 1389/3 1389/9 1390/4 1390/24 1391/2 1391/5 1393/7 1393/15 1394/6 1394/7 1394/17 1394/19 1399/5 1399/16 1401/3 1404/14 1404/15 1404/16 1404/23 1404/25 1405/2 1405/4 1405/7 1405/17 1406/2 1407/19 1411/14 1411/16 1426/8 1427/13 1427/25 1432/19 1432/23 1433/1 1433/22 1434/4 1435/14 1436/1 1438/18 1438/22 1439/4 1439/4 1440/1
copied [1] 1490/3 copies [1] 1353/21 copy [3] 1339/18 1451/12 1491/9 copying [1] 1491/5 COREY [1] 1310/19 corners [1] 1381/17 Corporation [2] 1313/11 1313/15 correct [484] corrected [1] 1502/7 correcting [2] 1472/24 1486/17 correction [2] 1330/8 1390/10 correctly [11] 1381/8 1396/3 1396/17 1416/23 1417/6 1427/21 1429/4 1443/20 1458/1 1458/4 1468/1 correctory [1] 1398/18 correlate [1] 1425/6 correlates [1] 1425/8 correlation [3] 1339/1 1352/12 1375/23 correlations [1] 1375/23 corroborate [2] 1378/5 1379/21 could [139] 1316/23 1317/19 1317/20 1318/6 1321/23 1322/4 1323/24 1324/3 1326/9 1326/10 1328/19 1329/3 1331/7 1333/22 1336/9 1341/1 1341/14 1342/1 1343/15 1344/22 1345/15 1346/6 1346/9 1347/7 1349/4 1349/9 1350/5 1350/18 1350/22 1354/25 1355/18 1355/25 1357/5 1357/13 1359/11 1362/23 1365/5 1365/10 1366/20 1366/24 1367/18 1368/12 1368/17 1368/22 1369/20 1370/4 1370/14 1372/17 1373/12 1374/3 1374/20 1380/3 1386/10 1386/17 1388/5 1389/11 1389/12 1391/2 1393/20 1393/22 1394/12 1395/12 1395/16 1396/7 1399/12 1400/11 1400/25 1403/12 1403/21 1403/25 1405/8 1405/13 1406/14 1407/4 1409/8 1411/15 1413/7 1415/6 1415/21 1418/7 1419/22 1419/24 1426/17 1430/22 1432/11 1435/1 1437/23 1439/24 1440/15 1440/15 1440/21 1441/1 1441/2 1441/11 1441/13 1441/17 1441/18 1441/18 1441/19 1441/25 1442/22 1444/4 1446/5 1450/2 1457/17 1464/20 1466/25 1467/1 1468/6 1468/13 1471/22 1473/14 1473/21 1473/25 1474/7 1475/12 1475/12 1475/22 1477/12 1477/20 1480/17 1481/12 1481/12 1481/22 1484/13 1490/2 1490/5 1490/6 1490/7 1490/17 1491/8 1499/4 1499/11 1499/25 1500/13 1502/13 1502/14 1502/15 1503/6 couldn't [3] 1422/5 1424/21 1426/8 count [1] 1498/16 counterbalanced [1] 1399/25 countries [1] 1371/8 couple [5] 1359/11 1362/19 1468/25 1499/23 1500/25 course [10] 1316/12 1346/8 1369/8 1415/1 1415/5 1417/10 1430/25 1456/8 1478/17 1504/14 course-type [1] 1456/8 COURT [13] 1309/1 1313/18 1322/7 1354/23 1401/4 1414/6 1497/6 1497/23 1499/2 1505/18 1506/4 1506/5 1506/13 Court's [3] 1316/23 1376/25 1378/10 courtesy [1] 1353/21 cover [5] 1329/3 1346/24 1383/9 1413/24 1430/20	D D-21100.1 [1] 1455/18 D-21101 [1] 1368/12 D-21101.1 [1] 1456/6 D-21102 [1] 1370/4 D-21103 [1] 1371/15 D-21104 [1] 1374/3 D-21105 [1] 1373/12 D-21106 [1] 1374/20 D-21109 [1] 1403/21 D-21110 [1] 1405/8	

D	demonstratives [3] 1367/15 1391/11 1418/4 DENNY [1] 1312/20 densities [3] 1360/19 1421/4 1425/14 density [15] 1337/25 1338/3 1360/18 1368/24 1369/3 1369/3 1400/2 1400/8 1419/18 1419/22 1419/23 1419/24 1419/25 1443/12 1448/9 Department [4] 1311/6 1311/9 1367/5 1387/19 depended [1] 1420/4 dependent [1] 1415/9 Depending [3] 1444/2 1447/9 1447/22 depends [6] 1316/13 1318/3 1435/25 1477/8 1483/20 1504/15 depiction [2] 1391/18 1404/1 depleting [1] 1397/12 depletion [12] 1330/10 1344/19 1344/21 1344/22 1351/8 1404/24 1445/16 1445/21 1449/4 1450/20 1472/20 1473/5 deposed [4] 1431/2 1431/3 1431/5 1431/6 deposition [20] 1334/22 1342/25 1350/12 1353/16 1353/23 1377/22 1377/24 1378/15 1384/15 1388/2 1389/21 1389/24 1398/1 1406/24 1411/7 1430/11 1431/4 1431/14 1436/25 1437/16 depositions [3] 1342/12 1378/13 1389/4 derived [1] 1344/18 describe [7] 1338/4 1362/23 1378/8 1378/9 1446/24 1447/13 1470/18 described [7] 1348/16 1411/23 1430/12 1430/12 1456/2 1467/2 1470/12 describes [1] 1470/20 describing [3] 1378/18 1469/7 1471/2 description [1] 1330/9 designated [2] 1342/23 1377/12 designing [1] 1446/24 desire [1] 1400/23 despite [1] 1502/18 detail [2] 1413/7 1481/12 detailed [1] 1382/1 details [1] 1422/12 determination [1] 1320/20 determine [16] 1315/20 1321/12 1347/20 1368/25 1369/1 1419/13 1443/1 1443/7 1447/14 1448/25 1457/18 1458/21 1458/24 1487/23 1488/4 1499/2 determined [6] 1328/1 1348/15 1348/17 1383/7 1392/20 1392/21 determining [1] 1481/13 developed [3] 1344/25 1474/11 1474/12 developing [1] 1448/2 device [4] 1322/7 1322/15 1326/12 1368/18 Dexter [1] 1310/20 diagnosing [1] 1362/2 diagonally [1] 1477/23 diameter [18] 1323/9 1381/16 1427/14 1427/16 1427/20 1428/3 1428/22 1428/23 1429/1 1429/3 1429/16 1429/17 1429/22 1430/3 1431/25 1457/7 1490/20 1490/21 did [271] didn't [40] 1320/22 1320/24 1321/13 1328/20 1330/24 1331/13 1332/19 1352/3 1369/18 1372/11 1372/21 1377/7 1377/14 1379/16 1379/16 1392/20 1394/15 1395/3 1399/22 1400/2 1400/4 1402/19 1404/1 1404/3	1406/16 1406/21 1408/25 1409/11 1413/14 1420/13 1420/14 1423/11 1429/11 1444/10 1444/10 1457/18 1466/10 1466/11 1472/11 1486/8 differ [2] 1374/5 1374/5 difference [7] 1326/10 1326/19 1360/14 1368/8 1368/21 1405/23 1502/5 differences [5] 1323/9 1326/11 1337/12 1424/18 1443/15 different [64] 1326/7 1335/6 1335/21 1335/22 1338/4 1343/17 1347/15 1347/17 1348/18 1348/19 1360/7 1360/17 1360/20 1361/25 1363/13 1363/17 1371/20 1371/21 1374/13 1374/25 1375/14 1375/16 1375/22 1376/17 1378/19 1383/2 1383/2 1387/4 1397/5 1397/18 1405/15 1405/17 1406/23 1415/13 1415/24 1417/23 1419/14 1420/6 1421/4 1425/11 1425/20 1425/23 1426/1 1426/2 1427/16 1427/20 1429/3 1431/25 1452/1 1456/21 1456/21 1457/3 1457/7 1457/12 1458/3 1458/14 1464/17 1464/24 1490/4 1490/5 1490/15 1499/10 1502/24 differential [3] 1320/12 1320/14 1320/23 differently [5] 1427/22 1429/12 1458/10 1458/11 1458/18 difficult [7] 1323/25 1324/1 1361/18 1409/3 1409/7 1428/4 1485/9 difficulty [1] 1360/13 Dillchek [1] 1371/8 dimensional [1] 1380/18 dimensions [1] 1381/17 DIRE [1] 1355/5 direct [20] 1315/19 1322/3 1324/16 1327/22 1331/20 1356/25 1364/24 1381/6 1387/4 1434/10 1436/20 1455/19 1459/7 1468/25 1469/11 1472/9 1489/6 1492/4 1497/22 1497/24 directed [1] 1450/17 direction [4] 1411/20 1435/18 1438/8 1438/10 directions [1] 1502/11 directly [1] 1367/7 Director [4] 1339/24 1350/13 1351/17 1352/6 Director McNutt [4] 1339/24 1350/13 1351/17 1352/6 disagree [12] 1408/25 1415/5 1460/20 1463/17 1463/25 1464/6 1464/7 1468/17 1494/2 1495/19 1495/20 1495/22 disagreed [2] 1462/4 1463/25 disagreement [3] 1401/21 1464/2 1495/21 disaster [1] 1369/21 discharge [2] 1411/10 1447/3 disclose [1] 1488/12 disclosed [2] 1377/21 1421/6 disclosure [1] 1430/17 discounted [3] 1391/25 1426/7 1452/18 discounting [1] 1415/18 discovery [1] 1430/25 discuss [2] 1386/5 1386/6 discussed [11] 1328/19 1329/17 1329/19 1340/4 1340/8 1351/25 1352/3 1398/13 1454/22 1483/22 1491/13 discussing [2] 1398/10 1409/23 discussion [6] 1336/5 1339/23 1403/24 1422/8 1428/10 1461/16 discussions [3] 1329/20 1329/21 1342/24
----------	--	---

D	1469/4 1470/6 1478/12 1494/22 1495/6 DOE's [1] 1337/6 DOE-NNSA [7] 1375/19 1450/4 1450/12 1450/16 1470/6 1478/12 1495/6 does [66] 1333/14 1339/8 1342/14 1342/19 1347/1 1347/5 1351/2 1353/9 1356/6 1356/12 1357/9 1357/12 1357/15 1357/18 1368/14 1373/5 1373/14 1374/5 1374/22 1379/8 1379/10 1388/7 1390/12 1390/14 1390/15 1399/18 1400/21 1407/19 1408/6 1408/8 1411/23 1411/25 1412/2 1414/16 1414/18 1415/15 1416/5 1418/9 1419/10 1420/9 1420/11 1424/11 1424/16 1432/13 1432/15 1433/4 1433/6 1438/18 1438/22 1440/2 1441/9 1449/10 1470/21 1471/17 1471/19 1489/10 1489/17 1490/23 1493/14 1493/20 1496/15 1496/19 1498/8 1499/6 1499/8 1502/21 doesn't [10] 1341/19 1355/17 1400/18 1420/17 1420/17 1425/7 1431/24 1474/4 1476/7 1503/23 DOI [1] 1450/17 doing [17] 1318/1 1318/3 1318/11 1329/19 1332/1 1334/9 1361/20 1381/6 1419/21 1431/7 1443/11 1444/17 1456/10 1465/11 1485/15 1489/6 1497/17 Domengeaux [1] 1309/21 DON [1] 1311/18 don't [62] 1323/22 1324/10 1328/4 1329/15 1331/25 1332/4 1332/21 1337/1 1337/3 1339/25 1340/11 1340/17 1341/21 1341/22 1341/23 1343/14 1343/23 1343/23 1347/8 1348/13 1349/5 1349/24 1351/25 1372/22 1380/8 1388/18 1389/18 1393/17 1403/19 1411/12 1412/24 1415/6 1416/8 1418/1 1418/15 1428/14 1436/9 1436/13 1436/13 1438/25 1439/10 1440/8 1440/16 1440/19 1441/21 1452/2 1452/3 1452/5 1460/8 1460/21 1462/14 1482/12 1482/14 1483/17 1485/24 1486/2 1487/3 1494/4 1494/17 1500/3 1504/23 1505/18 DONALD [1] 1313/3 done [35] 1323/12 1328/16 1331/13 1331/15 1331/23 1331/24 1332/4 1333/3 1333/10 1340/20 1341/1 1341/2 1350/2 1350/3 1353/10 1353/11 1355/9 1355/12 1356/15 1359/3 1360/1 1361/18 1375/12 1378/12 1378/13 1379/14 1381/5 1381/8 1387/11 1410/20 1489/18 1500/6 1500/7 1501/12 1503/21 Donnie [1] 1480/16 Doppler [1] 1334/9 dot [5] 1419/2 1419/24 1419/25 1486/23 1486/23 dots [1] 1419/8 double [4] 1426/1 1488/9 1501/25 1502/1 double-peak [1] 1488/9 doubt [4] 1349/2 1388/15 1430/16 1485/5 DOUGLAS [1] 1311/3 down [36] 1332/12 1335/5 1347/17 1349/21 1358/17 1363/6 1384/10 1391/21 1391/22 1391/24 1392/2 1392/4 1393/8 1414/20 1414/22 1415/7 1417/4 1417/5 1417/10 1417/13 1424/8 1424/13 1425/15 1435/23 1436/4	1438/10 1438/12 1440/22 1441/7 1472/6 1472/16 1472/16 1488/25 1489/1 1489/2 1502/15 downstream [6] 1319/22 1368/20 1371/20 1476/20 1476/25 1477/9 DOYEN [1] 1312/19 Dr [11] 1353/5 1379/10 1399/22 1413/1 1415/17 1417/24 1420/23 1421/10 1427/21 1470/8 1480/11 Dr. [288] Dr. Ballard [3] 1389/1 1395/1 1505/8 Dr. Bushnell [13] 1377/5 1377/11 1378/3 1378/5 1378/16 1378/19 1378/20 1379/17 1380/1 1380/16 1380/17 1381/1 1382/4 Dr. Bushnell's [4] 1378/8 1379/5 1379/10 1381/10 Dr. Charlie [1] 1336/18 Dr. Chu [1] 1461/25 Dr. Dykhuizen [104] 1316/24 1336/15 1336/20 1338/21 1343/17 1354/14 1355/3 1355/7 1356/4 1357/15 1361/6 1364/15 1365/2 1365/8 1365/25 1367/3 1367/20 1369/23 1375/12 1376/21 1376/25 1377/4 1378/2 1378/4 1378/14 1379/8 1380/11 1382/4 1382/8 1385/23 1386/12 1387/6 1389/21 1390/18 1395/14 1396/25 1398/5 1398/23 1400/24 1406/9 1407/6 1408/6 1410/8 1410/10 1413/19 1414/13 1418/9 1418/17 1418/20 1421/1 1421/7 1421/8 1421/11 1421/19 1422/1 1422/25 1423/6 1423/13 1424/3 1425/22 1428/12 1429/19 1429/25 1430/5 1430/18 1430/23 1430/25 1431/17 1432/6 1433/4 1433/9 1433/18 1433/19 1436/11 1438/17 1450/5 1453/4 1454/10 1460/13 1463/5 1464/22 1466/18 1470/1 1470/11 1470/25 1471/24 1472/19 1473/8 1474/5 1476/12 1477/11 1487/21 1488/2 1489/15 1490/25 1493/23 1494/12 1494/19 1494/21 1496/23 1499/5 1500/15 1503/1 1503/17 Dr. Dykhuizen's [8] 1322/25 1365/18 1376/23 1379/4 1413/22 1418/13 1431/12 1431/15 Dr. Griffiths [11] 1412/12 1412/14 1412/21 1412/22 1436/13 1479/15 1479/16 1480/9 1480/11 1481/7 1504/9 Dr. Griffiths' [10] 1413/9 1436/17 1439/17 1475/16 1479/2 1479/7 1479/12 1497/19 1497/25 1498/3 Dr. Hunter [18] 1315/17 1319/3 1324/23 1328/3 1333/14 1334/20 1336/12 1341/16 1342/19 1342/22 1346/11 1348/9 1348/23 1353/8 1453/16 1460/1 1476/13 1478/24 Dr. Johnson [3] 1399/18 1406/10 1415/13 Dr. Johnson's [1] 1415/16 Dr. Lockett [7] 1399/2 1399/14 1427/20 1427/21 1490/4 1490/21 1491/4 Dr. Lockett's [5] 1398/1 1398/9 1398/10 1427/5 1491/5 Dr. McNutt's [1] 1340/1 Dr. Morrow [2] 1316/24 1338/21 Dr. Nesic [2] 1415/4 1415/5 Dr. Pooladi-Darvish [1] 1436/14 Dr. Pooladi-Darvish's [1] 1436/18 Dr. Ratzel [3] 1467/2 1467/10 1468/3 Dr. Ratzel [11] 1336/13 1336/22 1337/10 1337/17 1338/20 1383/4
---	---	---

<p>D</p> <p>Dr. Ratzell... [5] 1407/11 1451/25 1453/25 1460/4 1500/1</p> <p>Dr. Ratzell's [3] 1338/5 1339/22 1460/9</p> <p>Dr. Ronald [1] 1354/5</p> <p>Dr. Stewart [4] 1409/3 1415/18 1476/9 1503/9</p> <p>Dr. Tim [1] 1426/25</p> <p>Dr. Tom [1] 1361/9</p> <p>Dr. Zaldivar [44] 1416/10 1416/11 1416/15 1418/13 1418/19 1418/21 1418/25 1419/7 1420/8 1420/20 1420/25 1421/12 1421/14 1422/1 1422/13 1423/6 1423/8 1423/13 1423/21 1424/7 1425/16 1425/22 1426/12 1427/17 1427/18 1427/19 1427/22 1428/1 1428/21 1429/4 1431/1 1431/2 1431/11 1431/13 1431/18 1431/20 1487/17 1488/20 1490/8 1490/15 1490/19 1490/23 1494/1 1502/7</p> <p>Dr. Zaldivar's [21] 1423/1 1423/15 1423/25 1424/6 1425/16 1426/9 1426/15 1429/19 1430/6 1430/9 1430/11 1430/24 1487/14 1488/11 1488/17 1489/25 1490/9 1490/12 1493/11 1494/3 1501/19</p> <p>Dr. Zick [3] 1470/1 1470/3 1504/14</p> <p>draft [10] 1450/7 1467/10 1468/5 1468/9 1470/12 1470/16 1470/18 1471/16 1498/5 1498/6</p> <p>drafted [5] 1442/8 1442/14 1442/18 1442/19 1469/5</p> <p>drafting [3] 1442/24 1450/6 1470/11</p> <p>drafts [2] 1450/7 1498/3</p> <p>draw [2] 1345/6 1345/6</p> <p>drawing [1] 1491/25</p> <p>drawn [3] 1348/10 1348/14 1438/22</p> <p>drill [4] 1444/13 1444/18 1444/19 1476/18</p> <p>Drilling [3] 1312/13 1312/16 1312/19</p> <p>driven [2] 1404/10 1404/11</p> <p>drop [2] 1337/22 1397/24</p> <p>drops [1] 1469/15</p> <p>due [11] 1404/24 1406/17 1408/8 1413/14 1417/3 1440/1 1472/4 1472/23 1474/24 1480/13 1504/18</p> <p>duly [2] 1315/7 1354/1</p> <p>dumping [1] 1368/4</p> <p>Dupree [1] 1395/23</p> <p>during [52] 1316/11 1317/10 1321/4 1321/14 1321/20 1336/16 1345/8 1353/18 1361/12 1361/23 1362/11 1362/18 1364/3 1364/5 1364/11 1372/17 1378/14 1387/14 1387/16 1387/25 1390/22 1391/20 1391/23 1393/15 1395/4 1395/24 1399/3 1399/24 1400/5 1400/7 1401/9 1401/11 1410/20 1425/2 1426/20 1431/13 1446/3 1461/2 1470/21 1478/17 1478/18 1481/19 1481/21 1482/17 1483/14 1483/18 1495/12 1496/4 1497/17 1497/22 1498/15 1500/16</p> <p>Dykhuizen [110] 1316/24 1336/15 1336/20 1338/21 1343/17 1351/20 1351/21 1354/1 1354/5 1354/14 1355/3 1355/7 1356/4 1357/15 1361/6 1364/15 1365/2 1365/8 1365/25 1367/3 1367/20 1369/23 1375/12 1376/21 1376/25 1377/4 1378/2 1378/4 1378/14 1379/8 1380/11 1382/4 1382/8 1385/23 1386/12 1387/6 1389/21 1390/18</p>	<p>1395/14 1396/25 1398/5 1398/23 1400/24 1406/9 1407/6 1408/6 1410/8 1410/10 1413/19 1414/13 1418/9 1418/17 1418/20 1421/1 1421/7 1421/8 1421/11 1421/19 1422/1 1422/25 1423/6 1423/13 1424/3 1425/22 1428/12 1429/19 1429/25 1430/5 1430/18 1430/23 1430/25 1431/17 1432/6 1433/4 1433/9 1433/18 1433/19 1436/11 1438/17 1450/5 1453/4 1454/10 1460/13 1463/5 1464/22 1466/18 1470/1 1470/11 1470/25 1471/24 1472/19 1473/8 1474/5 1476/12 1477/11 1480/11 1486/24 1487/21 1488/2 1489/15 1490/25 1493/23 1494/12 1494/19 1494/21 1496/23 1499/5 1500/15 1503/1 1503/17</p> <p>Dykhuizen's [9] 1322/25 1365/18 1376/23 1379/4 1413/22 1418/13 1431/12 1431/15 1438/2</p> <p>dynamics [6] 1379/9 1381/2 1381/4 1381/5 1381/7 1381/12</p>	<p>employed [4] 1356/17 1356/22 1412/21 1412/22</p> <p>employee [2] 1385/23 1462/7</p> <p>employees [1] 1395/22</p> <p>employer [2] 1367/6 1367/7</p> <p>encompass [1] 1411/23</p> <p>end [22] 1332/1 1346/9 1408/12 1412/17 1412/17 1416/20 1417/6 1439/18 1440/13 1440/16 1441/13 1441/14 1441/19 1441/22 1470/6 1473/12 1473/16 1475/15 1483/16 1491/21 1491/22 1496/21</p> <p>ended [7] 1322/20 1370/21 1403/6 1475/9 1475/11 1475/13 1492/4</p> <p>ends [1] 1439/9</p> <p>Energy [2] 1313/2 1313/7</p> <p>Enforcement [1] 1311/10</p> <p>engaged [1] 1352/4</p> <p>ENGEL [1] 1311/13</p> <p>engineer [5] 1356/20 1362/17 1386/2 1397/16 1400/22</p> <p>engineering [13] 1333/2 1345/17 1355/9 1356/8 1356/10 1356/12 1356/14 1356/16 1357/10 1358/20 1358/23 1364/15 1371/5</p> <p>engineers [21] 1357/1 1357/3 1360/11 1361/22 1362/11 1362/12 1382/25 1385/21 1387/21 1395/21 1402/23 1409/18 1409/21 1409/22 1410/15 1410/25 1465/11 1465/13 1495/19 1495/20 1495/24</p> <p>England [1] 1386/3</p> <p>enough [11] 1316/4 1321/7 1328/8 1366/2 1392/19 1400/18 1403/7 1441/18 1464/10 1479/22 1501/15</p> <p>entire [4] 1346/4 1440/2 1483/4 1503/5</p> <p>entirely [1] 1320/9</p> <p>entitled [1] 1506/9</p> <p>environment [2] 1311/10 1448/23</p> <p>Environmental [1] 1311/10</p> <p>environments [1] 1477/1</p> <p>EOS [5] 1337/7 1337/9 1337/13 1496/15 1496/24</p> <p>equal [2] 1419/22 1419/25</p> <p>equally [3] 1400/18 1467/22 1484/22</p> <p>equation [13] 1337/23 1338/1 1360/18 1360/23 1360/24 1361/1 1368/24 1368/25 1427/13 1428/25 1448/6 1469/7 1496/16</p> <p>equations [19] 1337/9 1337/13 1359/16 1360/21 1369/6 1369/7 1373/22 1373/23 1374/14 1391/3 1392/11 1394/23 1394/25 1395/2 1429/4 1458/14 1490/6 1490/14 1495/2</p> <p>equivalent [3] 1427/14 1427/16 1456/3</p> <p>erode [3] 1415/6 1415/7 1503/6</p> <p>eroded [3] 1349/16 1415/4 1446/5</p> <p>erosion [57] 1349/11 1349/12 1349/18 1351/3 1399/23 1399/24 1399/25 1408/10 1409/2 1409/3 1409/5 1409/10 1409/12 1409/13 1411/19 1411/20 1411/21 1415/9 1415/12 1415/19 1416/2 1435/15 1435/18 1439/22 1439/23 1440/2 1446/3 1446/6 1449/7 1470/24 1471/18 1471/19 1471/20 1472/4 1473/8 1473/9 1473/10 1473/12 1473/16 1473/20 1473/23 1473/24 1473/25 1474/3 1474/3 1474/7 1474/14 1474/15 1474/25 1475/4 1475/14 1475/20 1475/22 1476/5 1476/6 1476/8 1496/6</p> <p>erosional [8] 1435/15 1435/21 1436/2 1436/2 1438/5 1438/8 1475/8 1475/10</p>
	<p>E</p> <p>e-mail [34] 1328/11 1328/24 1328/25 1329/1 1329/20 1329/22 1329/23 1330/19 1331/9 1332/11 1332/15 1332/23 1350/7 1350/10 1350/11 1350/19 1351/14 1351/16 1351/25 1352/3 1395/18 1398/10 1467/10 1468/1 1468/3 1470/16 1479/15 1480/9 1480/11 1490/3 1491/4 1491/5 1498/1 1498/2</p> <p>each [6] 1346/20 1365/19 1367/10 1419/25 1445/14 1458/9</p> <p>earlier [5] 1316/15 1328/20 1336/5 1476/24 1504/21</p> <p>early [3] 1350/8 1400/5 1474/24</p> <p>easel [2] 1428/5 1428/7</p> <p>easier [1] 1497/5</p> <p>East [1] 1310/16</p> <p>EASTERN [2] 1309/2 1506/5</p> <p>eddies [1] 1381/18</p> <p>educational [2] 1356/3 1356/6</p> <p>Edwards [1] 1309/22</p> <p>effect [12] 1328/12 1347/21 1376/4 1376/5 1376/15 1378/21 1378/23 1407/18 1422/23 1424/25 1438/12 1448/25</p> <p>effective [2] 1394/2 1447/2</p> <p>effects [6] 1347/6 1347/25 1375/17 1407/16 1436/2 1438/13</p> <p>effort [3] 1326/1 1352/11 1394/16</p> <p>efforts [4] 1325/21 1449/18 1451/8 1451/14</p> <p>EISERT [1] 1312/6</p> <p>either [15] 1320/4 1345/13 1368/4 1377/13 1377/14 1392/7 1409/1 1435/7 1442/11 1447/20 1463/17 1463/18 1477/20 1490/10 1503/7</p> <p>elbow [3] 1376/11 1376/14 1376/15</p> <p>elbows [2] 1376/7 1381/13</p> <p>element [1] 1380/19</p> <p>elements [8] 1376/6 1376/20 1378/23 1378/25 1379/2 1379/25 1380/2 1380/23</p> <p>elevation [2] 1371/21 1488/18</p> <p>Ellis [3] 1311/20 1312/2 1312/5</p> <p>Elm [1] 1313/5</p> <p>ELMO [3] 1491/8 1491/11 1500/13</p> <p>else [3] 1467/15 1504/16 1505/5</p> <p>emissivity [1] 1479/20</p>	

<p>E</p> <p>error [34] 1338/16 1376/3 1411/22 1429/10 1430/12 1433/25 1435/1 1435/3 1435/6 1435/10 1435/13 1435/14 1436/7 1436/12 1436/14 1436/21 1437/3 1437/6 1440/12 1442/3 1449/11 1449/14 1454/9 1464/8 1472/23 1472/24 1480/4 1482/4 1482/5 1482/7 1483/5 1490/2 1490/19 1496/8 errors [1] 1480/13 escape [1] 1404/12 escaping [1] 1358/10 especially [6] 1339/3 1352/7 1409/19 1444/19 1482/14 1484/21 ESQ [50] 1309/19 1309/22 1310/3 1310/7 1310/10 1310/13 1310/16 1310/19 1310/19 1310/22 1311/3 1311/3 1311/7 1311/11 1311/11 1311/12 1311/12 1311/13 1311/13 1311/14 1311/14 1311/15 1311/18 1311/21 1311/21 1311/22 1311/22 1311/23 1312/3 1312/6 1312/6 1312/9 1312/10 1312/13 1312/16 1312/19 1312/19 1312/20 1312/20 1312/21 1313/3 1313/3 1313/4 1313/4 1313/5 1313/8 1313/8 1313/12 1313/15 1313/15 essence [2] 1322/8 1448/6 essentially [6] 1371/19 1371/24 1380/18 1384/9 1409/10 1477/6 establish [2] 1382/8 1404/25 establishing [1] 1342/21 estimate [143] 1316/14 1317/23 1321/16 1321/20 1321/21 1322/1 1323/7 1323/11 1323/25 1324/3 1324/5 1324/8 1324/13 1331/15 1332/17 1332/25 1333/12 1333/13 1341/4 1345/23 1346/1 1346/12 1349/13 1352/18 1352/19 1352/22 1352/23 1352/24 1353/4 1366/3 1366/18 1368/9 1371/24 1373/6 1375/10 1376/1 1384/10 1385/1 1385/2 1385/4 1386/8 1386/21 1386/23 1387/1 1387/3 1388/21 1390/21 1390/25 1392/13 1393/23 1393/24 1394/18 1395/6 1403/18 1403/19 1403/23 1405/10 1405/11 1407/7 1407/7 1407/8 1407/10 1407/13 1407/14 1408/7 1409/3 1411/8 1412/3 1412/5 1414/12 1414/17 1414/19 1421/13 1421/17 1432/20 1432/22 1432/24 1432/25 1433/22 1434/19 1434/20 1434/24 1434/25 1435/11 1435/14 1436/3 1436/12 1437/6 1437/7 1438/20 1438/24 1439/8 1439/12 1440/14 1441/19 1441/20 1448/2 1450/11 1462/5 1462/9 1463/3 1463/6 1464/3 1464/14 1465/17 1465/24 1465/25 1466/3 1466/20 1467/19 1468/4 1468/14 1481/3 1481/19 1481/20 1481/23 1482/2 1482/8 1482/11 1482/22 1482/23 1484/18 1484/21 1485/11 1486/19 1487/19 1489/18 1491/13 1491/21 1491/23 1492/5 1494/3 1495/9 1497/10 1501/7 1501/8 1501/16 1502/9 1502/13 1502/19 1502/22 1502/24 1503/13 estimated [5] 1366/10 1366/13 1366/16 1422/23 1464/25 estimates [30] 1316/15 1316/16 1320/25 1325/5 1325/13 1327/19 1335/1 1335/7 1335/17 1362/9 1384/16 1384/18 1384/19 1384/20 1387/15 1413/1</p>	<p>1413/4 1431/15 1433/7 1439/10 1451/21 1452/2 1452/22 1453/5 1453/18 1454/8 1464/23 1465/25 1485/10 1500/19 estimating [1] 1334/1 et [3] 1309/8 1309/11 1496/6 et cetera [1] 1496/6 evaluate [1] 1333/9 even [10] 1369/20 1370/9 1383/16 1410/12 1434/10 1436/6 1445/6 1445/7 1479/23 1485/7 evening [2] 1504/2 1505/24 event [4] 1330/9 1330/9 1395/11 1399/24 events [3] 1321/22 1330/7 1483/24 eventually [5] 1372/23 1372/25 1392/5 1394/14 1442/21 ever [11] 1362/17 1364/9 1364/12 1387/9 1389/7 1410/3 1470/14 1488/2 1495/15 1495/19 1495/20 every [5] 1328/19 1380/19 1407/20 1407/21 1419/2 everybody [2] 1333/23 1478/22 everyone [5] 1345/16 1414/8 1467/15 1503/25 1505/23 everything [3] 1333/5 1392/5 1439/3 evidence [5] 1350/24 1365/17 1415/25 1476/5 1485/12 exact [11] 1339/18 1350/21 1380/19 1380/20 1384/3 1457/4 1458/2 1468/20 1476/2 1484/3 1484/15 exactly [11] 1322/11 1324/10 1387/2 1426/22 1429/11 1434/13 1436/22 1445/5 1482/16 1486/18 1486/20 exam [4] 1331/20 1489/6 1492/5 1496/4 examination [13] 1315/14 1315/17 1315/20 1324/16 1355/5 1364/20 1364/24 1433/13 1433/18 1494/15 1497/23 1498/15 1500/16 examine [2] 1337/20 1383/21 examining [1] 1483/3 example [7] 1321/19 1338/3 1340/12 1349/14 1376/13 1441/9 1467/23 excellent [3] 1338/9 1413/18 1498/12 except [3] 1384/2 1395/2 1482/10 exception [1] 1384/3 excerpt [1] 1464/7 excluding [1] 1377/4 excuse [3] 1339/25 1427/24 1473/14 execution [2] 1386/22 1387/1 exercise [1] 1479/22 exhibit [10] 1328/22 1334/17 1334/19 1464/23 1470/15 1477/10 1489/16 1505/7 1505/11 1505/12 Exhibits [1] 1365/18 exist [2] 1316/23 1444/14 existed [3] 1449/20 1468/11 1468/15 exit [4] 1319/13 1368/7 1370/11 1371/21 exited [1] 1483/2 exiting [1] 1322/17 expanded [3] 1413/15 1498/6 1498/6 expect [18] 1357/2 1383/19 1385/6 1385/9 1414/18 1415/10 1415/12 1425/19 1426/2 1434/11 1434/15 1439/13 1440/16 1441/21 1441/22 1477/14 1478/5 1478/10 experience [16] 1357/7 1357/9 1357/10 1357/16 1359/19 1360/2 1360/10 1419/16 1421/9 1421/10 1434/7 1450/23 1455/9 1462/8 1462/12 1462/14 experimental [4] 1418/3 1420/8 1487/22</p>	<p>1488/3 experiments [5] 1359/24 1376/10 1376/10 1379/25 1420/10 expert [43] 1322/25 1364/15 1365/2 1365/8 1365/9 1365/13 1365/24 1366/22 1377/11 1377/13 1377/14 1377/19 1378/3 1378/12 1378/12 1379/13 1384/8 1390/15 1399/18 1402/1 1406/10 1412/12 1413/10 1416/12 1418/23 1421/8 1421/12 1429/24 1431/9 1435/9 1441/25 1452/25 1457/25 1469/25 1470/2 1473/8 1473/9 1473/11 1473/15 1474/5 1474/9 1481/15 1494/24 expert's [5] 1377/20 1377/20 1377/21 1377/22 1377/24 expertise [2] 1355/7 1475/14 experts [9] 1376/24 1377/16 1412/8 1412/9 1413/24 1414/23 1414/24 1430/19 1430/22 experts' [1] 1377/4 explain [16] 1370/6 1371/17 1391/16 1393/22 1403/23 1403/25 1413/6 1418/4 1418/9 1418/20 1418/22 1424/5 1428/4 1489/24 1497/23 1498/17 explained [2] 1322/7 1322/7 explaining [5] 1367/16 1368/14 1391/11 1418/19 1421/21 EXPLORATION [6] 1309/10 1311/17 1311/20 1312/2 1312/5 1312/9 explore [2] 1375/17 1431/12 expounding [1] 1421/21 express [4] 1369/5 1384/21 1401/21 1488/17 expressed [8] 1327/10 1346/7 1401/24 1461/10 1461/11 1461/12 1497/25 1498/9 expressing [1] 1343/17 extend [1] 1475/12 extended [1] 1398/17 extensive [1] 1360/10 extra [2] 1399/25 1408/14 extract [1] 1409/7 extrapolate [5] 1471/5 1471/17 1492/4 1492/18 1493/4 extrapolating [2] 1348/11 1470/19 extrapolation [5] 1344/14 1344/17 1434/21 1471/3 1479/24 extreme [1] 1478/25 extremely [1] 1479/3 extremes [2] 1499/16 1499/17</p> <p>F</p> <p>fact [28] 1333/15 1333/21 1339/8 1343/9 1347/1 1347/25 1360/6 1361/2 1379/1 1388/10 1388/12 1403/9 1404/12 1405/18 1406/17 1413/14 1426/24 1430/10 1452/2 1454/18 1466/13 1466/18 1470/22 1476/24 1483/10 1483/14 1492/25 1504/6 factor [19] 1337/13 1341/24 1390/5 1406/13 1406/16 1406/18 1406/20 1426/19 1429/7 1429/13 1429/23 1430/7 1430/10 1430/24 1431/20 1445/17 1494/4 1501/19 1501/22 factors [25] 1337/7 1337/19 1349/4 1349/11 1370/23 1371/2 1371/3 1371/9 1375/20 1375/23 1375/25 1376/10 1380/4 1380/22 1390/9 1390/10 1431/7 1431/24 1447/4 1447/4 1456/21 1456/22 1457/4 1458/3 1458/25 factually [1] 1349/7 failed [1] 1474/10</p>
--	--	--

F	Florida [1] 1310/5 flow [456] flow-based [1] 1325/5 flowing [28] 1363/1 1372/14 1374/9 1391/21 1392/11 1392/19 1393/25 1393/25 1394/1 1394/1 1400/7 1400/8 1401/13 1403/1 1403/3 1403/5 1403/8 1403/10 1403/10 1409/20 1446/3 1458/6 1459/1 1470/22 1485/22 1486/4 1486/5 1499/2 flows [14] 1356/11 1359/19 1360/15 1360/15 1373/3 1376/4 1406/14 1406/25 1407/2 1459/7 1464/25 1465/8 1490/17 1490/18 fluid [29] 1337/23 1338/3 1357/10 1357/16 1358/20 1358/23 1359/17 1364/15 1369/6 1379/9 1381/2 1381/4 1381/5 1381/7 1381/12 1416/21 1416/21 1416/22 1416/22 1421/2 1428/19 1448/4 1448/22 1458/7 1458/11 1459/4 1487/6 1496/12 1496/24 fluids [1] 1360/16 FLYNN [1] 1311/7 focus [1] 1350/20 focusing [1] 1350/19 follow [1] 1441/2 followed [9] 1376/12 1376/14 1376/14 1378/2 1400/13 1425/3 1425/4 1425/12 1425/13 following [2] 1350/24 1469/13 follows [3] 1315/7 1354/2 1470/19 footage [1] 1485/13 force [3] 1403/17 1404/13 1417/4 forced [5] 1369/19 1370/14 1372/8 1446/4 1454/15 forces [2] 1373/6 1417/9 foregoing [1] 1506/6 forensics [2] 1350/9 1352/12 forgot [1] 1461/5 form [4] 1402/21 1422/15 1460/24 1499/25 formal [1] 1462/14 format [4] 1328/5 1333/17 1333/18 1333/22 former [1] 1353/16 forming [2] 1365/20 1379/11 formulas [2] 1394/25 1443/13 formulate [2] 1373/22 1392/11 forth [4] 1361/14 1430/3 1431/10 1456/5 forward [2] 1336/7 1385/22 found [9] 1348/6 1359/16 1361/1 1376/1 1391/2 1420/3 1454/2 1455/11 1464/23 foundation [2] 1342/21 1389/19 four [8] 1339/20 1363/13 1385/10 1406/22 1409/9 1439/24 1464/24 1473/21 fourth [5] 1363/17 1363/19 1404/8 1444/7 1480/23 frame [1] 1330/2 FRANK [1] 1310/16 frankly [1] 1467/20 free [1] 1479/22 frequencies [1] 1425/7 frequency [1] 1417/5 friction [2] 1317/21 1447/4 Friday [12] 1328/10 1329/9 1330/3 1331/7 1331/11 1331/16 1333/25 1341/9 1454/15 1454/22 1461/8 1499/24 Friolot [1] 1312/12 FRTG [1] 1344/3 full [5] 1315/8 1330/2 1354/3 1439/25	1498/4 fully [1] 1375/3 function [2] 1351/7 1419/19 functional [1] 1422/15 furlough [1] 1503/21 further [8] 1348/23 1348/24 1349/7 1382/7 1459/22 1471/24 1471/25 1490/11 future [1] 1333/6
fair [11] 1316/4 1328/8 1412/11 1421/22 1436/16 1438/4 1464/10 1495/24 1496/2 1502/7 1503/2 fairly [5] 1333/2 1387/11 1404/6 1412/15 1426/17 familiar [1] 1381/4 Fannin [1] 1312/16 far [7] 1320/5 1348/17 1379/25 1380/3 1410/12 1411/13 1502/14 Farah [2] 1387/22 1390/2 farther [1] 1439/15 fast [1] 1415/7 faster [1] 1441/12 FCRR [4] 1313/18 1506/4 1506/12 1506/12 feature [1] 1337/22 feet [1] 1326/22 felt [2] 1316/17 1452/16 few [9] 1384/2 1404/17 1405/21 1409/14 1409/16 1412/16 1439/23 1500/16 1501/12 fictional [3] 1470/13 1470/20 1471/6 field [4] 1355/13 1360/2 1360/10 1389/3 fields [2] 1311/23 1375/22 Fifteenth [1] 1312/7 fifth [1] 1444/12 figure [4] 1337/24 1345/13 1468/6 1477/22 final [19] 1333/18 1344/12 1346/11 1346/13 1346/15 1351/6 1351/11 1407/17 1407/23 1407/25 1422/20 1438/18 1462/20 1463/16 1463/23 1464/5 1471/14 1471/17 1472/21 finally [2] 1327/14 1478/4 find [13] 1346/6 1358/11 1360/18 1366/3 1369/7 1371/9 1375/15 1402/12 1419/18 1468/22 1479/19 1488/1 1502/4 fine [4] 1428/13 1433/20 1486/17 1491/17 finish [2] 1414/12 1489/12 finished [2] 1433/10 1433/21 fire [1] 1357/24 firm [2] 1310/6 1503/10 first [46] 1316/17 1328/13 1328/17 1350/23 1361/11 1369/8 1369/9 1369/15 1372/20 1375/7 1379/4 1386/21 1387/7 1398/16 1401/11 1407/10 1407/11 1408/11 1409/8 1409/11 1409/14 1409/16 1418/2 1420/13 1420/18 1434/24 1438/17 1439/23 1439/24 1442/22 1443/4 1443/6 1447/25 1450/6 1450/7 1454/19 1456/7 1461/22 1463/3 1468/9 1470/12 1470/18 1471/21 1474/22 1481/10 1484/3 first-year [2] 1369/8 1456/7 fit [7] 1377/14 1404/1 1404/3 1425/18 1425/19 1479/20 1479/23 FITCH [1] 1313/15 fitting [1] 1479/22 five [5] 1333/24 1338/17 1385/9 1385/9 1406/22 fix [1] 1330/22 flange [1] 1404/3 flash [8] 1342/20 1469/14 1469/19 1469/24 1470/7 1470/10 1496/17 1496/21 FLEMING [1] 1313/5 flipped [1] 1385/8 floor [2] 1312/21 1486/7	G game [2] 1417/18 1421/22 gas [22] 1347/9 1355/18 1355/19 1358/1 1360/18 1394/1 1402/25 1403/3 1403/5 1416/24 1416/25 1417/9 1417/10 1417/12 1419/3 1419/5 1455/9 1459/1 1462/7 1462/12 1469/15 1482/15 GASAWAY [1] 1312/6 gauge [39] 1319/5 1319/16 1319/19 1320/3 1320/3 1320/7 1320/10 1320/18 1320/22 1368/2 1368/8 1370/22 1392/5 1393/8 1395/9 1395/10 1401/15 1401/17 1402/6 1402/6 1402/8 1402/10 1403/20 1403/25 1416/5 1439/16 1443/22 1455/24 1476/13 1476/18 1477/3 1478/13 1478/16 1478/19 1478/21 1478/24 1479/1 1479/3 1479/5 gauges [3] 1318/17 1326/21 1476/25 gave [6] 1337/11 1360/25 1403/11 1422/6 1452/13 1498/2 geared [1] 1331/4 gee [2] 1405/23 1449/23 general [3] 1339/10 1397/11 1397/14 General's [2] 1310/18 1310/22 generality [1] 1469/2 generally [3] 1338/1 1397/9 1450/17 generate [3] 1417/17 1417/19 1417/21 generated [4] 1360/24 1369/13 1376/10 1417/16 generating [1] 1358/15 generic [1] 1319/3 gentleman [2] 1344/1 1490/15 geometric [1] 1337/22 geometries [6] 1320/4 1363/3 1363/13 1371/10 1371/10 1375/16 geometry [47] 1315/21 1315/25 1316/6 1316/9 1316/10 1316/18 1317/24 1326/7 1327/14 1327/15 1345/13 1345/15 1345/18 1345/21 1347/22 1357/19 1363/4 1368/1 1368/23 1369/12 1376/13 1383/17 1383/18 1383/21 1383/25 1444/7 1448/17 1448/18 1449/1 1450/19 1453/22 1455/22 1456/18 1456/22 1457/3 1457/12 1458/2 1458/4 1459/4 1459/11 1459/12 1470/21 1470/22 1472/2 1473/3 1486/9 1496/6 geothermal [5] 1357/18 1357/20 1357/22 1359/21 1359/23 get [71] 1318/23 1323/7 1323/25 1329/17 1330/2 1330/7 1331/1 1331/5 1331/7 1331/10 1331/13 1331/18 1339/8 1340/25 1343/15 1344/8 1348/23 1349/7 1350/11 1350/21 1361/3 1361/18 1363/12 1371/22 1374/13 1374/16 1375/5 1375/7 1375/9 1380/12 1381/18 1381/19 1385/9 1391/1 1392/22 1392/23 1394/7 1394/10 1398/15 1400/23 1404/20 1406/6 1413/6 1429/11 1436/1 1437/24 1439/7 1439/15 1440/6 1441/13 1451/7 1452/14 1471/25 1478/16 1479/5	

<p>G</p> <p>get... [16] 1484/4 1484/16 1486/2 1494/9 1498/13 1499/15 1499/16 1501/25 1502/1 1502/24 1503/22 1504/12 1504/20 1504/22 1504/24 1505/4</p> <p>gets [5] 1326/16 1411/17 1427/11 1429/7 1499/9</p> <p>getting [11] 1330/14 1330/23 1333/18 1350/10 1369/14 1385/10 1410/12 1413/20 1429/9 1432/5 1488/5</p> <p>gist [1] 1340/17</p> <p>give [12] 1382/20 1400/18 1400/21 1402/10 1428/8 1436/24 1440/19 1441/9 1468/19 1472/24 1487/2 1504/24</p> <p>given [17] 1324/18 1337/19 1343/9 1363/10 1364/2 1379/24 1382/19 1383/8 1403/24 1404/6 1441/13 1443/1 1449/9 1449/19 1459/18 1472/3 1472/3</p> <p>gives [6] 1348/19 1379/14 1400/17 1403/18 1416/9 1504/19</p> <p>giving [2] 1350/17 1392/6</p> <p>GLADSTEIN [1] 1311/14</p> <p>global [1] 1422/19</p> <p>GmbH [1] 1309/8</p> <p>go [78] 1324/15 1325/3 1328/22 1332/12 1332/22 1336/7 1342/1 1348/3 1349/16 1350/18 1351/17 1354/22 1364/22 1366/24 1367/18 1368/12 1369/19 1370/4 1371/15 1373/12 1374/3 1374/20 1380/6 1381/17 1386/10 1386/17 1388/5 1391/14 1393/2 1393/20 1394/10 1395/12 1395/16 1396/7 1396/23 1398/3 1398/7 1398/20 1399/12 1403/21 1404/3 1405/8 1408/4 1411/13 1414/3 1418/7 1419/13 1422/9 1423/23 1425/15 1427/3 1427/7 1432/11 1433/2 1438/13 1439/25 1441/1 1442/21 1447/4 1451/13 1453/2 1453/13 1464/11 1464/20 1466/22 1469/4 1469/8 1470/17 1471/9 1471/22 1473/21 1476/20 1480/7 1491/8 1500/13 1502/14 1503/7 1503/7</p> <p>Godwin [3] 1313/2 1313/3 1313/7</p> <p>goes [15] 1376/25 1414/20 1417/8 1417/10 1417/12 1417/13 1417/13 1417/14 1422/25 1441/5 1441/6 1441/11 1445/14 1473/6 1502/10</p> <p>going [52] 1331/19 1333/4 1339/5 1342/18 1353/15 1353/18 1354/16 1358/14 1362/13 1363/5 1363/6 1363/6 1368/1 1369/11 1370/19 1370/20 1372/10 1377/18 1377/19 1380/5 1382/7 1392/2 1404/8 1404/20 1405/24 1411/21 1413/25 1417/4 1417/4 1423/16 1429/21 1436/3 1437/21 1437/23 1439/20 1442/20 1444/20 1446/13 1446/22 1451/5 1454/17 1454/18 1459/4 1474/7 1476/10 1477/4 1477/4 1477/19 1494/10 1501/6 1503/16 1504/4</p> <p>GoM [1] 1386/24</p> <p>gone [2] 1394/13 1394/14</p> <p>good [14] 1315/17 1315/18 1338/9 1346/1 1346/2 1404/22 1422/14 1459/24 1460/14 1465/14 1492/24 1503/13 1503/24 1505/23</p> <p>got [19] 1339/15 1350/11 1354/7 1375/1 1380/1 1382/18 1384/4 1385/7 1393/25 1394/8 1394/13 1394/14 1400/14</p>	<p>1426/18 1426/23 1457/20 1459/9 1474/6 1479/9</p> <p>gotten [1] 1329/8</p> <p>governing [1] 1360/21</p> <p>government [12] 1333/7 1333/13 1353/12 1361/11 1389/8 1390/3 1390/12 1410/1 1410/21 1454/12 1467/16 1501/15</p> <p>government's [1] 1332/25</p> <p>grade [1] 1369/18</p> <p>gradually [2] 1410/2 1410/3</p> <p>Grand [1] 1312/21</p> <p>GRANT [1] 1312/20</p> <p>graph [2] 1440/19 1477/23</p> <p>graphs [1] 1396/12</p> <p>great [7] 1318/18 1323/6 1323/8 1325/17 1326/2 1352/7 1478/18</p> <p>greater [20] 1323/23 1338/25 1346/9 1394/18 1411/11 1411/13 1411/15 1411/17 1411/17 1413/7 1413/7 1436/15 1481/12 1481/25 1482/10 1482/25 1486/17 1490/18 1501/5 1502/19</p> <p>greatest [1] 1438/5</p> <p>green [1] 1368/19</p> <p>GREENWALD [1] 1310/10</p> <p>Griffiths [16] 1409/4 1412/12 1412/14 1412/21 1412/22 1416/8 1436/13 1474/21 1475/2 1479/15 1479/16 1480/9 1480/11 1481/7 1503/9 1504/9</p> <p>Griffiths' [13] 1413/1 1413/9 1415/19 1436/17 1439/17 1475/16 1476/9 1479/2 1479/7 1479/12 1497/19 1497/25 1498/3</p> <p>gross [1] 1353/1</p> <p>group [3] 1332/1 1362/22 1460/17</p> <p>guess [5] 1385/6 1394/9 1394/10 1493/17 1496/2</p> <p>guessed [4] 1326/13 1394/7 1394/13 1394/13</p> <p>guesses [1] 1359/12</p> <p>guesstimate [1] 1504/19</p> <p>gulf [3] 1309/5 1322/17 1417/3</p> <p>guy [1] 1462/20</p> <p>guys [1] 1456/16</p> <p>GWENDOLYN [1] 1313/8</p>	<p>1420/10 1425/25 1426/1 1426/7 1431/12 1434/10 1434/13 1442/10 1442/25 1442/25 1445/13 1449/19 1449/25 1450/15 1451/7 1451/8 1451/24 1454/9 1455/9 1455/22 1455/24 1456/10 1456/14 1457/12 1457/17 1458/14 1459/18 1460/17 1461/16 1462/7 1462/17 1463/22 1464/5 1465/11 1465/13 1465/14 1466/8 1470/3 1478/4 1478/8 1486/8 1486/9 1487/18 1488/19 1488/21 1496/23 1498/3 1499/4 1499/22 1499/24 1505/3</p> <p>half [10] 1323/18 1401/7 1409/9 1418/12 1418/18 1428/2 1439/25 1439/25 1442/12 1473/21</p> <p>half flow [1] 1409/9</p> <p>Halliburton [2] 1313/2 1313/7</p> <p>hand [6] 1359/8 1359/9 1359/14 1474/13 1474/16 1490/10</p> <p>handled [1] 1458/17</p> <p>handwriting [2] 1334/19 1334/21</p> <p>happen [2] 1415/21 1415/23</p> <p>happened [5] 1316/11 1358/5 1409/12 1424/16 1464/13</p> <p>happening [2] 1319/20 1319/21</p> <p>happens [5] 1339/9 1409/13 1411/20 1415/20 1435/18</p> <p>happy [2] 1321/12 1489/11</p> <p>hard [7] 1391/5 1393/18 1405/7 1436/9 1467/18 1484/12 1502/3</p> <p>HARIKLIA [1] 1311/21</p> <p>HARVEY [1] 1311/14</p> <p>has [49] 1325/9 1350/20 1367/5 1377/12 1389/19 1392/10 1399/20 1400/16 1400/17 1401/4 1407/18 1409/4 1419/7 1419/12 1420/18 1421/16 1423/1 1423/14 1424/25 1425/2 1425/3 1425/7 1425/11 1425/12 1425/16 1425/17 1429/3 1438/17 1439/17 1444/14 1446/1 1446/2 1451/25 1452/1 1461/25 1462/20 1473/10 1479/4 1479/22 1480/25 1482/16 1486/24 1487/22 1487/24 1488/20 1489/2 1502/10 1503/9 1503/11</p>
<p>H</p> <p>H-U-N-T-E-R [1] 1315/11</p> <p>had [155] 1316/7 1316/17 1316/25 1318/5 1318/15 1318/18 1320/3 1320/10 1321/18 1322/8 1322/9 1322/9 1323/6 1323/8 1323/12 1324/17 1326/5 1326/7 1326/13 1326/13 1326/20 1327/2 1327/14 1328/4 1328/5 1328/6 1328/14 1328/18 1329/8 1329/10 1329/15 1329/15 1329/19 1331/18 1332/1 1332/20 1333/16 1333/21 1334/3 1334/5 1334/7 1334/9 1334/12 1335/4 1335/17 1337/11 1337/12 1338/21 1339/12 1341/7 1341/11 1344/14 1344/18 1345/16 1345/18 1346/3 1346/5 1346/18 1350/14 1350/15 1351/24 1360/8 1360/10 1363/5 1366/2 1368/1 1369/12 1369/17 1369/21 1370/13 1370/17 1370/20 1373/2 1373/4 1373/16 1378/7 1378/10 1378/25 1380/8 1380/10 1382/8 1382/16 1382/24 1383/7 1387/9 1387/11 1389/2 1389/7 1390/3 1391/1 1392/25 1402/7 1403/1 1403/4 1404/9 1405/18 1405/20 1410/3 1410/21 1412/16 1413/5 1415/7 1416/16 1420/9</p>	<p>H</p> <p>H-U-N-T-E-R [1] 1315/11</p> <p>had [155] 1316/7 1316/17 1316/25 1318/5 1318/15 1318/18 1320/3 1320/10 1321/18 1322/8 1322/9 1322/9 1323/6 1323/8 1323/12 1324/17 1326/5 1326/7 1326/13 1326/13 1326/20 1327/2 1327/14 1328/4 1328/5 1328/6 1328/14 1328/18 1329/8 1329/10 1329/15 1329/15 1329/19 1331/18 1332/1 1332/20 1333/16 1333/21 1334/3 1334/5 1334/7 1334/9 1334/12 1335/4 1335/17 1337/11 1337/12 1338/21 1339/12 1341/7 1341/11 1344/14 1344/18 1345/16 1345/18 1346/3 1346/5 1346/18 1350/14 1350/15 1351/24 1360/8 1360/10 1363/5 1366/2 1368/1 1369/12 1369/17 1369/21 1370/13 1370/17 1370/20 1373/2 1373/4 1373/16 1378/7 1378/10 1378/25 1380/8 1380/10 1382/8 1382/16 1382/24 1383/7 1387/9 1387/11 1389/2 1389/7 1390/3 1391/1 1392/25 1402/7 1403/1 1403/4 1404/9 1405/18 1405/20 1410/3 1410/21 1412/16 1413/5 1415/7 1416/16 1420/9</p>	<p>hasn't [1] 1420/21</p> <p>Hat [64] 1322/2 1323/1 1323/6 1323/7 1323/13 1324/2 1325/10 1325/12 1325/25 1326/1 1326/4 1326/9 1326/12 1326/13 1326/16 1327/2 1366/12 1366/13 1400/24 1401/1 1401/2 1401/4 1401/6 1401/9 1401/16 1401/16 1401/25 1402/13 1402/16 1402/20 1402/22 1402/25 1403/2 1403/11 1403/13 1403/15 1404/1 1405/5 1432/20 1439/11 1449/21 1451/16 1452/3 1452/20 1452/22 1453/18 1453/20 1454/3 1454/8 1454/8 1484/18 1484/21 1485/7 1485/12 1486/7 1486/23 1491/21 1492/5 1492/12 1492/20 1501/10 1501/11 1502/21 1502/22</p> <p>Hat 4 [1] 1326/1</p> <p>hate [1] 1385/18</p> <p>have [305]</p> <p>haven't [2] 1330/20 1463/8</p> <p>having [7] 1315/6 1315/20 1331/15 1354/1 1430/18 1473/4 1482/2</p> <p>HAYCRAFT [1] 1311/18</p> <p>HB [1] 1313/18</p> <p>HB-406 [1] 1313/18</p> <p>he [211]</p>

H	1382/6 1388/2 1389/23 1395/1 1399/8 1399/10 1406/24 1407/4 1413/5 1413/6 1413/7 1413/8 1413/10 1413/14 1413/15 1413/17 1413/18 1416/9 1416/17 1417/18 1418/14 1418/18 1418/19 1418/21 1418/22 1419/15 1420/16 1420/17 1420/18 1420/21 1421/1 1421/5 1421/9 1421/10 1421/10 1421/11 1421/21 1422/1 1422/3 1422/6 1422/8 1422/25 1423/1 1423/2 1423/4 1423/8 1423/12 1423/14 1423/15 1423/21 1424/11 1424/11 1424/16 1424/22 1425/1 1425/7 1426/7 1427/13 1429/4 1429/6 1429/9 1429/16 1429/16 1430/12 1430/16 1430/23 1431/4 1431/8 1431/10 1431/13 1431/13 1431/14 1431/15 1431/19 1431/22 1432/5 1462/12 1462/13 1462/19 1468/1 1468/3 1468/5 1470/4 1470/10 1479/9 1479/17 1480/4 1480/10 1480/20 1481/7 1481/12 1487/16 1487/18 1488/20 1490/1 1490/2 1490/6 1490/7 1490/7 1490/9 1490/17 1490/23 1493/16 1493/19 1493/21 1498/4 1498/5 1498/5 1498/6 1498/7 1498/8 1498/11 1503/9 Historical [1] 1396/1 history [2] 1325/5 1396/2 hold [3] 1356/24 1488/6 1497/24 holding [1] 1473/2 Holdings [3] 1312/12 1312/15 1312/18 hole [16] 1334/9 1427/15 1427/15 1427/19 1428/19 1428/20 1428/21 1428/22 1428/24 1428/25 1429/1 1429/5 1429/6 1475/25 1490/21 1490/23 holes [10] 1369/17 1369/19 1428/18 1429/16 1445/1 1476/4 1489/5 1489/9 1489/22 1490/20 homogenous [2] 1459/1 1459/3 honest [1] 1339/25 Honor [50] 1315/12 1342/18 1353/7 1353/13 1354/12 1355/2 1364/14 1364/20 1364/23 1365/16 1376/22 1377/10 1378/2 1379/3 1380/7 1380/13 1381/25 1382/7 1389/18 1395/23 1410/9 1411/3 1413/20 1414/2 1414/10 1418/11 1418/17 1420/24 1421/8 1421/23 1422/7 1422/9 1423/10 1428/6 1429/21 1430/14 1430/21 1431/6 1431/11 1431/21 1431/22 1433/10 1433/14 1504/5 1504/7 1504/8 1504/10 1504/14 1504/17 1505/6 HONORABLE [1] 1309/15 hope [5] 1312/3 1330/21 1341/1 1341/2 1504/13 hopefully [1] 1329/9 HORIZONTAL [1] 1309/4 horizontal [2] 1488/25 1489/1 horse [1] 1423/17 hot [1] 1357/22 hour [2] 1328/21 1405/21 hours [3] 1328/16 1369/14 1404/17 Houston [10] 1312/17 1313/9 1361/12 1361/14 1361/19 1361/21 1386/4 1395/21 1442/11 1442/11 how [59] 1329/18 1331/13 1340/11 1351/2 1355/12 1356/6 1356/12 1356/22 1358/11 1358/12 1367/23 1368/14 1374/5 1375/15 1379/22 1383/25 1391/16 1392/11 1393/3 1399/23 1400/3 1400/10 1401/6 1402/4 1403/19 1405/10 1406/15 1408/8	1409/2 1413/25 1418/20 1419/3 1419/4 1419/8 1419/9 1419/10 1424/13 1424/16 1425/6 1425/6 1425/8 1425/20 1433/19 1438/23 1441/12 1445/13 1446/10 1446/24 1452/8 1452/9 1459/3 1488/9 1488/21 1488/21 1489/2 1495/9 1499/2 1502/14 1504/15 however [4] 1347/25 1409/6 1475/2 1479/18 Hsieh [3] 1467/24 1504/4 1504/5 huh [1] 1331/22 humor [1] 1455/5 HUNTER [27] 1315/6 1315/10 1315/17 1319/3 1324/23 1328/3 1333/14 1334/20 1336/12 1341/16 1342/9 1342/19 1342/22 1346/11 1348/9 1348/23 1353/5 1353/8 1361/9 1361/23 1442/18 1442/21 1451/8 1453/16 1460/1 1476/13 1478/24 hydrates [2] 1402/21 1402/21 hydraulic [14] 1427/19 1428/3 1428/22 1428/22 1429/2 1429/15 1429/17 1429/22 1430/3 1431/25 1443/11 1444/17 1448/2 1497/9 hydraulics [4] 1317/24 1445/20 1446/7 1458/2 hydrocarbons [5] 1359/20 1359/21 1359/22 1359/25 1360/15 hypothesis [1] 1445/4
	I	
	I'd [14] 1330/25 1334/16 1367/10 1390/18 1400/24 1407/6 1416/10 1433/21 1442/7 1443/5 1469/11 1476/11 1481/10 1500/19 I'll [14] 1322/2 1343/2 1354/18 1364/19 1364/22 1382/11 1411/3 1421/20 1422/9 1432/5 1436/24 1447/12 1470/17 1489/11 I'm [61] 1315/16 1330/25 1337/15 1342/18 1353/9 1354/16 1354/22 1356/20 1367/6 1380/5 1382/2 1382/7 1388/11 1392/15 1392/17 1393/2 1403/17 1423/5 1423/16 1429/21 1431/11 1433/20 1437/23 1439/23 1441/8 1441/9 1451/5 1454/6 1454/17 1454/17 1456/14 1457/24 1461/9 1463/9 1463/10 1463/15 1464/8 1465/9 1465/13 1472/11 1473/9 1476/2 1476/8 1476/10 1477/22 1481/22 1488/5 1488/5 1489/11 1490/13 1490/13 1490/18 1492/16 1493/18 1494/10 1495/19 1499/5 1503/16 1503/22 1505/11 1505/13 I've [22] 1354/15 1355/10 1355/13 1356/15 1357/18 1358/3 1359/25 1368/16 1374/25 1375/14 1381/5 1386/13 1387/19 1387/20 1393/25 1398/14 1409/18 1451/24 1473/9 1481/15 1481/16 1505/3 i.e [1] 1479/19 idea [4] 1423/1 1462/19 1488/21 1489/2 Ideally [1] 1394/10 ideas [1] 1351/2 identical [4] 1360/8 1360/22 1390/9 1394/24 identified [4] 1370/9 1375/18 1376/8 1408/1 idle [2] 1482/17 1482/18 ignore [1] 1397/8 ignored [1] 1376/16 ignoring [1] 1492/16 Illinois [1] 1311/24	

illustrate [1] 1373/14	independently [3] 1406/15 1407/2 1407/5	interesting [9] 1351/18 1372/19 1409/4 1416/16 1422/22 1427/13 1479/5 1487/15 1498/13
image [1] 1424/2	index [1] 1480/24	Interests [1] 1310/19
images [4] 1339/15 1401/4 1401/5 1423/25	indicate [4] 1342/9 1466/14 1472/25 1476/7	intermediate [1] 1471/15
imagine [1] 1499/12	indicated [4] 1372/20 1442/20 1472/25 1505/4	internal [3] 1404/10 1404/11 1500/9
immediately [2] 1352/25 1483/2	indication [2] 1401/12 1490/19	internally [1] 1482/16
impact [14] 1318/6 1347/7 1349/10 1352/17 1378/23 1400/8 1422/20 1435/15 1435/22 1444/18 1446/6 1448/9 1477/4 1489/1	individual [3] 1335/19 1344/7 1367/1	interpret [1] 1362/13
impacts [1] 1425/21	individuals [1] 1389/5	interpretation [1] 1489/23
imperfect [2] 1425/18 1425/19	industry [1] 1397/23	interpreted [1] 1338/17
implication [2] 1378/25 1399/14	infinite [1] 1481/2	interpreting [1] 1489/18
implicitly [2] 1458/25 1470/20	influenced [1] 1319/24	interval [3] 1329/19 1358/11 1434/22
implied [1] 1392/6	inform [3] 1389/7 1389/10 1487/12	introduction [1] 1495/8
implies [2] 1380/22 1445/1	information [24] 1316/7 1318/21 1318/24 1328/25 1331/9 1333/21 1333/24 1335/4 1336/7 1339/13 1341/8 1350/13 1360/25 1386/22 1386/25 1387/13 1400/17 1400/19 1400/19 1400/21 1455/24 1460/5 1460/18 1497/10	inventory [1] 1358/8
important [6] 1358/13 1369/16 1429/2 1445/17 1473/10 1481/6	informative [2] 1450/1 1499/1	investigated [1] 1422/13
importantly [1] 1409/15	informed [1] 1328/9	investigation [1] 1355/11
imposed [4] 1422/13 1424/22 1424/24 1490/2	infrequent [1] 1412/15	investigative [1] 1358/3
imposes [1] 1424/15	initial [10] 1319/8 1365/19 1384/1 1394/9 1460/24 1470/13 1470/20 1472/21 1473/11 1498/3	involved [6] 1358/3 1358/6 1361/7 1386/8 1450/6 1470/9
imposing [2] 1424/12 1481/11	initially [4] 1392/4 1401/16 1408/11 1415/7	involvement [1] 1367/8
imposition [1] 1422/23	initiate [1] 1329/20	involves [1] 1500/1
imprecise [1] 1324/5	initiated [2] 1331/1 1332/2	Irpino [2] 1310/6 1310/7
impressive [1] 1421/13	inject [1] 1351/18	irregular [1] 1428/18
improper [1] 1495/17	injected [1] 1400/5	irregular-shaped [1] 1428/18
improve [1] 1375/13	injecting [2] 1391/19 1393/2	is [598]
inaccuracies [1] 1502/18	input [2] 1500/4 1500/5	Island [2] 1358/4 1358/15
inaccuracy [1] 1491/19	inputs [3] 1359/12 1424/12 1449/10	isn't [3] 1360/17 1440/18 1460/14
inaccurate [20] 1384/16 1384/22 1402/7 1424/24 1447/14 1484/21 1484/22 1485/7 1485/10 1485/18 1485/19 1485/20 1486/8 1486/9 1486/11 1486/12 1486/15 1487/1 1491/18 1492/2	inquiry [1] 1504/21	issue [7] 1350/8 1377/9 1377/10 1377/16 1429/23 1430/17 1432/1
INC [14] 1309/11 1311/18 1311/21 1312/3 1312/6 1312/9 1312/13 1312/14 1312/16 1312/17 1312/19 1312/20 1313/3 1313/8	inside [4] 1323/18 1326/4 1428/20 1457/13	issued [6] 1341/4 1377/3 1378/12 1450/11 1463/2 1463/21
incident [2] 1330/3 1358/5	insignificant.' [1] 1422/24	issues [4] 1334/10 1448/9 1453/15 1505/6
include [11] 1317/11 1317/14 1317/20 1325/12 1347/1 1347/6 1347/21 1364/7 1413/16 1448/4 1470/23	inspection [1] 1392/1	it [422]
included [10] 1347/9 1347/12 1347/16 1347/18 1365/19 1378/11 1430/23 1448/7 1454/3 1471/14	instability [2] 1421/15 1424/6	it's [85] 1316/2 1323/18 1323/20 1334/23 1336/1 1337/20 1337/21 1337/21 1337/24 1338/18 1338/18 1340/3 1341/21 1353/16 1354/14 1359/23 1359/24 1360/17 1372/22 1378/10 1384/10 1386/20 1387/11 1395/22 1397/2 1409/6 1410/12 1411/21 1414/4 1416/8 1417/9 1417/11 1417/11 1417/12 1417/12 1421/5 1421/13 1421/22 1428/15 1428/20 1434/16 1436/3 1436/17 1436/20 1439/1 1439/1 1439/3 1439/15 1439/18 1439/19 1441/14 1442/1 1442/3 1442/20 1442/20 1446/9 1457/7 1457/9 1460/15 1460/16 1465/7 1466/22 1469/7 1470/9 1472/19 1473/22 1473/23 1474/4 1476/6 1480/22 1482/17 1483/10 1484/22 1485/9 1485/9 1489/3 1491/3 1491/18 1498/12 1501/1 1502/3 1502/13 1503/4 1504/1 1505/13
includes [5] 1325/10 1325/13 1421/10 1448/9 1451/16	instrumentation [3] 1318/15 1326/21 1327/13	item [2] 1500/6 1505/17
including [10] 1333/7 1333/23 1336/25 1395/23 1396/12 1444/19 1448/17 1451/16 1453/18 1460/24	insufficient [4] 1339/12 1341/8 1460/5 1460/18	iterative [1] 1394/7
inconsistencies [1] 1424/15	integral [17] 1342/10 1342/14 1342/16 1343/6 1344/14 1344/25 1346/2 1411/17 1411/21 1437/20 1438/25 1440/18 1441/2 1462/22 1471/15 1474/4 1498/24	its [12] 1327/13 1327/14 1337/1 1337/25 1346/16 1353/12 1378/3 1387/15 1444/14 1454/16 1472/1 1478/15
incorrect [3] 1364/13 1414/25 1487/24	integrate [1] 1366/3	itself [1] 1317/18
incorrectly [3] 1363/18 1407/25 1429/5	integrated [7] 1366/4 1366/15 1407/7 1407/10 1407/19 1411/8 1447/24	
increase [9] 1345/5 1351/10 1405/13 1415/20 1440/2 1459/15 1471/9 1478/1 1478/6	integration [1] 1436/1	
increased [5] 1376/1 1376/1 1477/17 1494/3 1501/22	integrity [6] 1362/6 1369/17 1386/23 1387/1 1392/22 1410/21	
increases [4] 1408/16 1408/17 1477/20 1478/2	intended [2] 1495/11 1505/2	
increasing [12] 1349/13 1372/21 1414/25 1415/17 1439/19 1439/20 1440/1 1466/9 1466/13 1492/25 1493/3 1503/4	interact [1] 1412/25	
increments [1] 1372/9	interacted [1] 1386/3	
indeed [2] 1351/18 1363/18	interacting [1] 1361/21	
independent [9] 1316/5 1371/23 1379/8 1475/16 1480/12 1488/8 1488/12 1488/15 1496/21	interaction [1] 1333/7	
	interest [3] 1400/15 1416/17 1445/14	
	interested [4] 1363/4 1386/7 1386/8 1487/15	
		J
		Jackson [1] 1310/17
		JAMES [3] 1309/22 1310/22 1395/23
		January [3] 1350/8 1351/12 1352/15
		January 2011 [1] 1350/8
		Jefferson [1] 1309/23
		JENNY [1] 1313/3
		job [1] 1336/5
		Jodi [5] 1313/18 1313/20 1506/4 1506/12 1506/12

J	<p>Johnson [6] 1399/18 1399/22 1406/10 1414/24 1415/13 1415/17</p> <p>Johnson's [1] 1415/16</p> <p>joke [1] 1500/7</p> <p>JOSEPH [1] 1312/6</p> <p>JR [1] 1313/4</p> <p>judge [17] 1309/15 1349/5 1355/15 1370/6 1371/17 1377/3 1377/3 1377/17 1378/5 1379/3 1379/6 1381/11 1391/16 1393/22 1403/24 1416/11 1424/5</p> <p>Judge Barbier [4] 1355/15 1381/11 1391/16 1393/22</p> <p>Judge Shushan [2] 1379/3 1379/6</p> <p>judgment [7] 1345/17 1345/19 1345/22 1345/24 1345/24 1346/1 1384/9</p> <p>judgments [1] 1320/6</p> <p>JUDY [1] 1311/14</p> <p>Julian [4] 1489/4 1489/10 1489/18 1491/6</p> <p>July [64] 1324/17 1325/10 1327/10 1327/25 1328/3 1329/7 1329/14 1329/16 1331/12 1332/3 1332/4 1333/25 1335/6 1336/22 1339/12 1341/4 1341/9 1341/11 1341/15 1343/4 1344/12 1346/19 1348/5 1348/11 1348/24 1349/8 1362/6 1375/12 1386/21 1386/24 1408/12 1412/17 1412/18 1433/22 1434/17 1434/20 1438/19 1440/4 1440/11 1451/1 1451/2 1451/3 1451/7 1452/3 1453/15 1454/11 1454/12 1460/1 1460/13 1460/17 1461/6 1462/9 1462/16 1462/18 1464/13 1467/16 1467/25 1468/10 1468/14 1468/15 1470/6 1471/25 1484/24 1492/7</p> <p>July 12th [1] 1451/1</p> <p>July 14/15 [2] 1386/21 1386/24</p> <p>July 14th [1] 1451/2</p> <p>July 15th [9] 1344/12 1348/11 1348/24 1434/17 1451/3 1452/3 1462/18 1468/15 1471/25</p> <p>July 15th and [2] 1434/20 1440/11</p> <p>July 15th capping [1] 1438/19</p> <p>July 15th estimate [2] 1433/22 1462/9</p> <p>July 15th number [2] 1440/4 1462/16</p> <p>July 15th represents [1] 1468/14</p> <p>July 15th was [1] 1341/4</p> <p>July 26th [5] 1327/10 1328/3 1451/7 1453/15 1454/11</p> <p>July 28th [2] 1329/14 1331/12</p> <p>July 30-31 [2] 1467/16 1467/25</p> <p>July 30th [10] 1333/25 1335/6 1336/22 1339/12 1341/9 1341/15 1454/12 1460/1 1460/17 1461/6</p> <p>July 30th meeting [1] 1460/13</p> <p>July 31st [2] 1341/11 1346/19</p> <p>June [23] 1318/9 1320/25 1321/1 1323/2 1325/10 1325/12 1325/16 1339/12 1395/18 1398/12 1401/19 1408/15 1412/17 1412/18 1442/8 1442/10 1442/14 1445/7 1451/19 1452/22 1491/22 1492/7 1497/14</p> <p>June 11 [1] 1395/18</p> <p>June 15 [1] 1325/12</p> <p>June 15th [3] 1325/10 1325/16 1451/19</p> <p>June 15th with [1] 1452/22</p> <p>June 25th [1] 1492/7</p> <p>June 29th [4] 1398/12 1442/10 1442/14 1445/7</p> <p>junk [5] 1400/1 1400/3 1400/4 1400/6 1470/24</p>	<p>just [77] 1316/9 1316/22 1318/23 1318/23 1319/3 1326/10 1326/10 1328/25 1329/8 1332/12 1339/17 1341/17 1342/19 1342/20 1343/20 1344/21 1346/22 1347/25 1350/19 1350/19 1352/4 1353/17 1353/19 1355/2 1360/17 1368/16 1370/18 1373/6 1377/1 1379/4 1379/13 1381/11 1381/19 1382/8 1385/13 1392/25 1394/16 1397/1 1397/8 1398/25 1403/7 1414/19 1418/11 1418/25 1420/18 1425/8 1428/18 1432/8 1432/8 1436/14 1436/19 1437/5 1439/22 1441/9 1441/20 1441/23 1442/8 1460/21 1462/15 1463/12 1463/17 1464/8 1464/17 1465/23 1467/11 1468/23 1469/2 1472/10 1474/3 1480/17 1486/10 1489/11 1490/18 1491/9 1491/13 1502/14 1505/17</p> <p>Justice [4] 1311/6 1311/9 1367/5 1387/19</p> <p>justified [3] 1380/23 1394/16 1413/15</p> <p>justifies [2] 1380/2 1415/18</p> <p>justify [1] 1374/1</p>	<p>know [58] 1323/22 1328/4 1328/20 1329/15 1329/16 1331/12 1331/13 1340/11 1341/22 1342/19 1342/20 1343/22 1343/23 1343/23 1343/24 1344/5 1344/7 1345/18 1351/11 1351/25 1352/3 1368/24 1369/18 1380/8 1380/20 1385/23 1387/24 1388/10 1388/12 1388/13 1390/6 1392/11 1392/12 1392/13 1392/14 1395/19 1399/6 1404/6 1404/15 1405/13 1405/16 1409/11 1412/9 1412/12 1420/17 1439/1 1444/10 1444/11 1447/20 1463/13 1463/21 1482/12 1482/14 1486/8 1490/16 1492/6 1497/22 1504/23</p> <p>knowing [11] 1348/17 1349/5 1363/14 1368/21 1368/22 1368/23 1369/16 1374/12 1374/12 1383/7 1435/15</p> <p>known [22] 1315/21 1315/25 1316/18 1317/24 1318/15 1326/2 1327/15 1327/15 1349/19 1368/8 1368/23 1370/11 1370/11 1378/10 1392/10 1402/6 1444/13 1444/14 1456/18 1456/22 1472/1 1481/17</p> <p>KRAUS [1] 1311/3</p> <p>Ks [3] 1370/25 1371/1 1490/15</p> <p>Kuchler [2] 1313/11 1313/12</p> <p>KY [1] 1313/15</p>
K	<p>K-factor [6] 1337/13 1390/5 1406/13 1406/16 1406/18 1429/23</p> <p>K-factors [16] 1337/7 1337/19 1370/23 1371/2 1371/3 1371/9 1375/20 1375/23 1376/10 1380/4 1380/22 1390/9 1431/7 1456/21 1458/3 1458/25</p> <p>K-idle [1] 1482/18</p> <p>K-value [1] 1371/4</p> <p>K-values [2] 1376/19 1376/19</p> <p>Kanner [2] 1311/2 1311/3</p> <p>KARIS [1] 1311/21</p> <p>Katz [2] 1309/18 1312/21</p> <p>keep [5] 1358/13 1358/16 1358/17 1402/23 1486/17</p> <p>kept [1] 1361/2</p> <p>KERRY [1] 1312/13</p> <p>key [1] 1379/12</p> <p>kill [78] 1321/22 1327/19 1327/20 1333/3 1366/9 1366/10 1367/22 1368/8 1370/1 1370/14 1370/20 1370/21 1390/18 1390/19 1390/22 1391/7 1391/8 1391/12 1391/17 1391/22 1393/16 1393/23 1394/18 1395/4 1395/5 1395/6 1395/11 1396/14 1396/21 1397/5 1397/17 1397/17 1398/11 1398/14 1398/16 1398/24 1398/25 1399/1 1399/3 1399/18 1399/20 1399/24 1400/5 1400/10 1400/11 1400/13 1432/16 1439/12 1446/4 1459/12 1481/19 1481/21 1481/23 1482/8 1482/17 1482/18 1483/4 1483/10 1483/10 1483/14 1483/16 1483/16 1483/18 1483/20 1483/24 1484/16 1484/23 1485/3 1485/9 1486/15 1486/24 1491/14 1493/5 1500/23 1500/24 1502/9 1502/12 1502/15</p> <p>kink [17] 1426/13 1426/16 1426/25 1427/10 1427/11 1427/23 1427/24 1428/17 1429/8 1431/15 1445/1 1470/24 1476/5 1489/5 1489/9 1489/22 1489/25</p> <p>kinked [1] 1317/12</p> <p>KIRBY [1] 1313/15</p> <p>Kirkland [3] 1311/20 1312/2 1312/5</p> <p>knew [7] 1331/2 1345/3 1360/10 1369/11 1369/12 1394/15 1481/18</p>	<p>L</p> <p>Lab [6] 1324/17 1325/3 1325/25 1334/12 1336/13 1453/16</p> <p>Lab's [1] 1495/12</p> <p>label [2] 1424/10 1501/8</p> <p>labeled [2] 1424/10 1453/7</p> <p>labeling [1] 1452/6</p> <p>Laboratories [2] 1356/18 1360/9</p> <p>laboratory [2] 1363/9 1457/24</p> <p>labs [25] 1325/4 1327/7 1327/8 1329/5 1338/6 1364/10 1453/5 1456/10 1456/18 1456/21 1457/3 1457/11 1457/11 1458/1 1458/6 1458/9 1458/16 1459/14 1459/17 1464/16 1464/24 1465/10 1465/11 1495/4 1497/16</p> <p>labs' [2] 1452/2 1465/7</p> <p>lack [3] 1441/16 1474/24 1475/3</p> <p>laed.uscourts.gov [1] 1313/20</p> <p>Lafayette [1] 1309/24</p> <p>Lake [1] 1310/14</p> <p>Lamar [1] 1313/9</p> <p>LANGAN [1] 1311/21</p> <p>language [1] 1348/13</p> <p>lapel [1] 1494/17</p> <p>large [14] 1338/22 1372/11 1403/6 1425/3 1425/4 1425/8 1425/12 1425/13 1425/13 1431/7 1435/13 1447/20 1447/24 1454/9</p> <p>largely [3] 1323/21 1350/2 1450/18</p> <p>larger [3] 1373/6 1385/21 1436/8</p> <p>largest [3] 1324/8 1324/12 1453/8</p> <p>Lasalle [1] 1311/23</p> <p>laser [2] 1350/21 1457/5</p> <p>last [25] 1329/18 1330/13 1343/6 1395/23 1404/15 1404/23 1404/25 1407/19 1411/14 1411/16 1412/16 1436/1 1444/14 1445/9 1463/5 1468/24 1473/23 1473/24 1474/3 1474/20 1483/16 1501/12 1503/9 1505/7 1505/17</p> <p>late [2] 1348/5 1442/8</p> <p>later [11] 1328/8 1387/17 1391/25 1405/21 1405/21 1408/20 1435/9 1454/10 1456/6 1481/11 1498/6</p>	

L	<p>latest [1] 1398/17 Law [1] 1310/6 layer [1] 1378/7 laying [2] 1417/2 1417/11 lead [1] 1336/16 leader [1] 1345/25 leading [2] 1395/21 1449/17 leads [3] 1404/21 1485/25 1490/11 leak [7] 1326/1 1326/3 1326/3 1426/25 1429/8 1431/15 1489/25 leaked [1] 1329/10 leaking [2] 1322/11 1404/9 leaks [5] 1426/13 1427/23 1427/24 1447/3 1489/18 learn [1] 1430/9 learned [1] 1481/16 learning [1] 1316/9 LEASING [1] 1309/8 least [14] 1324/12 1329/1 1374/9 1374/24 1380/20 1403/10 1404/17 1406/1 1439/13 1446/23 1450/11 1478/22 1490/3 1504/13 led [3] 1373/2 1453/25 1459/22 leeway [1] 1346/8 left [9] 1346/24 1348/17 1348/17 1358/12 1367/22 1394/16 1439/15 1474/12 1502/5 legal [1] 1352/4 less [22] 1346/5 1348/25 1353/17 1373/2 1384/4 1393/15 1393/17 1406/20 1408/16 1411/11 1411/16 1416/2 1447/10 1472/2 1472/25 1479/9 1484/14 1485/3 1485/7 1485/7 1485/8 1485/9 let [15] 1321/13 1332/6 1341/25 1346/11 1354/16 1378/17 1380/5 1388/11 1457/18 1463/10 1463/12 1470/15 1474/22 1489/24 1492/9 let's [10] 1316/16 1331/5 1332/22 1367/11 1368/7 1414/3 1423/17 1428/12 1477/19 1504/3 level [1] 1319/22 Levin [1] 1310/2 Lewis [3] 1311/17 1313/2 1313/7 LI [1] 1312/20 liable [1] 1333/8 Liberty [1] 1499/9 lie [1] 1486/20 light [4] 1403/23 1416/21 1416/22 1425/6 lighter [1] 1404/12 like [38] 1334/16 1365/17 1367/10 1370/15 1379/15 1384/15 1384/19 1385/8 1390/18 1400/24 1406/16 1407/6 1413/24 1414/4 1416/10 1418/25 1419/3 1419/16 1420/2 1420/4 1423/11 1424/19 1425/9 1428/4 1432/4 1433/21 1442/7 1469/11 1473/18 1475/10 1476/11 1481/10 1492/24 1494/6 1494/9 1494/17 1496/6 1500/19 liked [1] 1479/17 likelihood [2] 1393/14 1405/3 likely [8] 1385/13 1411/10 1415/23 1437/12 1437/16 1437/19 1499/12 1504/11 limit [4] 1402/12 1404/22 1410/2 1481/4 limited [3] 1318/20 1430/21 1470/23 line [56] 1317/19 1320/10 1327/19 1327/20 1327/21 1339/3 1344/25 1345/6 1348/10 1348/13 1348/20 1349/1 1357/1 1361/10 1367/1 1367/22</p>	<p>1367/22 1368/8 1370/1 1370/14 1370/20 1370/21 1371/13 1387/8 1401/8 1424/9 1424/9 1438/18 1438/22 1439/4 1440/21 1441/2 1441/7 1441/9 1441/11 1441/23 1459/8 1459/10 1459/11 1459/12 1460/24 1466/5 1467/20 1480/23 1486/18 1486/19 1486/20 1486/21 1486/21 1486/22 1494/9 1500/25 1503/7 1503/7 1503/8 1503/14 linear [3] 1344/22 1440/5 1440/13 linearly [2] 1348/19 1503/4 lines [1] 1333/5 liquid [12] 1355/18 1355/19 1355/20 1358/1 1360/19 1416/25 1417/1 1417/8 1419/4 1419/5 1459/1 1469/14 liquids [1] 1355/18 Liskow [1] 1311/17 listed [4] 1319/4 1327/8 1334/25 1453/17 listen [1] 1463/9 listened [2] 1430/11 1431/17 listening [1] 1361/22 lists [7] 1365/19 1398/22 1460/23 1505/7 1505/10 1505/11 1505/12 literature [1] 1375/21 little [17] 1318/13 1354/8 1371/22 1381/14 1390/7 1391/24 1410/12 1417/9 1422/20 1436/24 1455/16 1458/17 1476/10 1480/17 1491/10 1502/25 1504/14 LLC [8] 1309/18 1309/22 1311/2 1312/12 1312/13 1312/16 1312/19 1313/11 LLP [8] 1310/12 1311/20 1312/2 1312/5 1312/9 1312/15 1312/18 1313/14 LMRP [1] 1392/13 local [1] 1421/3 location [4] 1379/1 1444/17 1476/6 1492/1 Lockett [11] 1397/16 1398/12 1399/2 1399/14 1427/1 1427/20 1427/21 1427/21 1490/4 1490/21 1491/4 Lockett's [5] 1398/1 1398/9 1398/10 1427/5 1491/5 logic [2] 1330/6 1485/20 logical [5] 1372/21 1372/22 1397/25 1419/23 1473/18 logically [1] 1400/14 long [10] 1355/12 1356/22 1376/11 1376/12 1401/6 1446/3 1449/15 1470/9 1504/15 1505/14 longer [2] 1329/4 1413/25 look [21] 1320/13 1327/23 1327/24 1329/22 1330/9 1368/22 1377/7 1382/5 1395/9 1397/2 1397/8 1421/9 1421/11 1427/13 1436/11 1436/13 1436/13 1436/14 1475/15 1477/23 1500/19 looked [12] 1320/12 1371/1 1371/7 1398/14 1405/19 1405/19 1405/21 1407/24 1455/12 1463/22 1490/3 1491/3 looking [29] 1316/4 1316/22 1317/9 1318/10 1321/11 1321/14 1327/15 1327/19 1327/20 1327/20 1333/19 1335/17 1335/22 1335/23 1351/6 1373/25 1390/8 1390/11 1402/9 1436/6 1436/6 1436/17 1436/18 1456/18 1457/11 1458/2 1458/6 1467/11 1491/3 looks [6] 1425/9 1449/23 1492/24 1494/9 1501/3 1502/3 loop [6] 1394/8 1394/10 1394/13 1394/14 1488/14 1488/16</p>	<p>Los [2] 1312/4 1312/22 lost [1] 1498/16 lot [10] 1356/15 1413/5 1416/11 1416/17 1440/17 1446/18 1446/22 1481/16 1482/2 1483/17 lots [3] 1355/10 1417/22 1447/25 LOUISIANA [15] 1309/2 1309/6 1309/20 1309/24 1310/8 1310/14 1310/22 1310/24 1311/3 1311/4 1311/19 1312/14 1313/13 1313/19 1506/6 low [16] 1397/3 1404/7 1437/10 1439/8 1439/9 1440/13 1440/15 1440/21 1441/1 1441/5 1441/11 1447/15 1472/5 1473/6 1493/17 1503/6 lower [65] 1333/5 1385/14 1390/25 1391/5 1391/5 1391/17 1393/6 1393/18 1400/14 1400/14 1400/15 1400/15 1400/16 1400/17 1400/19 1400/21 1400/22 1402/12 1403/14 1403/18 1403/23 1404/13 1404/22 1404/25 1405/1 1405/2 1405/2 1405/7 1405/13 1437/12 1437/17 1437/19 1437/22 1440/6 1441/19 1454/7 1467/1 1482/6 1483/20 1484/4 1484/4 1484/7 1484/8 1484/8 1484/11 1484/12 1484/12 1484/14 1484/16 1484/16 1492/8 1492/8 1492/11 1492/14 1492/16 1492/17 1492/20 1493/1 1493/5 1494/5 1494/6 1496/19 1496/22 1502/12 1502/25 lowest [2] 1452/3 1465/24 LP [2] 1313/12 1313/15 LUIS [1] 1312/20 Lundy [3] 1310/12 1310/12 1310/13 Luxenberg [1] 1310/9 Lynch [2] 1387/24 1388/10</p>
M		<p>M.S [1] 1356/8 Macondo [13] 1316/5 1317/10 1357/19 1361/7 1366/1 1366/17 1370/16 1372/6 1442/6 1442/10 1443/2 1448/22 1450/24 made [25] 1316/14 1316/15 1322/1 1324/1 1325/9 1325/16 1326/19 1336/4 1336/22 1340/19 1348/21 1387/3 1418/14 1421/18 1451/9 1452/21 1460/21 1465/17 1466/1 1466/5 1467/7 1494/8 1499/23 1499/24 1504/21 Magazine [1] 1310/7 Magistrate [2] 1377/3 1378/5 Magistrate Judge [2] 1377/3 1378/5 magnitude [1] 1406/19 mail [34] 1328/11 1328/24 1328/25 1329/1 1329/20 1329/22 1329/23 1330/19 1331/9 1332/11 1332/15 1332/23 1350/7 1350/10 1350/11 1350/19 1351/14 1351/16 1351/25 1352/3 1395/18 1398/10 1467/10 1468/1 1468/3 1470/16 1479/15 1480/9 1480/11 1490/3 1491/4 1491/5 1498/1 1498/2 mainly [2] 1418/2 1472/4 maintaining [1] 1358/8 major [2] 1326/10 1326/11 make [29] 1321/16 1321/20 1321/21 1373/5 1380/5 1381/8 1391/1 1391/4 1402/22 1402/24 1403/2 1403/5 1403/7 1403/19 1404/9 1406/21 1409/25 1411/16 1419/7 1446/14 1449/4 1449/7 1462/23 1475/16 1480/17 1481/10 1482/16 1482/19 1502/5 makes [5] 1350/11 1376/18 1384/22</p>	

M	May 8th that [1] 1503/11 maybe [11] 1385/10 1391/24 1392/4 1394/12 1424/17 1424/25 1441/5 1466/14 1474/10 1476/12 1501/5 MAZE [1] 1310/19 MC [1] 1386/23 McCutchen [1] 1313/14 McNutt [6] 1329/8 1339/24 1350/7 1350/13 1351/17 1352/6 McNutt's [1] 1340/1 MD [1] 1309/4 me [75] 1326/5 1332/6 1339/25 1341/25 1346/11 1350/23 1360/6 1360/9 1360/24 1361/10 1361/25 1362/21 1364/13 1367/25 1368/3 1369/1 1373/6 1374/2 1377/8 1378/17 1379/14 1379/21 1379/24 1380/2 1381/8 1381/9 1383/5 1383/13 1387/12 1387/12 1387/13 1388/11 1389/10 1391/4 1391/10 1401/23 1401/23 1403/11 1403/18 1404/6 1404/21 1405/25 1408/25 1409/7 1409/22 1410/8 1413/7 1427/24 1441/10 1460/22 1463/10 1464/8 1464/9 1465/1 1465/16 1465/24 1467/7 1468/22 1470/15 1473/14 1474/15 1474/22 1475/4 1476/21 1477/22 1485/25 1489/8 1489/24 1490/11 1492/9 1494/2 1500/21 1500/22 1501/18 1505/16 mean [14] 1342/15 1347/17 1353/9 1381/22 1384/18 1402/15 1412/3 1428/3 1458/11 1467/5 1472/11 1474/4 1476/17 1498/17 meaning [1] 1320/23 means [10] 1319/19 1321/23 1337/9 1347/9 1400/12 1416/23 1416/25 1452/7 1463/10 1483/11 meant [1] 1468/6 measure [5] 1318/5 1349/2 1368/3 1368/19 1371/3 measured [7] 1319/7 1370/19 1374/10 1374/10 1403/16 1445/23 1445/24 measurement [7] 1322/2 1326/4 1382/25 1404/6 1415/22 1443/18 1443/23 measurements [12] 1316/19 1326/9 1333/1 1333/9 1348/16 1383/1 1383/24 1383/25 1384/4 1401/17 1409/5 1409/6 measuring [2] 1370/21 1434/7 mechanical [8] 1313/23 1317/11 1317/15 1317/20 1355/9 1356/9 1357/9 1364/15 mechanics [7] 1357/10 1357/17 1358/20 1358/23 1359/17 1364/16 1369/6 mechanism [2] 1352/5 1396/15 meet [1] 1362/17 meeting [29] 1333/25 1334/4 1334/16 1335/2 1335/16 1336/10 1337/11 1339/14 1341/11 1341/15 1341/25 1342/2 1342/2 1342/5 1343/12 1343/18 1451/7 1454/11 1460/1 1460/2 1460/6 1460/8 1460/13 1460/19 1461/2 1461/5 1461/7 1461/12 1499/24 meetings [9] 1341/7 1342/3 1342/23 1348/5 1410/21 1461/9 1461/10 1461/15 1467/16 meltdown [1] 1358/19 melting [1] 1358/17 member [6] 1336/13 1356/20 1356/25 1357/2 1450/23 1453/17 members [3] 1331/17 1344/4 1453/23 memory [3] 1451/23 1460/14 1460/16 mention [2] 1444/12 1474/10	mentioned [4] 1347/25 1355/14 1412/1 1468/25 merit [1] 1351/24 met [5] 1362/19 1385/25 1387/25 1395/20 1412/14 meter [7] 1368/17 1384/9 1384/12 1434/11 1434/14 1456/3 1466/25 method [53] 1370/1 1370/6 1371/14 1371/17 1371/19 1372/17 1373/8 1373/9 1373/11 1373/15 1373/16 1374/5 1374/7 1374/17 1374/24 1374/25 1375/3 1375/4 1375/5 1375/6 1376/18 1387/2 1387/7 1389/2 1390/5 1390/6 1390/7 1390/9 1394/7 1394/15 1394/21 1394/24 1405/15 1419/6 1420/5 1421/13 1421/16 1457/17 1459/5 1459/7 1459/9 1485/19 1485/20 1486/8 1486/9 1486/15 1487/18 1487/21 1487/24 1487/25 1488/7 1496/11 1497/2 Method 1 [4] 1370/1 1370/6 1374/25 1387/2 Method 2 [3] 1371/17 1371/19 1375/3 methodology [3] 1329/17 1484/3 1484/15 methods [16] 1321/12 1327/8 1358/20 1358/24 1369/23 1369/25 1374/6 1374/18 1374/23 1383/15 1383/16 1387/8 1420/15 1453/17 1486/11 1486/12 Methods 1 [2] 1374/6 1387/8 MEXICO [1] 1309/5 mic [1] 1494/17 MICHAEL [1] 1312/19 Michoud [1] 1383/23 microphone [1] 1428/8 mics [1] 1494/16 mid [4] 1316/25 1320/25 1362/14 1362/24 mid-June [1] 1320/25 mid-May [3] 1316/25 1362/14 1362/24 middle [12] 1332/22 1332/25 1351/11 1368/5 1368/5 1368/18 1440/16 1440/22 1474/22 1479/18 1480/16 1480/22 might [20] 1316/11 1331/18 1332/6 1334/24 1345/20 1357/2 1359/12 1362/13 1373/7 1402/21 1402/21 1437/2 1444/11 1446/10 1452/5 1472/23 1472/24 1473/18 1478/22 1479/21 MIKE [5] 1312/9 1353/16 1353/23 1362/17 1505/2 Mile [2] 1358/4 1358/15 miles [1] 1412/24 MILLER [2] 1312/13 1371/7 million [43] 1344/15 1345/7 1345/12 1347/1 1347/20 1352/18 1366/16 1407/8 1407/14 1411/11 1412/5 1414/18 1434/16 1434/24 1435/4 1435/6 1435/11 1436/2 1436/4 1436/7 1436/12 1436/21 1437/1 1437/6 1437/9 1437/10 1438/2 1438/24 1439/5 1439/7 1439/8 1440/5 1440/7 1440/12 1440/14 1440/23 1440/23 1441/3 1463/3 1486/19 1486/22 1493/25 1499/14 mind [5] 1341/24 1345/18 1348/1 1440/24 1452/5 mine [15] 1334/23 1378/24 1381/21 1397/19 1399/9 1399/11 1407/1 1426/24 1426/24 1457/6 1465/14 1490/10 1490/11 1490/19 1494/16 minimum [3] 1403/11 1461/13 1502/12
----------	--	--

M	<p>morning [1] 1505/24 Morrow [14] 1316/24 1336/18 1338/21 1360/9 1360/24 1361/13 1361/20 1455/6 1456/15 1462/4 1462/7 1462/16 1465/14 1465/15 Morrow's [3] 1470/8 1470/8 1500/7 most [20] 1324/5 1357/23 1358/4 1359/9 1359/10 1359/14 1363/4 1393/4 1408/20 1409/15 1422/22 1427/13 1456/14 1466/12 1478/25 1484/24 1485/18 1499/12 1502/16 1504/11 mostly [4] 1416/24 1416/25 1416/25 1417/1 motion [25] 1354/13 1354/14 1354/15 1354/16 1364/18 1364/19 1376/22 1377/2 1377/5 1378/4 1421/2 1422/13 1422/14 1423/20 1424/7 1424/11 1424/12 1424/20 1424/22 1424/23 1424/24 1426/3 1426/3 1426/5 1488/13 motions [2] 1488/25 1489/1 move [14] 1348/24 1380/6 1382/11 1390/18 1400/24 1407/6 1416/10 1420/24 1421/25 1423/17 1428/13 1428/14 1438/10 1471/25 moved [2] 1346/23 1412/23 moves [5] 1424/13 1472/13 1472/14 1472/16 1472/16 moving [6] 1392/10 1413/21 1414/23 1416/1 1422/5 1422/6 Mr [1] 1504/4 Mr. [27] 1362/20 1362/21 1377/9 1378/14 1379/18 1386/1 1386/2 1386/14 1386/20 1388/10 1389/23 1395/19 1395/20 1396/9 1396/19 1414/9 1418/18 1470/8 1498/15 1499/5 1499/18 1500/7 1500/15 1504/4 1504/12 1505/8 1505/21 Mr. Adams [1] 1505/8 Mr. Cernich [1] 1414/9 Mr. Hill [5] 1386/1 1386/2 1386/14 1386/20 1389/23 Mr. Hsieh [1] 1504/4 Mr. Lynch [1] 1388/10 Mr. Mason [2] 1362/20 1362/21 Mr. Morrow's [2] 1470/8 1500/7 Mr. Regan [8] 1377/9 1378/14 1379/18 1418/18 1498/15 1499/5 1499/18 1500/15 Mr. Tooms [4] 1395/19 1395/20 1396/9 1396/19 Mr. Zick [1] 1504/12 Mr. Ziegler's [1] 1505/21 Ms. [2] 1388/22 1389/17 Ms. Saidi [2] 1388/22 1389/17 much [39] 1318/20 1323/25 1329/3 1331/13 1336/16 1353/8 1358/11 1358/12 1359/24 1361/18 1381/15 1381/20 1392/11 1393/3 1393/24 1396/15 1396/20 1397/10 1400/19 1404/18 1404/19 1413/25 1416/9 1419/3 1419/4 1426/23 1427/16 1437/12 1437/16 1437/19 1445/13 1452/8 1459/11 1470/9 1488/21 1489/2 1494/9 1499/2 1502/5 mud [21] 1317/19 1320/10 1391/19 1391/20 1391/22 1391/24 1392/1 1392/2 1392/4 1392/7 1392/9 1392/9 1392/10 1392/11 1392/25 1393/2 1393/25 1446/4 1482/12 1482/15 1483/1 multiphase [36] 1337/7 1337/12 1339/1 1347/6 1347/9 1347/12 1355/10 1355/14 1355/15 1355/16 1355/20</p>	<p>1355/22 1356/11 1357/16 1359/19 1359/22 1360/15 1360/15 1364/16 1368/17 1375/17 1375/20 1375/24 1375/25 1376/4 1384/11 1384/12 1434/8 1447/7 1448/22 1449/1 1458/16 1458/21 1459/4 1470/10 1487/6 multiple [2] 1334/5 1335/2 multiply [2] 1369/2 1369/3 multistage [1] 1496/24 Munger [1] 1312/18 must [8] 1405/1 1406/1 1406/3 1440/6 1475/17 1475/19 1492/7 1492/7 my [147] 1320/21 1326/5 1330/19 1334/21 1334/21 1335/3 1336/5 1341/24 1343/8 1343/11 1345/24 1346/1 1350/3 1352/2 1352/14 1354/5 1356/10 1356/14 1356/21 1358/2 1360/13 1363/19 1364/13 1365/9 1365/12 1367/5 1367/6 1367/7 1371/6 1373/25 1375/10 1376/1 1376/3 1376/4 1380/4 1380/21 1380/22 1381/6 1381/19 1384/8 1384/12 1384/16 1384/19 1384/21 1384/22 1385/2 1386/6 1386/7 1386/8 1394/3 1394/9 1398/17 1399/20 1400/12 1400/12 1400/14 1400/16 1400/17 1400/19 1404/10 1404/23 1405/2 1405/12 1406/16 1406/22 1409/10 1411/21 1413/13 1413/16 1416/17 1417/20 1418/2 1419/16 1419/17 1420/3 1420/9 1420/11 1420/11 1420/14 1420/15 1420/16 1420/20 1424/16 1425/9 1428/2 1437/18 1439/23 1440/18 1440/24 1441/7 1441/8 1441/17 1447/23 1449/10 1451/23 1452/5 1457/9 1457/24 1457/25 1459/25 1460/14 1461/10 1461/17 1464/1 1465/9 1465/19 1466/17 1467/4 1467/7 1468/7 1468/9 1470/2 1471/14 1471/20 1473/20 1474/9 1475/1 1479/10 1480/3 1482/10 1482/19 1482/22 1483/22 1484/12 1484/14 1487/24 1488/19 1490/25 1491/2 1492/18 1494/6 1495/1 1496/23 1497/6 1497/7 1498/7 1498/21 1498/22 1499/16 1501/6 1502/15 1502/22 1503/7 1503/7 1503/8 1503/22 1506/7 myself [8] 1320/14 1321/24 1340/1 1343/10 1361/13 1361/20 1363/9 1381/5</p>
		N
		<p>N.W [3] 1312/7 1312/10 1313/16 name [7] 1315/8 1344/6 1354/3 1354/5 1455/2 1489/10 1491/6 named [4] 1344/1 1362/17 1385/23 1455/4 names [1] 1360/7 NATHANIEL [1] 1311/12 national [21] 1325/4 1327/7 1329/5 1363/9 1364/10 1453/5 1456/10 1457/3 1457/11 1457/11 1457/24 1458/1 1458/9 1459/14 1459/17 1464/16 1464/24 1465/7 1465/10 1465/11 1495/4 Natural [1] 1311/10 nature [3] 1326/12 1444/18 1498/4 nauseam [1] 1422/25 near [3] 1441/22 1499/17 1502/17 necessary [1] 1437/5 need [24] 1315/24 1329/9 1330/6 1330/9 1330/13 1330/15 1340/25 1351/7 1360/21 1374/9 1419/18</p>

<p>N</p> <p>need... [13] 1443/11 1445/20 1446/10 1446/14 1447/9 1463/12 1467/13 1470/4 1471/8 1474/2 1494/7 1497/10 1502/16</p> <p>needed [10] 1340/16 1340/20 1341/18 1383/13 1383/15 1397/4 1398/15 1401/17 1405/11 1454/11</p> <p>needs [1] 1352/11</p> <p>negative [1] 1479/20</p> <p>negligible [1] 1409/5</p> <p>negotiated [1] 1367/6</p> <p>negotiations [1] 1367/8</p> <p>neither [3] 1322/1 1361/15 1484/6</p> <p>Nesic [3] 1414/24 1415/4 1415/5</p> <p>never [7] 1347/19 1420/16 1421/16 1425/20 1471/15 1487/18 1487/22</p> <p>new [17] 1309/6 1309/20 1310/8 1310/11 1310/11 1311/4 1311/19 1312/14 1313/13 1313/19 1328/9 1333/3 1350/13 1350/23 1454/12 1475/25 1492/9</p> <p>next [13] 1318/24 1325/20 1328/16 1339/11 1340/20 1340/21 1353/12 1353/15 1388/21 1388/21 1445/15 1446/16 1461/7</p> <p>nice [3] 1331/6 1343/13 1499/9</p> <p>night [1] 1499/19</p> <p>nil [1] 1390/10</p> <p>NNSA [12] 1348/4 1375/19 1407/11 1408/1 1450/4 1450/12 1450/16 1470/6 1473/1 1478/12 1495/6 1497/16</p> <p>no [72] 1326/24 1328/17 1329/4 1331/25 1335/12 1336/2 1343/21 1347/4 1347/8 1347/24 1349/5 1350/10 1352/18 1353/7 1357/1 1357/4 1360/4 1360/17 1364/12 1367/9 1369/22 1373/6 1376/18 1379/7 1379/19 1384/19 1387/16 1388/17 1389/10 1390/17 1396/12 1398/14 1398/16 1400/14 1401/23 1405/6 1413/13 1415/6 1416/8 1418/1 1422/7 1430/16 1431/14 1431/21 1437/5 1437/14 1439/10 1440/15 1454/6 1462/19 1466/22 1467/7 1468/21 1468/21 1470/3 1473/9 1473/14 1475/14 1485/5 1487/5 1487/14 1488/11 1488/15 1488/21 1489/2 1489/24 1491/6 1492/16 1495/1 1495/18 1499/22 1503/4</p> <p>nobody [1] 1364/12</p> <p>nodal [2] 1318/4 1334/7</p> <p>noisy [1] 1426/8</p> <p>nominally [1] 1385/5</p> <p>non [7] 1377/13 1377/19 1377/20 1377/22 1377/23 1459/20 1479/19</p> <p>non-physical [2] 1459/20 1479/19</p> <p>non-testifying [5] 1377/13 1377/19 1377/20 1377/22 1377/23</p> <p>nonchanging [1] 1392/7</p> <p>none [7] 1327/8 1352/2 1360/4 1372/1 1401/23 1452/10 1453/17</p> <p>NONJURY [1] 1309/14</p> <p>normal [2] 1374/17 1430/25</p> <p>North [1] 1310/23</p> <p>not [222]</p> <p>notably [1] 1358/4</p> <p>note [6] 1335/3 1389/16 1390/2 1390/12 1422/22 1470/19</p> <p>notes [16] 1325/17 1325/21 1334/15 1336/9 1337/16 1337/16 1341/15 1341/22 1342/1 1342/9 1342/20</p>	<p>1342/21 1343/20 1343/22 1343/24 1343/25</p> <p>nothing [3] 1352/18 1468/18 1471/6</p> <p>notice [3] 1415/22 1424/14 1429/2</p> <p>noticed [4] 1416/19 1417/2 1490/4 1490/5</p> <p>notion [1] 1469/1</p> <p>now [70] 1318/13 1320/12 1325/8 1327/14 1330/23 1331/23 1339/22 1341/25 1342/12 1353/19 1361/7 1367/10 1369/19 1369/22 1373/8 1381/6 1382/3 1388/12 1392/12 1393/8 1393/22 1393/24 1394/12 1396/13 1398/14 1399/15 1399/22 1400/9 1400/24 1401/5 1402/9 1403/17 1404/23 1407/6 1410/9 1411/7 1412/7 1412/12 1413/17 1414/19 1414/23 1415/13 1426/12 1428/3 1429/11 1429/25 1430/17 1431/8 1432/8 1435/9 1435/25 1439/22 1441/8 1451/1 1451/12 1455/6 1455/21 1461/16 1462/3 1464/1 1464/16 1469/4 1473/8 1474/7 1476/24 1477/19 1491/25 1496/11 1498/11 1499/18</p> <p>nowhere [1] 1424/16</p> <p>nuance [1] 1345/2</p> <p>nuclear [8] 1356/8 1356/12 1356/14 1356/16 1358/4 1358/7 1359/1 1359/4</p> <p>number [101] 1329/13 1329/15 1336/3 1336/7 1340/4 1340/9 1340/15 1340/20 1340/25 1343/13 1343/15 1344/12 1344/15 1344/16 1344/17 1345/7 1346/15 1346/16 1346/22 1347/1 1347/13 1349/3 1350/20 1353/1 1355/11 1358/3 1360/20 1361/25 1370/9 1372/9 1376/16 1378/21 1381/6 1385/25 1386/4 1390/23 1390/24 1391/1 1391/4 1395/20 1395/22 1396/11 1397/3 1399/20 1406/5 1406/7 1409/24 1411/18 1419/1 1429/10 1429/11 1430/22 1434/1 1434/6 1435/1 1435/4 1435/4 1435/6 1436/4 1436/4 1436/21 1438/2 1438/10 1440/4 1440/5 1440/6 1440/11 1442/19 1447/1 1447/19 1447/19 1447/21 1447/24 1449/9 1449/20 1451/16 1452/12 1459/18 1461/13 1462/16 1462/17 1464/16 1465/3 1465/16 1466/4 1466/16 1466/18 1466/24 1467/2 1470/5 1472/5 1472/13 1472/22 1473/19 1480/17 1482/24 1485/15 1485/17 1492/24 1494/21 1498/16</p> <p>numbered [1] 1506/9</p> <p>numbers [22] 1324/10 1334/23 1335/5 1335/9 1337/6 1337/10 1346/13 1346/13 1383/8 1389/3 1399/10 1426/23 1441/8 1452/5 1453/11 1465/5 1465/6 1465/20 1465/23 1467/21 1486/25 1490/6</p> <p>numerical [6] 1417/16 1417/18 1419/2 1419/6 1420/5 1420/15</p> <p>numerous [3] 1331/4 1421/17 1422/11</p> <p>nutshell [1] 1381/11</p>	<p>1424/8 1485/23 1486/10</p> <p>observations [4] 1332/2 1416/19 1444/13 1444/24</p> <p>observe [2] 1323/24 1336/2</p> <p>observed [3] 1424/7 1475/3 1487/4</p> <p>observing [1] 1405/18</p> <p>obstruction [1] 1368/18</p> <p>obstructions [1] 1444/11</p> <p>obtained [3] 1390/24 1397/3 1495/10</p> <p>obtains [1] 1422/20</p> <p>obvious [1] 1419/8</p> <p>obviously [8] 1386/2 1424/24 1435/2 1447/1 1451/25 1473/23 1484/7 1504/2</p> <p>occasions [1] 1385/25</p> <p>occur [2] 1475/4 1487/9</p> <p>occurred [5] 1347/6 1349/18 1350/23 1399/25 1470/23</p> <p>ocean [2] 1352/24 1353/4</p> <p>October [2] 1309/7 1315/2</p> <p>odd [2] 1363/3 1427/15</p> <p>odd-shaped [1] 1427/15</p> <p>off [25] 1326/16 1329/8 1332/12 1372/7 1372/13 1406/18 1408/11 1408/16 1408/18 1428/10 1429/13 1430/6 1430/10 1430/24 1431/20 1444/24 1457/9 1470/24 1471/11 1471/13 1474/13 1478/16 1493/25 1500/24 1501/19</p> <p>offer [1] 1365/17</p> <p>offers [1] 1421/12</p> <p>Office [7] 1309/23 1310/4 1310/18 1310/22 1310/23 1311/7 1311/15</p> <p>official [6] 1313/18 1332/25 1333/13 1463/6 1506/4 1506/13</p> <p>Offshore [3] 1312/13 1312/16 1312/19</p> <p>often [6] 1359/15 1359/21 1360/7 1361/15 1385/20 1412/25</p> <p>Oh [5] 1331/25 1337/18 1423/5 1432/25 1485/4</p> <p>oil [78] 1309/4 1309/4 1322/11 1322/13 1322/16 1332/15 1340/5 1347/9 1360/2 1366/7 1366/11 1366/14 1366/16 1369/5 1369/19 1369/20 1369/21 1373/18 1375/10 1389/3 1390/4 1390/24 1391/2 1391/5 1392/18 1392/19 1392/23 1392/25 1393/3 1393/7 1394/1 1394/5 1394/6 1394/17 1397/24 1399/4 1401/3 1402/25 1403/3 1403/5 1403/7 1403/9 1403/17 1404/5 1404/9 1404/12 1404/14 1404/16 1404/24 1405/17 1407/8 1407/15 1411/10 1414/18 1425/3 1425/4 1425/4 1425/5 1425/8 1425/12 1427/25 1428/20 1432/23 1433/1 1434/16 1448/10 1449/24 1453/4 1453/21 1455/9 1462/7 1462/12 1469/14 1475/3 1482/15 1496/25 1497/3 1499/15</p> <p>Okay [50] 1317/5 1319/7 1320/6 1321/21 1322/12 1323/20 1325/9 1327/1 1327/23 1329/3 1329/7 1329/22 1332/8 1341/14 1344/9 1353/5 1353/8 1353/12 1353/20 1354/19 1355/4 1377/7 1380/5 1380/12 1382/22 1404/1 1411/2 1411/5 1421/22 1423/18 1424/7 1428/13 1428/17 1430/9 1432/2 1432/4 1432/11 1433/12 1436/25 1441/11 1452/21 1465/3 1469/19 1474/11 1491/7 1494/24 1501/4 1504/1 1505/19 1505/23</p> <p>Oldenburg [1] 1344/3</p> <p>OLGA [12] 1397/20 1397/21 1397/22 1397/23 1397/25 1422/2 1422/5 1422/8 1423/2 1423/4 1423/8 1423/15</p>
---	---	---

<p>○</p> <p>Olson [1] 1312/18 once [5] 1327/13 1372/14 1385/7 1439/15 1499/15 one [102] 1318/8 1318/11 1318/14 1320/2 1320/3 1320/3 1320/12 1320/13 1320/23 1320/25 1321/1 1322/13 1323/17 1330/21 1331/16 1333/12 1335/10 1338/5 1339/17 1340/5 1344/3 1346/13 1346/13 1346/23 1347/24 1352/7 1352/14 1353/19 1362/25 1363/5 1364/1 1366/6 1368/4 1368/24 1375/5 1375/18 1376/18 1376/24 1377/12 1377/19 1379/23 1384/3 1387/7 1388/21 1391/25 1397/7 1404/8 1411/12 1411/19 1411/20 1414/12 1419/17 1420/20 1420/25 1425/2 1425/17 1425/24 1426/5 1429/23 1430/17 1430/18 1431/8 1435/14 1435/18 1438/8 1438/12 1441/23 1443/24 1445/23 1446/15 1447/13 1452/3 1453/23 1457/6 1457/6 1457/8 1459/7 1459/9 1460/12 1460/15 1461/8 1461/8 1461/9 1461/10 1461/15 1461/16 1463/17 1465/25 1466/8 1466/16 1467/4 1479/8 1479/11 1479/20 1479/22 1481/2 1481/3 1481/14 1482/19 1484/1 1484/3 1490/3 one's [2] 1322/11 1332/13 one-day [1] 1435/14 one-sixth [1] 1466/16 ones [2] 1466/10 1466/11 ongoing [1] 1333/16 only [33] 1323/17 1333/3 1342/22 1360/6 1360/13 1368/24 1373/18 1373/24 1374/14 1395/3 1411/20 1411/21 1414/20 1419/19 1425/16 1426/5 1427/9 1427/11 1428/24 1435/18 1445/23 1446/2 1446/9 1457/23 1459/17 1462/24 1466/16 1471/20 1479/6 1487/9 1498/2 1499/9 1501/7 open [11] 1370/10 1375/3 1391/20 1397/4 1397/4 1399/8 1409/25 1410/3 1410/22 1483/15 1505/17 opened [2] 1397/7 1399/7 opening [5] 1351/3 1410/1 1410/4 1410/23 1416/11 operation [1] 1446/4 opine [1] 1430/5 opinion [23] 1377/20 1377/21 1379/7 1385/13 1393/14 1395/8 1405/3 1417/24 1421/6 1430/23 1431/19 1433/7 1434/16 1437/18 1441/25 1442/4 1462/6 1468/7 1475/8 1480/3 1488/17 1489/21 1497/6 opinions [17] 1365/20 1365/24 1366/22 1379/5 1379/11 1418/5 1418/9 1423/20 1424/5 1431/14 1431/15 1433/5 1465/9 1465/9 1494/25 1497/2 1497/25 opportunity [3] 1387/17 1431/12 1466/11 opposed [2] 1377/5 1462/16 opposing [2] 1390/15 1390/17 opposition [1] 1354/16 orange [1] 1424/9 order [10] 1376/25 1377/4 1378/10 1378/11 1406/1 1486/1 1487/22 1488/3 1504/18 1505/22 orders [1] 1406/18 oriented [1] 1318/23 orifice [2] 1368/19 1368/23</p>	<p>original [12] 1375/19 1376/3 1376/8 1378/4 1382/15 1382/16 1382/22 1402/5 1406/16 1429/3 1472/23 1485/25 originally [4] 1361/4 1383/4 1412/22 1498/14 Orleans [8] 1309/6 1309/20 1310/8 1311/4 1311/19 1312/14 1313/13 1313/19 oscillary [1] 1421/2 oscillates [1] 1489/2 oscillating [1] 1488/13 oscillation [10] 1417/18 1417/19 1417/22 1419/11 1425/2 1425/20 1426/2 1488/16 1488/21 1488/24 oscillatory [2] 1422/14 1423/20 other [53] 1317/15 1321/12 1322/13 1322/19 1324/10 1330/19 1331/16 1333/20 1333/23 1333/24 1338/21 1345/9 1346/9 1349/4 1356/25 1357/3 1360/15 1363/9 1364/3 1364/17 1364/18 1364/19 1370/16 1371/8 1373/19 1375/6 1377/4 1385/21 1400/9 1400/11 1401/24 1406/19 1412/8 1412/9 1421/25 1425/19 1426/1 1426/8 1430/19 1438/12 1450/17 1457/8 1457/24 1459/18 1460/25 1465/11 1466/10 1466/11 1473/3 1478/25 1481/15 1495/4 1495/24 others [6] 1328/15 1336/25 1337/11 1339/24 1384/25 1447/23 otherwise [3] 1373/3 1373/7 1387/14 our [17] 1321/13 1324/9 1350/24 1351/6 1352/24 1353/18 1359/4 1359/12 1373/3 1376/24 1383/9 1401/11 1401/12 1447/15 1467/15 1467/19 1467/23 ourselves [1] 1474/2 out [82] 1321/22 1322/17 1324/6 1326/7 1327/22 1328/24 1329/10 1331/6 1332/3 1333/3 1335/20 1337/24 1341/3 1344/11 1344/12 1346/10 1349/21 1352/22 1352/23 1353/4 1358/11 1360/18 1363/16 1367/13 1369/19 1370/16 1375/15 1375/21 1376/1 1386/17 1389/12 1391/25 1392/5 1392/16 1392/17 1403/1 1403/3 1403/5 1403/8 1403/10 1403/12 1403/17 1404/8 1404/9 1404/14 1404/20 1404/21 1405/12 1405/19 1406/1 1406/4 1406/6 1407/2 1407/9 1415/11 1416/19 1418/18 1428/20 1429/1 1429/8 1439/16 1440/18 1441/8 1443/17 1444/24 1445/1 1450/4 1453/8 1455/23 1458/17 1466/15 1466/20 1468/6 1472/10 1477/22 1479/5 1485/16 1485/22 1486/6 1491/11 1498/14 1500/20 outcome [2] 1348/4 1459/22 outside [1] 1418/12 outstanding [1] 1505/7 over [34] 1317/12 1318/24 1329/19 1331/24 1332/4 1333/10 1333/20 1333/24 1333/25 1347/2 1347/7 1347/15 1366/10 1379/14 1388/11 1390/24 1391/2 1396/10 1397/12 1415/1 1415/4 1415/6 1415/13 1415/17 1428/12 1432/19 1440/2 1446/11 1492/15 1492/25 1493/1 1500/10 1503/5 1505/8 overall [3] 1348/1 1396/14 1396/20 overlay [1] 1330/10 overrule [5] 1343/2 1354/16 1411/2</p>	<p>1418/24 1421/20 overstated [1] 1472/20 own [12] 1326/5 1401/12 1412/9 1412/10 1412/10 1435/10 1436/6 1436/7 1436/11 1436/14 1440/24 1446/25 owners [1] 1359/5</p> <p>P</p> <p>p.m [1] 1329/7 PA [1] 1310/3 pace [5] 1330/14 1330/23 1330/23 1330/24 1331/1 pad [2] 1428/12 1428/13 page [16] 1314/2 1325/20 1325/22 1327/24 1332/22 1333/1 1335/1 1348/3 1348/6 1365/9 1365/12 1442/22 1443/5 1445/15 1450/14 1469/8 pages [5] 1418/13 1418/16 1418/18 1418/20 1443/5 pairs [3] 1443/18 1444/1 1444/4 Papantonio [1] 1310/2 paper [2] 1375/22 1497/13 paragraph [15] 1332/23 1429/23 1443/17 1444/7 1444/12 1444/23 1445/9 1446/1 1463/4 1463/8 1463/11 1467/12 1480/16 1480/18 1480/22 parameter [4] 1326/15 1446/24 1447/2 1479/18 parameters [19] 1421/3 1421/3 1422/16 1422/18 1422/19 1443/6 1446/19 1446/22 1446/24 1447/1 1447/6 1447/11 1447/19 1447/23 1447/24 1448/1 1449/13 1460/25 1479/22 Pardon [1] 1410/8 part [18] 1324/5 1324/8 1324/12 1329/1 1333/4 1373/18 1377/1 1395/24 1402/1 1416/24 1457/15 1471/16 1472/9 1473/5 1480/25 1489/15 1489/16 1489/17 participate [1] 1362/6 particular [7] 1354/17 1358/5 1378/22 1390/8 1457/6 1469/19 1499/3 particularly [1] 1386/7 parties [4] 1333/8 1430/21 1505/16 1505/21 pass [2] 1398/16 1433/10 passages [2] 1415/11 1415/11 passed [1] 1359/5 past [3] 1349/12 1474/25 1475/4 patch [1] 1444/4 path [13] 1326/3 1347/22 1351/10 1363/5 1368/9 1368/10 1368/10 1392/1 1444/10 1445/6 1445/14 1448/20 1488/22 paths [11] 1326/1 1347/15 1347/17 1363/13 1441/24 1445/2 1445/11 1445/13 1446/2 1446/5 1476/8 pattern [1] 1416/22 PAUL [2] 1311/22 1395/18 pay [1] 1367/6 PC [3] 1310/9 1313/2 1313/7 1488/9 1488/9 peaked [1] 1351/11 peaks [3] 1425/25 1426/1 1440/21 peer [1] 1413/9 peer-reviewed [1] 1413/9 pending [3] 1354/13 1376/22 1377/2 Pennsylvania [1] 1312/10 Pensacola [1] 1310/5 people [20] 1321/11 1329/17 1330/20 1331/1 1331/3 1340/12 1345/20 1381/6</p>
--	--	---

P		
people... [12] 1383/2 1400/17 1401/24 1402/10 1410/10 1442/20 1447/7 1452/15 1459/18 1481/16 1495/21 1498/19	1373/20 1395/11 1400/6 1400/10 1400/11 1405/17 1425/17 1425/25 1432/9 1483/3	plotted [1] 1500/20 plug [3] 1369/22 1481/5 1481/17 plume [1] 1444/24
people's [1] 1345/18	permanent [1] 1461/2	plus [33] 1335/14 1338/13 1338/16 1338/18 1338/18 1385/5 1433/25 1434/11 1435/10 1436/20 1436/23 1436/25 1437/3 1437/8 1437/18 1461/13 1461/23 1461/23 1462/1 1462/9 1463/7 1463/14 1480/4 1485/1 1487/2 1491/19 1498/20 1498/22 1498/23 1498/23 1498/24 1499/11 1502/10
per [51] 1338/13 1338/14 1363/25 1366/7 1366/11 1366/14 1367/13 1369/5 1375/10 1385/14 1388/14 1389/3 1389/9 1390/4 1390/24 1391/2 1391/5 1393/7 1393/15 1394/5 1394/6 1394/17 1394/19 1399/4 1399/16 1401/3 1404/14 1404/16 1405/4 1405/7 1405/17 1406/2 1427/25 1432/23 1433/1 1433/22 1449/24 1452/20 1453/21 1481/24 1484/18 1485/11 1485/16 1486/13 1486/16 1486/18 1486/25 1491/23 1492/11 1493/7 1500/11	permitted [1] 1376/24 person [6] 1343/10 1360/9 1361/19 1361/21 1455/6 1490/16 personal [3] 1329/1 1434/7 1449/18 personally [3] 1320/6 1321/24 1496/1 perspective [2] 1321/7 1340/14 PETITION [1] 1309/8 PETOSA [1] 1310/16 petroleum [4] 1313/11 1313/14 1360/10 1360/11 PH.D [10] 1315/6 1354/1 1355/9 1356/9 1416/17 1417/20 1419/17 1421/5 1421/10 1456/15 Ph.D.'s [2] 1456/13 1456/15 phase [9] 1347/11 1357/20 1357/23 1357/25 1358/1 1368/17 1375/19 1417/14 1496/21 phases [5] 1355/18 1394/3 1397/5 1469/15 1482/21 phenomena [2] 1349/9 1477/12 phenomenon [1] 1487/6 phone [4] 1329/8 1460/2 1461/25 1498/2 phonetic [1] 1371/8 photo [1] 1489/23 photos [1] 1489/19 phrase [1] 1470/14 physical [3] 1440/17 1459/20 1479/19 physics [1] 1417/22 PI [9] 1398/15 1415/20 1416/3 1480/20 1480/24 1481/2 1481/4 1481/11 1481/13 pick [2] 1315/19 1419/12 picked [1] 1375/21 picking [1] 1494/6 piece [3] 1322/14 1413/18 1498/12 pieces [1] 1322/15 pipe [16] 1355/21 1370/24 1376/11 1376/12 1381/16 1381/20 1419/1 1419/22 1419/23 1427/15 1444/13 1444/18 1444/20 1444/20 1467/20 1476/18 pipes [2] 1457/4 1457/13 piping [6] 1355/16 1381/13 1387/5 1397/24 1397/25 1428/23 place [6] 1349/12 1349/18 1376/11 1473/25 1496/9 1501/2 placed [3] 1376/20 1378/23 1380/19 places [1] 1424/25 placing [2] 1348/22 1380/1 Plaintiffs [7] 1309/18 1309/21 1310/2 1310/6 1310/9 1310/12 1310/15 planning [1] 1353/17 plans [1] 1362/4 plausible [1] 1441/4 played [1] 1353/24 PLC [5] 1311/19 1311/22 1312/4 1312/7 1312/10 please [33] 1315/5 1315/8 1354/3 1354/23 1354/25 1355/1 1356/1 1357/5 1365/5 1365/6 1365/10 1366/20 1366/24 1368/12 1370/4 1370/6 1371/17 1374/3 1388/5 1389/11 1391/14 1393/20 1395/12 1408/4 1414/8 1423/23 1427/3 1433/2 1461/5 1463/11 1489/24 1491/8 1500/13 pleased [2] 1361/4 1364/12 plot [1] 1424/9 plots [1] 1425/1	point [29] 1319/13 1319/13 1320/1 1329/4 1335/20 1340/3 1345/6 1348/15 1348/16 1348/19 1352/22 1353/4 1382/3 1387/14 1430/9 1436/20 1439/10 1439/12 1443/17 1461/19 1479/8 1479/11 1479/21 1480/23 1500/21 1500/22 1501/6 1502/6 1503/10 pointed [4] 1322/17 1326/7 1327/22 1331/6 pointer [2] 1440/24 1457/5 points [11] 1368/4 1396/11 1415/24 1416/1 1418/18 1419/19 1419/20 1420/1 1481/9 1481/10 1503/11 Polk [1] 1313/11 Pooladi [2] 1436/14 1436/18 poor [1] 1418/3 port [1] 1323/17 portion [7] 1374/9 1374/10 1374/11 1374/12 1413/21 1417/14 1463/12 portions [1] 1377/23 portrayed [1] 1322/13 ports [3] 1322/9 1323/14 1323/16 pose [1] 1360/5 posed [3] 1360/6 1380/8 1380/10 position [9] 1356/24 1380/20 1381/6 1442/15 1442/23 1444/14 1459/25 1460/9 1467/7 possibility [1] 1409/24 possible [5] 1351/9 1371/10 1439/19 1474/25 1503/5 possibly [3] 1452/19 1475/12 1487/12 post [6] 1309/23 1310/4 1310/23 1311/7 1311/15 1450/15 post-accident [1] 1450/15 postulates [1] 1493/12 potential [9] 1347/6 1347/15 1347/21 1369/17 1384/6 1446/3 1449/10 1449/14 1449/15 potentially [2] 1409/8 1481/6 power [2] 1359/21 1359/23 PowerPoint [3] 1324/22 1386/14 1451/13 Poydras [4] 1311/18 1312/13 1313/12 1313/18 preceded [1] 1376/11 preceding [2] 1468/20 1469/8 precise [1] 1320/19 precisely [1] 1324/3 predict [14] 1373/23 1373/24 1374/14 1374/15 1393/2 1393/6 1417/17 1417/25 1418/1 1421/15 1424/11 1424/19 1459/17 1473/6 predicted [9] 1339/5 1372/24 1406/20 1422/17 1422/18 1424/10 1425/24 1459/14 1494/1 predicting [2] 1424/23 1466/8 prediction [4] 1352/7 1390/3 1390/13 1420/19 predictions [3] 1389/8 1459/18 1464/17 preferred [1] 1371/6

P	primary [1] 1435/13 principal [3] 1330/25 1356/20 1356/25 principles [3] 1358/21 1358/24 1447/25 prior [11] 1316/16 1318/20 1325/6 1325/9 1325/22 1339/20 1350/4 1360/2 1396/14 1450/18 1451/9 probabilities [3] 1385/8 1437/21 1437/24 probability [7] 1385/11 1393/17 1405/6 1414/21 1414/22 1484/13 1499/16 probable [3] 1441/21 1441/22 1502/16 probably [24] 1321/1 1330/7 1330/25 1339/17 1343/11 1344/6 1345/2 1346/23 1351/15 1351/16 1394/12 1399/15 1411/13 1414/1 1429/12 1452/12 1460/9 1460/22 1484/22 1500/7 1503/8 1503/14 1503/15 1505/13 problem [10] 1318/10 1351/15 1354/18 1380/25 1400/15 1425/15 1429/20 1442/11 1479/19 1487/14 problems [2] 1421/25 1455/12 procedure [7] 1378/1 1394/9 1400/14 1487/14 1487/25 1488/6 1488/6 procedures [2] 1402/13 1402/15 proceed [4] 1315/12 1321/13 1433/14 1452/9 proceeded [1] 1479/9 proceeding [1] 1359/4 proceedings [3] 1313/23 1506/1 1506/8 process [9] 1352/4 1372/17 1391/20 1469/19 1470/7 1470/9 1470/10 1476/5 1476/6 processes [9] 1351/8 1435/15 1435/21 1436/2 1438/6 1438/8 1474/25 1475/8 1475/11 Proctor [1] 1310/3 produced [1] 1407/1 production [15] 1309/10 1311/18 1311/18 1311/21 1311/21 1312/3 1312/3 1312/6 1312/6 1312/9 1312/10 1409/19 1410/2 1410/5 1410/24 productivity [1] 1480/24 professional [1] 1357/9 profile [1] 1488/18 program [1] 1422/2 programs [4] 1357/1 1357/4 1359/11 1473/10 progress [1] 1458/22 promised [1] 1504/24 proper [6] 1376/19 1377/15 1378/25 1424/10 1429/14 1497/2 properly [1] 1363/2 properties [9] 1338/1 1360/19 1360/20 1394/2 1394/2 1420/5 1448/4 1482/12 1482/15 propose [1] 1390/15 proposes [3] 1415/4 1415/13 1416/23 proposing [1] 1363/3 proprietary [1] 1387/13 prorating [1] 1387/4 protecting [1] 1330/19 protocol [1] 1377/18 prove [1] 1475/4 provenance [1] 1342/19 provide [5] 1327/8 1370/10 1383/19 1454/12 1495/9 provided [9] 1353/21 1383/4 1383/5 1383/13 1383/16 1383/18 1384/4 1391/10 1453/17 provides [5] 1325/21 1325/22 1375/23 1479/20 1480/12 providing [2] 1364/10 1379/5 proxy [4] 1409/10 1439/22 1471/20	1473/20 psi [10] 1326/10 1326/10 1326/14 1403/6 1403/17 1403/17 1404/11 1445/24 1467/23 1467/23 PT [36] 1319/4 1319/16 1319/19 1320/2 1320/7 1320/13 1320/18 1393/8 1439/16 1443/22 1444/3 1444/4 1444/5 1474/21 1474/24 1475/2 1476/10 1476/13 1476/16 1476/18 1476/20 1476/24 1477/3 1477/12 1477/14 1477/17 1477/19 1477/19 1478/1 1478/13 1478/19 1478/20 1479/3 1479/6 1483/8 1498/14 PT-B [36] 1319/4 1319/16 1319/19 1320/2 1320/7 1320/13 1320/18 1393/8 1439/16 1443/22 1444/3 1444/4 1444/5 1474/21 1474/24 1475/2 1476/10 1476/13 1476/16 1476/18 1476/20 1476/24 1477/3 1477/12 1477/14 1477/17 1477/19 1477/19 1478/1 1478/13 1478/19 1478/20 1479/3 1479/6 1483/8 1498/14 pull [14] 1316/20 1322/23 1324/20 1332/9 1336/9 1350/5 1354/7 1438/10 1438/12 1438/13 1442/8 1450/2 1474/17 1479/13 pulls [1] 1464/22 pump [1] 1392/10 pumped [1] 1483/1 pumping [3] 1358/9 1391/7 1391/8 purport [1] 1416/15 purpose [6] 1320/16 1340/4 1340/8 1450/9 1495/6 1495/8 purposes [8] 1316/18 1320/16 1325/4 1340/5 1353/17 1470/5 1486/21 1497/3 push [1] 1371/4 pushed [1] 1493/2 pushing [4] 1342/9 1343/4 1343/11 1428/20 put [32] 1316/25 1317/5 1318/17 1319/1 1320/25 1322/4 1328/5 1333/17 1333/21 1334/16 1339/5 1359/10 1368/18 1385/21 1408/13 1409/23 1436/23 1438/14 1449/13 1454/7 1455/18 1465/23 1473/20 1486/23 1499/25 1500/21 1500/23 1501/5 1501/12 1501/13 1502/12 1502/15 putting [6] 1333/19 1345/9 1358/12 1402/7 1445/4 1471/10
	Q	
preordained [1] 1473/5 preparation [2] 1386/22 1386/25 prepare [5] 1367/15 1391/8 1391/11 1407/10 1418/4 prepared [7] 1331/2 1386/14 1388/21 1389/16 1407/11 1423/22 1495/4 PRESCOTT [1] 1313/4 present [2] 1323/10 1460/22 presentation [12] 1316/24 1317/6 1324/18 1324/22 1327/5 1327/23 1332/17 1336/22 1339/22 1386/14 1386/20 1452/21 presentations [2] 1335/19 1361/22 presented [17] 1324/23 1335/1 1335/16 1337/5 1339/19 1339/19 1339/21 1362/21 1363/14 1374/24 1382/18 1406/25 1407/14 1422/3 1422/21 1424/8 1461/17 presenting [2] 1375/3 1382/2 presents [1] 1424/9 presided [1] 1333/25 president [2] 1353/16 1387/25 press [8] 1341/3 1344/11 1345/7 1349/20 1449/24 1463/2 1467/16 1495/9 pressure [143] 1315/21 1316/6 1316/18 1316/19 1318/15 1318/21 1318/24 1319/4 1319/5 1319/5 1319/7 1319/8 1319/12 1319/12 1319/16 1319/19 1319/19 1319/24 1319/25 1320/1 1320/3 1320/4 1320/7 1320/10 1320/21 1320/22 1321/19 1321/20 1326/4 1326/8 1326/9 1326/13 1326/18 1326/21 1327/1 1327/3 1333/1 1337/22 1338/3 1344/24 1345/4 1345/4 1348/18 1357/21 1363/12 1368/2 1368/3 1368/7 1368/8 1368/8 1368/20 1368/20 1368/21 1368/22 1368/25 1369/14 1370/8 1370/11 1370/21 1370/22 1371/20 1371/21 1371/22 1383/12 1383/13 1391/7 1391/8 1392/5 1392/13 1392/14 1392/14 1392/15 1392/18 1393/8 1393/11 1395/9 1395/10 1396/1 1396/2 1396/10 1396/19 1397/2 1397/9 1397/23 1401/15 1401/17 1401/17 1402/6 1402/6 1402/12 1402/24 1403/2 1403/4 1403/6 1403/7 1403/9 1403/11 1403/14 1403/14 1403/24 1404/10 1404/11 1407/17 1407/23 1407/25 1408/9 1409/5 1409/6 1415/22 1416/5 1419/3 1428/19 1439/16 1443/7 1443/12 1443/14 1443/18 1443/19 1443/23 1444/5 1445/23 1448/15 1449/1 1455/24 1469/15 1472/24 1476/25 1477/3 1477/6 1477/7 1477/12 1477/14 1477/17 1477/19 1478/1 1478/20 1479/3 1481/1 1481/1 1483/8 1483/15 1483/18 1500/5 pressures [20] 1315/24 1317/24 1318/13 1320/23 1327/15 1368/11 1370/11 1372/10 1372/11 1374/8 1374/8 1374/13 1392/20 1392/21 1392/22 1396/12 1426/23 1468/23 1472/2 1490/5 pretty [6] 1388/17 1441/14 1485/21 1493/19 1503/13 1503/13 prevented [1] 1480/25 previous [3] 1398/17 1405/1 1468/22 previously [4] 1315/7 1383/8 1445/1 1467/11 primarily [1] 1331/24	qualified [2] 1465/11 1465/13 quantifiable [2] 1323/23 1324/12 quantify [4] 1324/3 1450/16 1485/22 1501/7 quantitative [2] 1333/9 1454/3 quantitatively [4] 1324/2 1417/24 1418/1 1421/15 question [21] 1317/9 1335/18 1354/18 1380/9 1380/10 1388/15 1410/9 1414/12 1423/3 1423/9 1436/9 1445/6 1468/13 1473/14 1479/21 1481/22 1490/25 1491/2 1492/9 1496/11 1496/23 questioned [2] 1378/14 1389/23 questions [9] 1348/7 1364/18 1411/4 1431/14 1478/15 1494/11 1494/21 1497/8 1497/19 quick [3] 1340/25 1463/10 1505/6 quickly [5] 1360/8 1409/12 1409/13 1410/4 1410/23 quit [1] 1394/9 quite [9] 1326/17 1348/13 1360/7	

Q	1467/10 1468/3 Ratzell [13] 1336/13 1336/22 1337/10 1337/17 1338/20 1351/22 1383/4 1407/11 1451/25 1453/25 1457/2 1460/4 1500/1 Ratzell's [3] 1338/5 1339/22 1460/9 RE [2] 1309/4 1309/7 reach [2] 1439/7 1440/22 reactor [7] 1358/4 1358/7 1358/9 1358/14 1358/15 1358/17 1359/6 read [25] 1320/22 1337/3 1354/15 1379/4 1388/2 1389/4 1389/21 1396/3 1396/17 1398/1 1398/18 1402/7 1413/9 1434/11 1434/15 1443/20 1450/5 1458/1 1458/4 1463/8 1463/9 1463/11 1468/1 1475/15 1481/15 reading [6] 1326/21 1392/6 1392/14 1402/6 1402/8 1450/22 readings [6] 1315/21 1320/7 1327/1 1327/3 1478/16 1478/21 reads [3] 1319/24 1319/25 1477/3 ready [1] 1329/17 real [2] 1318/14 1360/6 realistic [1] 1481/4 realize [1] 1377/8 really [12] 1315/24 1316/13 1318/25 1320/2 1329/9 1336/3 1343/14 1392/24 1401/11 1417/11 1452/10 1503/23 reason [7] 1340/8 1388/15 1428/25 1435/13 1454/7 1457/6 1494/17 reasonable [10] 1392/3 1400/4 1405/7 1420/2 1425/9 1441/10 1473/19 1475/10 1485/21 1486/14 rebuttal [12] 1365/3 1365/11 1365/12 1406/22 1413/21 1414/23 1416/10 1430/15 1474/6 1474/7 1474/18 1474/20 rebutted [1] 1431/1 rec [1] 1376/25 recalculated [1] 1375/25 recall [43] 1315/22 1324/10 1331/4 1332/16 1332/18 1332/21 1332/23 1337/17 1339/19 1339/25 1340/17 1341/21 1343/14 1343/17 1350/7 1350/10 1377/18 1384/15 1399/2 1415/2 1451/10 1452/2 1452/4 1452/17 1460/8 1460/21 1461/15 1461/16 1462/14 1469/1 1470/11 1489/6 1491/4 1491/5 1493/16 1493/19 1494/22 1495/6 1496/13 1497/11 1497/20 1499/19 1500/17 recalling [1] 1377/25 received [5] 1328/24 1361/9 1367/5 1380/1 1504/17 receiving [1] 1350/7 recent [1] 1330/8 recently [1] 1412/15 recess [3] 1414/4 1414/6 1504/2 recognize [6] 1329/24 1334/19 1348/5 1348/8 1452/22 1460/12 recollection [3] 1332/7 1333/14 1341/23 recommendation [1] 1336/4 recommended [2] 1336/7 1346/19 record [7] 1315/9 1354/4 1377/17 1379/7 1428/10 1436/19 1506/8 recorded [1] 1313/23 recovered [5] 1349/23 1350/1 1350/4 1350/14 1383/22 rectangle [1] 1428/19 red [3] 1370/9 1494/9 1503/2 redacted [1] 1332/13 redacting [1] 1505/21 redid [3] 1384/3 1408/19 1452/15	redirect [5] 1353/6 1353/7 1494/14 1494/15 1494/20 redo [1] 1467/13 redone [1] 1375/14 reduce [3] 1349/17 1399/10 1415/12 reduced [6] 1370/20 1370/21 1371/22 1373/17 1408/13 1415/12 reduces [1] 1408/14 reducing [1] 1397/12 reduction [4] 1382/18 1382/21 1397/6 1408/3 redundant [1] 1375/1 refer [1] 1340/11 reference [5] 1325/4 1380/6 1410/15 1446/6 1495/1 references [3] 1371/1 1379/4 1431/6 referred [2] 1343/6 1351/19 referring [6] 1316/14 1333/21 1350/13 1410/14 1443/22 1445/11 refers [2] 1337/19 1342/16 refine [2] 1375/13 1467/22 refinements [1] 1467/24 reflect [2] 1332/19 1476/22 reflected [5] 1327/5 1334/13 1343/13 1470/6 1471/16 reflects [2] 1319/22 1468/15 reformulate [1] 1391/3 refresh [2] 1332/6 1333/14 REGAN [12] 1311/22 1315/16 1354/12 1377/9 1378/14 1379/18 1418/18 1433/17 1498/15 1499/5 1499/18 1500/15 regard [2] 1495/12 1500/8 regarding [13] 1376/23 1388/2 1414/14 1422/21 1424/5 1431/14 1431/16 1495/19 1497/2 1497/8 1497/19 1497/25 1498/8 regime [3] 1390/9 1458/21 1458/24 region [1] 1350/22 regretted [1] 1470/14 regular [5] 1367/5 1412/17 1416/22 1488/9 1488/11 Regulatory [2] 1359/1 1359/5 reinforces [1] 1333/15 relate [3] 1356/6 1356/12 1357/10 related [3] 1316/6 1417/7 1497/13 relates [1] 1355/7 relationship [3] 1337/21 1338/2 1344/22 relative [2] 1453/20 1477/13 relatively [1] 1392/6 relayed [1] 1401/23 release [7] 1341/3 1344/11 1345/7 1349/20 1463/2 1467/16 1495/10 released [7] 1358/6 1366/4 1366/16 1434/17 1434/24 1435/5 1464/3 releasing [1] 1392/15 relevant [4] 1357/7 1357/16 1377/23 1410/13 reliable [6] 1315/24 1384/19 1412/5 1433/7 1455/11 1498/14 reliance [3] 1376/23 1377/4 1378/15 relied [5] 1376/24 1377/14 1379/20 1379/22 1491/1 relied-upon [2] 1376/24 1377/14 relies [2] 1378/2 1479/3 rely [10] 1320/6 1377/16 1377/19 1379/10 1382/9 1383/12 1383/14 1470/1 1485/12 1494/24 relying [7] 1377/12 1379/12 1379/15 1379/16 1476/8 1489/21 1489/22 remained [1] 1338/22 remember [2] 1349/24 1496/4 repeat [4] 1379/19 1468/13 1473/14
R		
Rafferty [1] 1310/3 raise [1] 1445/16 raised [1] 1382/15 raises [1] 1357/4 ram [12] 1336/25 1368/5 1368/5 1387/5 1391/19 1391/20 1393/4 1393/4 1397/4 1397/4 1399/8 1483/9 rams [5] 1317/15 1396/13 1399/7 1483/9 1483/14 range [34] 1325/13 1325/14 1326/15 1326/17 1335/9 1335/10 1335/16 1383/9 1383/10 1385/3 1385/20 1399/3 1399/15 1411/23 1417/19 1417/21 1434/3 1437/13 1437/15 1438/2 1438/5 1451/21 1451/22 1452/1 1452/4 1452/14 1479/24 1493/19 1493/24 1494/1 1501/22 1501/24 1502/2 1502/10 ranges [3] 1385/21 1420/6 1452/13 ranging [1] 1453/5 rapid [1] 1408/11 rapidly [1] 1409/20 rate [119] 1317/23 1320/7 1320/20 1320/24 1321/4 1321/8 1321/16 1321/21 1323/7 1323/11 1324/13 1325/6 1326/11 1328/10 1328/15 1332/1 1332/17 1332/19 1333/11 1335/1 1335/6 1335/17 1339/13 1340/4 1340/9 1341/9 1351/7 1351/9 1352/18 1362/9 1363/24 1364/7 1366/5 1366/9 1366/12 1367/1 1367/12 1369/4 1370/12 1370/19 1374/14 1375/8 1378/24 1380/21 1380/21 1385/12 1386/21 1386/23 1387/1 1387/3 1387/15 1388/3 1389/8 1390/16 1390/19 1390/19 1391/17 1392/10 1393/15 1393/23 1397/14 1397/15 1399/2 1399/15 1399/19 1401/3 1401/25 1405/4 1407/21 1412/1 1412/2 1414/25 1415/20 1417/25 1418/2 1420/9 1420/10 1420/18 1426/9 1426/12 1427/12 1432/16 1438/18 1439/9 1441/24 1443/1 1446/13 1449/19 1450/10 1450/16 1454/12 1454/22 1457/21 1459/23 1460/6 1460/19 1463/23 1463/23 1463/24 1464/6 1464/14 1464/17 1464/23 1467/15 1468/10 1468/19 1469/21 1472/3 1473/6 1474/3 1480/13 1481/1 1481/20 1485/24 1492/25 1495/13 1496/20 1496/21 1499/3 rates [43] 1327/25 1328/4 1349/1 1367/24 1367/25 1368/15 1369/24 1370/1 1371/12 1372/15 1383/14 1383/15 1387/4 1387/10 1395/5 1396/14 1396/20 1399/6 1400/25 1401/9 1415/24 1416/1 1417/17 1417/19 1417/21 1421/16 1422/18 1422/23 1425/22 1425/24 1427/9 1427/11 1430/6 1430/10 1431/16 1432/9 1469/20 1480/4 1480/5 1493/12 1493/16 1494/1 1496/19 rather [4] 1340/20 1459/15 1467/14 1492/25 Ratzel [5] 1463/21 1464/4 1467/2		

R		
<p>repeat... [1] 1481/22</p> <p>repeated [2] 1359/12 1382/17</p> <p>report [115] 1323/1 1348/4 1365/2 1365/3 1365/8 1365/9 1365/11 1365/12 1365/19 1365/19 1375/19 1376/9 1377/22 1378/3 1378/8 1379/4 1379/7 1379/8 1380/4 1381/7 1382/16 1382/16 1394/4 1407/12 1408/1 1413/5 1413/6 1413/10 1414/24 1415/2 1416/9 1416/13 1416/16 1416/18 1418/13 1418/18 1418/20 1418/21 1418/23 1420/25 1421/5 1421/11 1421/22 1422/8 1422/8 1422/10 1422/25 1423/2 1423/12 1423/25 1424/3 1424/16 1429/22 1430/1 1430/3 1430/5 1430/14 1430/15 1430/23 1431/1 1431/2 1431/8 1431/10 1431/22 1435/5 1435/9 1450/4 1450/6 1451/25 1452/25 1455/23 1457/2 1457/25 1463/21 1464/1 1464/4 1464/4 1464/11 1464/12 1466/19 1467/4 1467/6 1467/11 1467/13 1468/5 1468/8 1469/4 1469/10 1470/2 1470/4 1470/6 1470/12 1470/18 1471/16 1473/1 1473/11 1473/15 1474/6 1474/6 1474/7 1474/9 1474/18 1474/20 1475/16 1478/12 1481/18 1488/19 1493/11 1493/21 1494/22 1494/24 1495/1 1495/7 1495/11 1505/21</p> <p>report you [1] 1473/11</p> <p>reported [3] 1332/3 1449/24 1468/23</p> <p>Reporter [3] 1313/18 1506/4 1506/13</p> <p>reporting [1] 1389/16</p> <p>reports [8] 1365/13 1365/17 1378/12 1429/16 1432/5 1452/17 1469/25 1481/15</p> <p>represent [7] 1381/14 1419/11 1428/18 1465/9 1468/3 1468/7 1502/15</p> <p>representation [6] 1323/1 1336/6 1367/21 1425/9 1459/25 1503/2</p> <p>representations [1] 1371/9</p> <p>representative [2] 1343/1 1390/22</p> <p>represented [10] 1317/19 1337/10 1349/1 1368/19 1390/4 1419/1 1427/19 1428/21 1460/4 1487/1</p> <p>representing [2] 1381/15 1427/15</p> <p>represents [5] 1397/6 1429/16 1460/9 1468/10 1468/14</p> <p>reproduce [10] 1363/10 1402/2 1424/2 1426/17 1489/25 1490/2 1490/6 1490/9 1490/10 1490/17</p> <p>reproduced [1] 1429/9</p> <p>reputation [1] 1385/18</p> <p>request [4] 1331/15 1362/15 1362/24 1499/23</p> <p>required [4] 1333/18 1392/21 1402/24 1469/15</p> <p>requirement [2] 1373/25 1378/9</p> <p>requires [1] 1445/10</p> <p>researchers [1] 1450/17</p> <p>reservoir [38] 1319/5 1319/7 1319/8 1334/5 1344/24 1345/4 1348/17 1351/9 1366/4 1366/17 1397/11 1404/25 1407/9 1407/17 1407/23 1407/25 1408/3 1408/9 1409/18 1409/21 1409/22 1410/15 1410/25 1445/16 1445/21 1445/23 1449/4 1450/20 1472/21 1472/24 1473/4 1476/18 1477/7 1477/16 1477/20 1478/8 1480/25 1481/3</p> <p>resistance [36] 1325/18 1337/19 1337/20 1368/22 1370/10 1371/3</p>	<p>1374/8 1374/15 1384/10 1392/12 1392/16 1392/17 1392/24 1397/6 1398/15 1400/1 1408/14 1416/3 1431/24 1443/18 1444/1 1444/2 1444/3 1456/22 1457/3 1477/8 1477/8 1477/13 1477/16 1477/21 1478/2 1478/4 1478/5 1481/5 1482/17 1483/11</p> <p>resistances [18] 1347/2 1370/9 1370/12 1370/25 1371/23 1373/25 1374/1 1374/2 1374/16 1379/24 1446/2 1446/10 1446/15 1447/2 1457/12 1457/19 1457/20 1473/2</p> <p>resistant [2] 1478/9 1478/9</p> <p>resistance [1] 1393/1</p> <p>resolved [1] 1505/22</p> <p>resources [2] 1311/10 1321/13</p> <p>respect [28] 1316/9 1318/13 1325/25 1327/12 1330/23 1331/23 1332/24 1334/25 1336/3 1336/24 1337/5 1340/14 1341/17 1342/14 1344/11 1349/11 1349/20 1350/1 1350/8 1352/17 1354/13 1437/15 1438/1 1451/6 1481/19 1486/6 1489/5 1505/21</p> <p>respond [7] 1399/23 1400/3 1400/10 1406/15 1416/5 1416/12 1418/13</p> <p>responded [6] 1329/22 1330/1 1351/14 1351/16 1351/17 1406/22</p> <p>responding [1] 1332/16</p> <p>responds [1] 1418/21</p> <p>response [25] 1329/23 1332/15 1361/7 1361/12 1361/16 1361/24 1362/11 1362/18 1364/4 1364/5 1364/11 1386/3 1387/14 1387/16 1388/1 1395/21 1401/10 1401/11 1408/19 1412/16 1426/21 1478/18 1480/13 1495/12 1497/17</p> <p>responses [1] 1413/24</p> <p>responsibility [1] 1357/1</p> <p>rest [2] 1340/2 1397/8</p> <p>restrict [1] 1339/9</p> <p>restriction [1] 1408/17</p> <p>restrictions [15] 1316/11 1316/22 1316/23 1317/1 1317/10 1317/11 1317/14 1317/15 1317/16 1317/20 1317/21 1317/21 1318/1 1318/8 1345/8</p> <p>result [12] 1378/18 1380/1 1380/24 1383/9 1410/5 1410/24 1413/8 1417/21 1422/12 1424/17 1459/20 1496/19</p> <p>resulted [4] 1378/24 1408/2 1420/6 1450/10</p> <p>results [27] 1327/9 1330/14 1330/24 1333/18 1338/10 1361/1 1361/2 1363/8 1363/15 1372/19 1374/18 1375/1 1378/5 1381/7 1381/9 1382/5 1398/17 1422/6 1422/20 1425/1 1453/18 1467/20 1470/2 1479/5 1490/7 1490/9 1496/20</p> <p>resume [1] 1414/9</p> <p>retained [1] 1421/12</p> <p>returned [1] 1483/19</p> <p>reveal [1] 1444/24</p> <p>revealed [1] 1444/13</p> <p>review [10] 1362/4 1387/17 1387/21 1388/19 1396/5 1413/1 1426/25 1442/20 1493/21 1505/16</p> <p>reviewed [11] 1330/7 1386/13 1387/20 1387/23 1388/8 1413/9 1450/7 1451/8 1451/24 1469/5 1500/10</p> <p>reviewing [4] 1381/10 1436/18 1453/15 1493/11</p> <p>reviews [1] 1467/4</p> <p>rewrote [1] 1481/12</p> <p>RICHARD [3] 1311/14 1313/8 1387/24</p>	<p>Richeson [1] 1313/11</p> <p>ridiculous [2] 1406/21 1461/24</p> <p>RIG [1] 1309/4</p> <p>right [90] 1315/5 1317/1 1317/7 1317/19 1319/12 1319/12 1319/19 1319/23 1320/16 1320/20 1321/21 1322/14 1323/18 1323/19 1324/1 1324/14 1325/1 1325/13 1325/14 1325/17 1327/21 1328/1 1329/5 1338/14 1338/16 1339/7 1339/10 1341/25 1343/2 1343/7 1348/15 1352/2 1353/19 1354/21 1364/17 1365/21 1367/22 1368/6 1377/25 1378/1 1382/10 1389/4 1391/19 1401/5 1406/23 1406/25 1414/8 1415/14 1418/24 1421/20 1426/13 1432/4 1443/25 1445/12 1451/19 1453/11 1455/3 1455/9 1456/8 1456/22 1457/4 1458/14 1461/15 1467/24 1476/3 1477/11 1482/24 1484/1 1484/24 1487/10 1490/10 1490/13 1490/14 1491/24 1492/15 1492/20 1492/23 1493/9 1493/9 1493/15 1500/24 1501/2 1501/3 1501/14 1501/20 1502/5 1502/11 1503/19 1504/16 1505/5</p> <p>right-hand [1] 1490/10</p> <p>rigor [1] 1488/7</p> <p>ring [1] 1452/5</p> <p>rise [6] 1315/4 1407/20 1407/21 1414/5 1414/7 1505/25</p> <p>riser [48] 1317/12 1320/13 1322/8 1345/10 1348/21 1408/16 1408/18 1408/20 1416/20 1417/2 1417/6 1417/9 1417/10 1417/10 1417/11 1417/12 1417/13 1417/15 1419/1 1422/5 1422/6 1422/23 1424/8 1424/13 1424/20 1425/15 1426/3 1426/3 1426/5 1428/17 1429/19 1430/6 1430/10 1431/16 1444/24 1470/23 1471/13 1471/13 1473/3 1476/1 1476/5 1476/22 1488/18 1488/20 1488/22 1488/25 1500/24 1501/13</p> <p>riser's [1] 1488/13</p> <p>rises [1] 1357/21</p> <p>rising [2] 1417/3 1417/4</p> <p>RMR [4] 1313/18 1506/4 1506/12 1506/12</p> <p>road [1] 1355/2</p> <p>ROBERT [2] 1312/6 1312/9</p> <p>ROBERTS [1] 1312/16</p> <p>ROBIN [1] 1310/10</p> <p>role [1] 1340/1</p> <p>Ron [3] 1351/19 1351/20 1351/21</p> <p>RONALD [2] 1354/1 1354/5</p> <p>Room [1] 1313/18</p> <p>Rouge [1] 1310/24</p> <p>round [8] 1406/5 1406/7 1406/7 1427/15 1428/25 1429/1 1485/15 1485/17</p> <p>routines [1] 1469/12</p> <p>ROV [1] 1485/13</p> <p>Roy [2] 1309/21 1309/22</p> <p>rubber [2] 1402/16 1404/2</p> <p>rule [2] 1354/19 1378/10</p> <p>Rule 703 [1] 1378/10</p> <p>ruled [1] 1379/3</p> <p>run [2] 1359/24 1420/11</p> <p>running [2] 1421/4 1439/16</p> <p>runs [1] 1353/17</p> <p>rush [4] 1454/15 1499/19 1499/21 1500/6</p> <p>rushed [1] 1454/17</p>
		S
		s/Jodi [1] 1506/12

S	1463/14 1469/12 1469/14 scale [1] 1490/7 scan [1] 1350/21 Schell [1] 1313/11 schematic [1] 1319/3 scientist [1] 1330/18 scientists [7] 1333/10 1333/20 1338/21 1339/5 1339/11 1363/10 1498/19 scope [2] 1418/12 1418/15 SCOTT [3] 1311/12 1354/23 1494/19 screen [3] 1342/21 1438/17 1480/23 sea [5] 1319/12 1333/3 1368/4 1392/15 1477/6 seabed [2] 1349/21 1393/11 seal [3] 1402/17 1402/18 1404/2 SEAN [1] 1313/5 seated [2] 1315/5 1414/8 second [14] 1324/23 1332/22 1340/8 1344/8 1443/5 1443/17 1446/1 1465/17 1465/25 1467/12 1468/5 1469/12 1473/12 1473/16 second-highest [2] 1465/17 1465/25 secretary [12] 1328/9 1328/14 1331/16 1331/18 1336/25 1339/23 1340/1 1340/14 1341/16 1342/5 1460/2 1461/20 Secretary Chu [2] 1328/9 1328/14 section [7] 1309/5 1311/10 1419/4 1419/4 1419/22 1422/9 1469/9 sectional [1] 1350/22 sections [1] 1419/1 see [46] 1317/1 1319/5 1323/18 1325/7 1329/1 1330/21 1332/6 1335/9 1335/10 1335/10 1335/11 1340/11 1342/11 1342/12 1350/25 1368/5 1379/13 1387/16 1395/10 1397/9 1406/3 1408/25 1410/15 1415/25 1451/14 1453/4 1463/5 1463/8 1466/18 1468/9 1469/7 1469/17 1477/11 1477/11 1477/14 1477/17 1481/12 1481/12 1485/24 1486/2 1486/4 1486/22 1487/12 1489/19 1504/3 1505/24 seem [5] 1372/21 1400/4 1441/10 1452/17 1495/21 seemed [8] 1361/3 1364/12 1386/7 1395/20 1409/1 1409/20 1461/25 1468/7 seems [9] 1350/23 1379/15 1405/2 1405/25 1412/11 1440/19 1457/7 1475/10 1498/20 seen [9] 1342/12 1350/12 1386/12 1389/14 1390/17 1395/14 1398/5 1401/4 1448/3 send [1] 1370/18 senior [1] 1386/2 sense [10] 1345/15 1350/11 1359/14 1379/16 1379/20 1406/22 1440/17 1462/23 1462/24 1467/7 sensitive [3] 1375/15 1424/17 1488/24 sensitivities [1] 1382/13 sensitivity [7] 1383/9 1421/3 1422/12 1422/16 1422/17 1422/21 1447/15 sent [4] 1332/11 1442/19 1479/15 1480/9 sentence [8] 1330/13 1420/25 1431/8 1449/15 1463/5 1474/20 1474/22 1474/23 separate [2] 1379/17 1412/24 separated [1] 1380/23 separation [2] 1496/11 1497/3 September [4] 1349/23 1349/25 1350/4 1480/10 September 20th, and [1] 1350/4	series [1] 1498/2 Services [2] 1313/3 1313/8 session [3] 1309/14 1315/1 1384/4 set [8] 1330/24 1395/2 1430/3 1431/10 1456/5 1470/8 1479/23 1483/20 setter [1] 1330/25 settle [1] 1341/18 several [1] 1318/24 shaped [2] 1427/15 1428/18 share [5] 1364/3 1387/13 1387/15 1401/19 1408/22 shared [1] 1364/5 she [12] 1329/8 1350/15 1350/20 1350/20 1351/2 1351/6 1351/12 1379/4 1388/24 1388/25 1390/3 1390/3 she's [1] 1350/17 shift [1] 1316/3 ship [2] 1326/25 1370/18 shore [1] 1383/22 short [2] 1419/1 1505/22 Shot [1] 1400/3 shots [1] 1470/24 should [32] 1316/2 1320/19 1331/2 1334/14 1337/3 1339/9 1351/25 1352/2 1379/1 1382/19 1394/12 1399/10 1400/9 1406/19 1428/13 1438/2 1461/13 1461/20 1462/21 1466/14 1467/17 1467/18 1472/11 1486/25 1490/14 1494/3 1497/6 1499/2 1500/7 1500/21 1500/23 1501/5 shouldn't [2] 1352/5 1400/7 show [17] 1324/22 1332/6 1368/16 1374/22 1378/21 1378/22 1385/19 1418/19 1421/16 1432/13 1470/15 1479/4 1487/18 1489/8 1489/11 1489/11 1490/20 showed [7] 1363/19 1372/24 1372/25 1380/19 1457/19 1464/8 1464/9 showing [3] 1396/9 1397/2 1408/8 shown [6] 1322/6 1323/16 1323/17 1460/12 1489/16 1498/13 shows [5] 1385/19 1409/4 1422/19 1425/2 1425/17 Shushan [5] 1377/3 1377/17 1378/6 1379/3 1379/6 shut [7] 1336/1 1372/5 1392/21 1392/23 1450/18 1451/2 1467/15 shut-in [2] 1450/18 1467/15 shutting [1] 1325/6 side [5] 1317/1 1320/4 1437/9 1437/10 1490/11 sides [2] 1315/21 1317/8 significant [19] 1323/24 1324/4 1338/22 1347/10 1349/6 1358/16 1360/14 1376/5 1392/19 1401/13 1405/20 1449/23 1473/12 1473/16 1473/24 1474/4 1475/3 1476/8 1482/4 significantly [3] 1323/24 1436/8 1479/12 Simcox [5] 1313/18 1313/20 1506/4 1506/12 1506/12 similar [19] 1357/19 1374/16 1375/2 1378/24 1380/1 1380/21 1380/24 1381/9 1394/21 1394/23 1394/25 1407/1 1416/17 1417/20 1422/6 1426/20 1426/22 1459/18 1474/16 similarly [1] 1478/1 simple [5] 1374/7 1387/11 1419/21 1420/4 1426/17 simplification [1] 1419/6 simply [2] 1378/4 1390/8 simulated [1] 1397/24 simulating [1] 1429/10 since [16] 1329/10 1375/12 1378/25
---	--	--

S		
<p>since... [13] 1387/11 1387/19 1394/15 1404/23 1406/7 1406/24 1407/16 1413/9 1425/14 1452/7 1460/22 1470/20 1481/16 SINCLAIR [1] 1310/19 single [15] 1345/23 1346/3 1357/20 1368/17 1375/19 1425/25 1434/4 1443/18 1443/23 1469/24 1470/7 1488/9 1496/17 1496/21 1497/5 single-day [2] 1345/23 1346/3 single-peak [1] 1488/9 single-phase [4] 1357/20 1368/17 1375/19 1496/21 single-stage [3] 1469/24 1470/7 1496/17 sir [5] 1330/25 1343/23 1353/9 1461/8 1503/19 site [2] 1412/23 1412/24 situation [3] 1316/6 1478/4 1478/8 six [13] 1334/14 1335/1 1353/17 1375/7 1375/9 1385/10 1409/9 1465/5 1465/20 1473/21 1475/20 1475/22 1475/23 sixth [2] 1444/23 1466/16 size [2] 1489/5 1489/22 sizes [1] 1419/12 skeptical [9] 1478/20 1478/22 1478/23 1478/23 1478/24 1479/1 1479/6 1479/7 1479/9 skepticism [1] 1478/13 skewed [1] 1414/19 skin [1] 1317/20 skip [2] 1401/5 1447/12 skirt [31] 1322/10 1323/5 1323/9 1323/14 1323/20 1324/6 1325/18 1326/3 1326/6 1326/23 1402/16 1402/18 1404/21 1405/11 1405/15 1405/19 1405/21 1406/1 1406/6 1406/13 1406/14 1406/17 1407/2 1452/9 1452/9 1452/14 1453/9 1485/16 1485/22 1486/7 1492/16 sliced [1] 1323/18 slide [2] 1338/6 1502/4 slides [3] 1338/5 1460/12 1460/15 slightly [3] 1363/17 1371/20 1452/1 slipped [1] 1444/14 sloppiness [1] 1334/22 slow [1] 1415/7 slowly [4] 1372/12 1397/12 1415/4 1415/6 slug [9] 1425/12 1425/13 1425/13 1487/3 1487/4 1487/6 1487/9 1487/12 1488/10 slugs [2] 1425/8 1425/14 small [22] 1326/21 1372/9 1376/2 1381/15 1385/8 1385/11 1393/18 1399/24 1405/6 1406/3 1411/19 1414/21 1414/22 1415/11 1424/14 1425/3 1425/4 1452/13 1452/14 1480/4 1484/13 1499/16 smaller [2] 1339/9 1381/15 smallest [1] 1409/14 Smart [1] 1456/16 SMITH [1] 1313/4 SNL [1] 1469/12 so [178] 1315/24 1316/4 1316/20 1318/17 1322/2 1322/23 1323/11 1323/18 1324/12 1326/17 1326/18 1326/20 1328/13 1329/7 1331/8 1332/4 1333/20 1333/25 1335/16 1335/22 1337/1 1337/10 1338/16 1341/18 1343/4 1344/11 1345/16 1346/3 1347/12 1349/16 1353/1 1355/19</p>	<p>1357/22 1359/14 1359/22 1359/25 1360/8 1361/4 1361/19 1363/9 1368/7 1369/12 1370/11 1371/21 1372/2 1372/11 1372/12 1373/25 1374/12 1375/21 1376/4 1377/18 1380/8 1380/12 1381/18 1381/20 1383/6 1383/8 1385/5 1385/20 1392/2 1392/9 1392/10 1392/23 1393/1 1394/12 1394/16 1397/5 1400/7 1400/21 1401/4 1401/17 1402/3 1402/12 1402/19 1402/23 1403/1 1403/11 1404/2 1404/6 1404/10 1404/12 1404/19 1405/1 1405/19 1406/5 1407/3 1409/6 1409/7 1410/2 1411/20 1413/7 1416/17 1417/6 1417/13 1417/16 1417/18 1419/2 1419/7 1419/12 1420/8 1420/14 1420/20 1422/15 1423/20 1424/21 1424/21 1425/8 1425/20 1425/22 1426/2 1427/14 1428/8 1429/4 1429/9 1429/15 1432/16 1434/3 1435/21 1436/9 1436/17 1436/23 1436/25 1437/9 1439/13 1439/17 1439/25 1441/4 1441/11 1441/16 1442/10 1442/22 1443/4 1443/18 1445/20 1446/9 1448/2 1448/25 1449/17 1449/25 1453/15 1457/21 1458/16 1459/3 1462/7 1462/13 1470/16 1471/9 1471/14 1472/9 1472/13 1473/25 1474/11 1481/12 1481/13 1482/5 1489/21 1490/16 1492/6 1492/20 1493/15 1493/23 1496/23 1497/5 1498/4 1498/8 1499/11 1499/24 1500/3 1500/24 1501/2 1501/5 1501/12 1501/15 1502/2 1502/14 1503/23 1504/22 software [1] 1313/24 Soileau [1] 1310/12 solely [3] 1318/6 1436/6 1436/11 solid [2] 1355/19 1358/1 solids [1] 1355/19 solution [6] 1394/7 1439/17 1440/16 1441/4 1441/5 1503/5 solving [1] 1380/24 some [80] 1317/7 1317/25 1318/5 1325/21 1326/3 1326/20 1328/25 1333/16 1334/15 1334/24 1335/22 1335/23 1336/9 1337/5 1343/10 1345/18 1357/15 1361/14 1362/14 1370/15 1370/17 1372/19 1373/2 1373/16 1376/14 1384/10 1384/23 1384/24 1384/24 1387/20 1392/4 1392/11 1392/25 1396/15 1398/23 1400/17 1401/4 1405/11 1405/12 1405/13 1407/24 1410/11 1411/14 1411/19 1411/19 1413/13 1413/15 1418/14 1419/7 1419/8 1419/21 1420/10 1420/14 1420/15 1422/20 1426/12 1428/18 1430/9 1447/22 1448/21 1448/21 1449/25 1451/5 1460/23 1461/17 1461/19 1467/13 1470/2 1475/11 1479/5 1482/6 1488/19 1494/16 1497/19 1498/3 1498/13 1498/23 1498/23 1503/6 1503/11 somebody [2] 1385/18 1388/13 somehow [1] 1378/7 someone [2] 1347/19 1486/23 someplace [1] 1372/10 something [21] 1315/19 1319/7 1320/19 1330/18 1332/21 1344/19 1349/15 1352/4 1355/22 1357/25 1370/23 1373/8 1381/1 1384/15 1400/22 1414/4 1421/6 1430/18 1484/8 1487/15 1489/9 somewhere [6] 1346/6 1401/7 1439/1</p>	<p>1441/6 1492/23 1502/17 soon [4] 1331/2 1331/5 1401/15 1504/24 sooner [1] 1475/13 sorry [12] 1354/22 1388/11 1423/5 1428/2 1431/11 1454/6 1472/11 1481/22 1495/19 1499/5 1505/11 1505/13 sort [5] 1337/21 1371/5 1381/17 1441/9 1488/24 sound [3] 1420/2 1447/15 1493/20 sounds [6] 1423/11 1432/4 1434/5 1473/18 1476/2 1486/14 source [3] 1362/4 1395/24 1475/1 sources [1] 1460/23 South [3] 1310/4 1310/12 1312/3 spacing [1] 1376/6 speaking [4] 1332/5 1340/22 1340/23 1447/6 specializing [1] 1356/9 specialty [1] 1356/14 specific [2] 1335/4 1418/14 specifically [3] 1349/3 1378/2 1378/15 specify [1] 1385/20 spelled [1] 1354/6 spelling [2] 1315/9 1354/4 spend [2] 1321/13 1361/12 spends [1] 1418/17 spill [3] 1309/4 1332/15 1348/12 split [1] 1445/9 spoke [2] 1462/3 1497/22 spot [1] 1501/14 spreadsheet [8] 1359/10 1359/11 1359/15 1454/21 1455/2 1499/18 1499/25 1500/2 spreadsheets [2] 1369/13 1500/3 squeeze [1] 1504/13 stability [3] 1356/10 1425/21 1489/1 stable [2] 1420/3 1420/12 stack [110] 1316/16 1316/17 1318/14 1318/17 1321/2 1321/19 1324/15 1325/6 1325/22 1327/12 1327/13 1331/3 1333/2 1335/24 1336/1 1336/24 1337/1 1338/7 1345/9 1348/16 1348/22 1348/24 1366/5 1366/8 1367/11 1367/13 1367/20 1367/21 1367/23 1367/25 1368/3 1369/9 1369/11 1369/12 1369/24 1370/2 1371/13 1372/12 1373/10 1373/17 1373/19 1373/21 1376/7 1383/11 1383/17 1383/18 1383/21 1383/23 1383/24 1384/7 1385/12 1387/5 1387/10 1387/15 1387/18 1387/21 1388/3 1389/8 1390/16 1390/17 1394/22 1395/1 1395/3 1408/13 1409/23 1412/2 1414/14 1432/25 1433/23 1438/19 1447/23 1449/18 1449/25 1451/1 1451/6 1451/9 1454/20 1455/16 1455/21 1456/2 1457/16 1458/17 1458/22 1459/2 1459/12 1459/23 1461/3 1461/13 1464/17 1464/25 1465/8 1465/18 1466/1 1466/20 1468/12 1468/16 1468/18 1468/21 1468/24 1471/3 1471/10 1471/11 1472/1 1473/4 1484/24 1485/8 1500/5 1500/8 1500/10 1502/24 staff [3] 1356/20 1356/25 1357/2 stage [4] 1469/24 1470/7 1496/17 1497/5 stand [3] 1435/5 1449/23 1475/7 standard [27] 1333/17 1333/18 1333/22 1358/20 1362/25 1368/16 1369/5 1369/6 1369/7 1371/1 1371/5 1376/15</p>

S	strike [2] 1420/24 1423/16 strong [1] 1341/24 stuck [1] 1449/22 studied [1] 1357/25 studies [1] 1422/21 study [1] 1421/18 stymied [2] 1449/19 1450/18 subject [2] 1396/1 1441/12 submitted [3] 1359/1 1359/4 1500/1 subsequent [1] 1330/15 substance [1] 1338/2 subtle [1] 1419/18 subtract [1] 1353/2 subtypes [1] 1370/13 successful [1] 1358/18 successive [1] 1446/14 such [10] 1317/11 1317/14 1320/12 1326/21 1349/11 1352/7 1378/11 1415/21 1416/4 1479/24 suck [1] 1402/20 sucked [1] 1402/20 sucking [1] 1402/23 suddenly [1] 1405/16 suffer [1] 1429/20 sufficient [3] 1321/15 1321/18 1402/25 sufficiently [1] 1380/3 sugar [1] 1381/14 suggest [1] 1467/6 suggests [2] 1396/14 1396/20 Suite [9] 1309/23 1310/4 1310/16 1311/18 1312/13 1312/16 1313/5 1313/9 1313/12 summarize [6] 1357/15 1388/7 1408/6 1433/4 1450/9 1450/10 summarized [1] 1457/2 summarizes [2] 1338/6 1388/9 summarizing [3] 1333/18 1348/4 1366/25 summary [5] 1356/3 1357/7 1366/22 1450/14 1451/13 summer [1] 1474/12 supervise [1] 1357/3 supervisor [1] 1362/21 support [7] 1364/10 1364/12 1379/21 1439/16 1453/22 1457/23 1489/21 supported [2] 1452/10 1452/15 supporting [1] 1457/25 supports [1] 1459/5 supposed [6] 1391/20 1402/17 1404/2 1430/2 1464/4 1477/22 suppression [1] 1357/24 sure [26] 1318/11 1330/6 1337/15 1337/18 1337/18 1370/8 1381/8 1402/24 1403/3 1403/5 1403/7 1404/9 1409/25 1437/25 1440/25 1446/14 1456/14 1463/15 1465/13 1468/14 1473/15 1486/14 1488/5 1498/19 1501/9 1502/8 surface [3] 1326/2 1333/4 1369/20 surrogate [1] 1359/23 suspect [3] 1467/22 1479/25 1490/11 suspected [1] 1429/15 sustain [1] 1432/5 Sutherland [1] 1312/15 sworn [2] 1315/7 1354/2 symmetric [2] 1411/12 1499/9 synthesize [1] 1336/6 system [16] 1318/11 1352/25 1355/17 1359/23 1369/22 1370/17 1371/4 1372/4 1372/8 1381/13 1384/20 1393/3 1397/25 1402/22 1417/17 1446/18 systemic [1] 1352/12 systems [5] 1355/10 1356/9 1357/24	T T-H-O-M-A-S [1] 1315/10 T-kill [1] 1482/18 tables [2] 1390/8 1457/22 tabulated [1] 1376/9 tail [1] 1491/21 tails [2] 1385/10 1408/11 take [19] 1317/10 1332/12 1364/19 1414/3 1419/14 1437/20 1440/12 1443/11 1447/8 1447/9 1447/10 1460/14 1465/23 1466/11 1471/11 1493/3 1501/25 1501/25 1504/11 taken [5] 1333/1 1336/10 1341/15 1343/25 1396/11 takes [2] 1373/25 1504/15 taking [3] 1349/14 1434/19 1473/25 talk [11] 1316/16 1318/13 1322/2 1380/15 1423/11 1431/9 1431/24 1443/4 1455/16 1477/19 1480/20 talked [7] 1348/1 1412/7 1414/13 1431/4 1459/7 1476/12 1476/24 talking [13] 1317/1 1324/15 1332/18 1337/23 1410/17 1410/24 1421/4 1431/23 1446/23 1469/2 1470/19 1494/17 1497/16 talks [2] 1338/1 1429/22 tank [2] 1469/1 1469/20 tasks [1] 1362/1 team [47] 1320/17 1320/21 1320/25 1321/10 1321/13 1321/24 1323/12 1324/17 1324/17 1324/17 1325/3 1325/3 1325/20 1327/18 1327/18 1328/14 1329/18 1333/23 1334/3 1334/4 1334/7 1334/9 1334/12 1334/12 1335/12 1335/13 1336/13 1336/16 1338/20 1340/2 1345/25 1350/2 1350/3 1388/13 1388/13 1442/25 1449/18 1450/12 1450/16 1450/23 1451/21 1452/10 1453/24 1454/15 1460/4 1460/16 1495/12 team's [1] 1345/24 teams [12] 1323/12 1333/11 1334/1 1334/5 1335/2 1335/6 1335/17 1335/22 1341/7 1355/11 1358/4 1465/14 teams' [1] 1333/24 technical [3] 1332/1 1356/20 1356/25 techniques [1] 1321/11 tell [9] 1331/18 1334/22 1355/14 1377/8 1379/21 1381/11 1405/23 1410/12 1501/18 telling [2] 1329/17 1332/24 tells [2] 1405/25 1430/2 temperature [13] 1338/3 1382/13 1382/24 1407/16 1407/18 1407/20 1407/22 1419/3 1443/7 1443/12 1448/12 1449/2 1466/23 temperatures [2] 1383/10 1421/2 ten [1] 1385/9 tend [1] 1498/19 tenders [1] 1364/14 tends [1] 1457/5 tenth [1] 1460/24 term [4] 1453/20 1471/19 1476/16 1476/20 terms [10] 1322/14 1323/11 1326/8 1326/11 1327/1 1360/11 1360/12 1442/25 1450/12 1475/7 test [14] 1386/23 1387/1 1391/19 1391/20 1392/22 1393/4 1393/4 1396/13 1397/4 1397/4 1399/7 1399/8 1483/9 1483/14
----------	--	--

T	1379/12 1379/17 1385/5 1387/2 1388/17 1392/3 1394/8 1397/9 1409/9 1409/10 1410/17 1411/22 1412/24 1415/23 1416/4 1419/17 1421/6 1424/24 1426/17 1428/4 1428/12 1430/14 1434/13 1435/2 1436/16 1437/14 1437/18 1438/4 1438/13 1438/22 1438/25 1439/11 1443/10 1446/8 1446/23 1447/18 1448/11 1449/21 1450/22 1451/23 1451/23 1452/12 1453/7 1454/14 1455/21 1455/23 1456/9 1456/14 1457/15 1457/24 1462/23 1462/24 1469/9 1471/5 1472/4 1473/19 1473/20 1475/6 1476/22 1480/1 1482/11 1482/19 1482/19 1483/5 1483/9 1483/17 1484/22 1485/4 1485/8 1485/14 1486/17 1487/24 1489/20 1489/24 1491/1 1491/17 1491/19 1491/25 1492/14 1492/16 1493/8 1493/10 1493/15 1495/21 1496/2 1497/5 1499/12 1500/25 1501/12 1502/3 1503/1 1503/8 1503/9 1503/17 1503/24 their [31] 1317/5 1332/2 1332/2 1332/17 1335/4 1335/6 1338/9 1338/25 1348/1 1357/4 1361/2 1362/25 1363/8 1363/14 1363/18 1374/1 1374/8 1377/15 1377/16 1378/25 1380/19 1381/7 1381/9 1381/9 1382/25 1408/25 1412/9 1412/10 1412/10 1452/15 1465/14 theirs [1] 1363/20 them [27] 1317/4 1317/5 1318/18 1321/13 1322/17 1325/22 1332/16 1332/20 1332/21 1332/24 1333/19 1333/19 1335/3 1335/23 1338/2 1342/20 1342/25 1343/11 1345/6 1348/1 1363/19 1369/13 1397/9 1456/14 1465/23 1471/2 1504/24 then [83] 1316/6 1317/18 1319/5 1321/1 1324/15 1327/12 1330/9 1330/13 1331/6 1333/19 1333/25 1334/12 1334/25 1335/12 1336/10 1337/24 1338/5 1339/23 1341/11 1341/25 1345/6 1348/19 1348/20 1350/20 1351/6 1363/6 1368/9 1369/2 1377/22 1378/6 1381/16 1383/5 1393/2 1393/3 1404/15 1405/20 1406/3 1407/13 1407/14 1407/16 1415/7 1416/24 1416/25 1417/4 1421/1 1425/4 1425/18 1426/1 1434/20 1434/21 1435/6 1436/20 1438/22 1439/17 1440/16 1441/1 1441/1 1441/6 1441/7 1441/17 1443/13 1445/15 1447/20 1448/25 1449/9 1449/10 1454/11 1454/22 1455/16 1463/25 1464/11 1469/14 1470/17 1471/8 1471/12 1479/20 1479/23 1479/25 1481/16 1485/23 1491/8 1499/15 1504/9 there [132] 1318/20 1320/9 1320/24 1321/7 1321/10 1321/15 1321/18 1322/16 1323/4 1323/14 1324/22 1325/10 1325/17 1326/2 1326/6 1326/17 1327/2 1327/3 1328/25 1330/21 1331/19 1332/23 1332/25 1334/4 1334/24 1336/2 1336/12 1336/17 1336/18 1337/22 1338/9 1339/7 1339/15 1339/23 1340/16 1340/19 1345/3 1345/15 1345/15 1345/20 1346/23 1349/4 1349/11 1349/15 1352/18 1354/17 1356/19 1356/24 1358/21 1360/1 1360/14 1360/17 1361/14 1361/15 1361/15 1362/8 1369/17 1369/22 1370/16	1376/21 1379/14 1384/10 1396/15 1405/3 1405/6 1407/24 1409/24 1411/14 1418/14 1419/13 1419/13 1419/21 1421/17 1421/25 1422/11 1422/14 1424/2 1424/14 1428/12 1428/17 1431/25 1436/2 1436/24 1438/12 1442/6 1443/6 1443/22 1444/11 1445/1 1445/4 1445/23 1447/4 1450/5 1450/15 1451/7 1451/21 1453/4 1454/2 1454/21 1460/4 1460/23 1461/16 1463/5 1464/16 1466/14 1466/22 1467/17 1468/21 1469/7 1473/23 1476/7 1478/12 1478/15 1478/18 1479/11 1481/16 1483/15 1483/17 1484/7 1484/13 1486/23 1486/24 1487/23 1488/4 1492/1 1492/23 1493/9 1501/13 1502/4 1503/2 1503/23 1504/21 there's [17] 1316/25 1328/11 1349/3 1354/17 1376/22 1385/10 1396/1 1407/8 1420/24 1429/23 1440/8 1443/5 1454/6 1468/18 1474/3 1481/9 1481/9 therefore [12] 1356/15 1358/10 1370/18 1373/18 1378/24 1380/22 1399/9 1400/6 1409/15 1452/14 1488/20 1494/6 these [72] 1318/8 1318/24 1330/14 1330/24 1333/8 1334/13 1335/1 1335/6 1335/22 1336/12 1337/16 1339/5 1339/20 1341/22 1342/9 1342/20 1342/22 1342/24 1343/20 1343/22 1343/24 1343/25 1363/13 1365/13 1365/17 1369/6 1369/7 1373/20 1373/24 1374/12 1374/14 1375/7 1376/20 1388/9 1389/4 1397/3 1398/17 1404/8 1406/12 1410/19 1410/20 1419/8 1419/15 1423/25 1424/17 1425/1 1425/14 1425/17 1427/5 1427/9 1427/9 1427/11 1433/7 1441/8 1447/6 1448/7 1450/18 1452/6 1452/7 1453/15 1455/12 1457/18 1457/22 1470/23 1476/4 1486/21 1490/13 1490/14 1490/18 1494/5 1497/3 1498/4 thesis [4] 1356/10 1416/17 1419/17 1421/10 they [100] 1317/7 1317/11 1323/12 1325/5 1326/2 1326/5 1327/9 1327/11 1328/4 1328/16 1332/19 1333/16 1335/3 1338/13 1338/25 1339/2 1339/3 1339/4 1339/7 1339/12 1339/16 1339/16 1339/17 1339/21 1341/7 1347/4 1347/18 1347/21 1347/25 1349/5 1359/5 1359/11 1359/14 1361/2 1361/10 1362/25 1363/1 1363/3 1363/4 1363/5 1363/8 1363/9 1363/11 1363/18 1363/23 1364/12 1375/15 1375/20 1376/20 1380/3 1381/7 1382/5 1383/2 1384/2 1389/2 1389/7 1394/25 1396/13 1397/24 1399/9 1401/23 1402/3 1403/1 1404/9 1404/15 1404/17 1408/25 1409/1 1409/25 1410/2 1410/4 1410/22 1410/23 1414/25 1415/21 1424/1 1426/11 1426/23 1427/6 1429/24 1431/14 1433/8 1446/10 1446/15 1446/15 1452/6 1458/14 1458/17 1465/13 1465/15 1470/3 1486/20 1486/21 1490/9 1490/19 1490/21 1496/10 1499/22 1500/12 1501/22 they'll [1] 1341/18 they're [13] 1335/20 1335/21 1377/12 1404/19 1429/24 1429/25 1430/19 1431/7 1431/8 1431/9 1485/10 1490/10 1494/4
---	---	--

T	three [47] 1322/8 1322/16 1323/12 1325/4 1327/7 1353/18 1357/25 1358/4 1358/15 1366/25 1369/23 1369/25 1374/18 1374/22 1374/25 1380/18 1381/16 1388/9 1393/25 1394/3 1397/3 1397/5 1404/8 1404/14 1404/20 1406/18 1432/9 1435/9 1452/2 1453/5 1456/10 1456/18 1456/21 1457/3 1457/11 1458/1 1458/6 1458/9 1458/16 1459/14 1459/17 1464/16 1464/24 1465/7 1465/10 1482/21 1483/24	1343/12 1364/13 1387/12 1387/12 1409/18 1409/22 1452/8 1452/9 1454/11 1460/16 1479/16 Tolles [1] 1312/18 Tom [7] 1342/9 1361/9 1361/9 1361/23 1442/18 1442/21 1451/8 tomorrow [3] 1504/3 1504/12 1504/14 too [9] 1326/16 1327/2 1342/12 1350/12 1353/22 1387/23 1429/22 1431/7 1454/2 took [11] 1334/15 1337/15 1337/16 1343/22 1343/24 1349/12 1407/4 1414/6 1416/17 1477/22 1488/11 Tooms [5] 1395/18 1395/19 1395/20 1396/9 1396/19 top [156] 1318/4 1318/6 1320/11 1321/22 1322/2 1322/9 1323/1 1323/6 1323/7 1323/13 1323/14 1324/2 1325/10 1325/12 1325/25 1326/1 1326/4 1326/9 1326/12 1326/13 1326/16 1326/16 1327/1 1332/12 1348/3 1350/20 1366/9 1366/10 1366/12 1366/13 1369/21 1390/18 1390/19 1390/22 1391/7 1391/8 1391/12 1391/17 1391/19 1391/22 1392/15 1393/16 1393/23 1394/18 1395/4 1395/5 1395/6 1395/11 1396/14 1396/21 1397/2 1397/5 1397/16 1397/17 1398/11 1398/14 1398/16 1398/24 1398/25 1399/1 1399/3 1399/18 1399/20 1399/24 1400/5 1400/10 1400/11 1400/13 1400/24 1401/1 1401/2 1401/4 1401/6 1401/9 1401/16 1401/16 1401/25 1402/13 1402/16 1402/20 1402/22 1402/25 1403/2 1403/2 1403/11 1403/12 1403/13 1403/15 1404/1 1404/5 1405/5 1424/2 1432/16 1432/20 1439/11 1439/12 1449/21 1451/16 1452/3 1452/12 1452/19 1452/22 1453/18 1453/20 1454/3 1454/8 1454/8 1457/9 1469/5 1469/6 1481/19 1481/21 1481/23 1482/8 1482/17 1483/4 1483/9 1483/10 1483/10 1483/14 1483/15 1483/16 1483/18 1483/20 1483/24 1484/16 1484/18 1484/21 1484/23 1485/3 1485/7 1485/9 1485/12 1486/7 1486/15 1486/23 1486/24 1489/16 1489/17 1491/14 1491/21 1492/5 1492/12 1492/20 1493/5 1493/17 1499/14 1500/23 1500/24 1501/10 1501/11 1502/9 1502/12 1502/15 1502/21 1502/22 Top Hat [29] 1400/24 1401/1 1401/2 1401/4 1401/6 1401/9 1401/16 1401/16 1401/25 1402/16 1402/20 1402/22 1402/25 1403/2 1403/15 1404/1 1405/5 1432/20 1485/12 1486/7 1486/23 1491/21 1492/5 1492/12 1492/20 1501/10 1501/11 1502/21 1502/22 Top Kill [22] 1321/22 1390/18 1390/19 1390/22 1391/7 1391/8 1391/12 1391/17 1391/22 1393/16 1393/23 1432/16 1439/12 1485/9 1486/15 1486/24 1491/14 1500/23 1500/24 1502/9 1502/12 1502/15 topic [8] 1316/22 1353/3 1356/10 1429/23 1430/16 1430/17 1431/9 1431/24 Torts [1] 1311/6 total [14] 1320/15 1326/1 1329/9 1334/14 1339/14 1353/18 1370/15 1414/19 1427/12 1453/4 1460/6
thing [9] 1316/1 1322/19 1331/15 1354/8 1419/10 1419/17 1443/4 1443/6 1462/24	three-dimensional [1] 1380/18 three-phase [1] 1357/25 through [51] 1318/24 1325/5 1350/22 1355/16 1357/23 1366/5 1366/7 1367/10 1368/2 1368/9 1369/24 1370/1 1370/14 1370/20 1370/20 1371/4 1371/12 1372/3 1372/8 1373/9 1373/17 1373/19 1373/20 1385/12 1387/10 1393/3 1397/24 1405/4 1412/18 1417/8 1417/10 1417/12 1417/14 1417/17 1420/13 1425/3 1429/5 1438/23 1443/13 1444/20 1445/2 1445/14 1446/4 1458/7 1458/22 1459/2 1460/4 1474/8 1477/23 1493/25 1500/9	
things [21] 1316/4 1319/20 1319/21 1320/13 1322/8 1337/17 1378/22 1393/25 1411/18 1415/23 1419/3 1436/19 1442/7 1447/19 1451/16 1476/17 1495/22 1496/3 1496/6 1496/8 1498/20	throughout [3] 1355/22 1450/15 1473/25 tighter [2] 1346/6 1346/23 tilt [2] 1323/3 1323/8 Tim [3] 1397/16 1398/12 1426/25 time [119] 1316/10 1316/17 1318/20 1320/11 1320/23 1321/4 1321/20 1329/4 1329/19 1330/2 1331/9 1333/16 1335/23 1339/14 1340/3 1340/19 1345/9 1346/4 1347/2 1349/20 1351/3 1351/7 1354/19 1358/2 1358/9 1361/12 1361/14 1366/2 1366/6 1366/9 1366/10 1367/1 1367/6 1370/15 1371/25 1372/1 1373/14 1373/16 1373/19 1383/1 1383/3 1390/22 1391/17 1391/23 1393/2 1393/5 1393/16 1395/11 1396/10 1397/9 1397/12 1397/13 1400/5 1400/7 1401/22 1404/24 1405/17 1408/10 1408/12 1408/15 1408/19 1410/11 1415/14 1415/18 1419/10 1419/11 1419/12 1419/13 1419/14 1420/13 1425/2 1425/10 1425/11 1425/12 1425/17 1425/19 1425/25 1426/1 1432/9 1434/21 1436/9 1436/25 1439/11 1439/12 1439/14 1440/3 1441/15 1442/2 1446/3 1446/11 1452/16 1460/6 1460/8 1460/19 1463/9 1464/2 1472/1 1474/1 1474/6 1475/11 1478/12 1480/13 1481/18 1483/3 1483/4 1483/8 1491/22 1492/15 1492/18 1492/19 1492/25 1493/1 1493/4 1494/13 1499/9 1499/23 1503/5 1505/4 1505/16 timeline [1] 1432/13 times [22] 1316/15 1322/22 1323/4 1335/21 1335/21 1362/19 1369/4 1369/4 1370/17 1374/15 1374/25 1375/1 1375/14 1385/9 1386/4 1395/20 1428/23 1450/15 1468/25 1472/12 1487/24 1498/17	
think [102] 1317/7 1320/18 1324/14 1331/25 1332/4 1333/15 1334/21 1336/1 1336/5 1337/3 1339/15 1342/13 1343/25 1346/6 1347/8 1347/8 1349/2 1349/14 1349/24 1372/22 1384/19 1389/18 1393/17 1394/15 1400/13 1403/5 1405/6 1408/10 1409/3 1409/13 1410/11 1411/12 1411/12 1412/9 1413/5 1413/17 1413/18 1415/6 1415/23 1416/8 1418/1 1421/14 1421/21 1421/22 1423/17 1429/25 1431/7 1434/10 1436/16 1438/2 1438/4 1439/18 1440/8 1440/19 1441/1 1441/4 1441/14 1442/2 1443/4 1445/13 1447/18 1449/15 1449/21 1451/24 1452/7 1452/25 1454/14 1455/4 1455/23 1457/8 1457/9 1459/9 1459/24 1461/22 1462/1 1467/17 1468/25 1472/9 1473/19 1474/13 1474/15 1480/11 1483/17 1485/20 1486/4 1486/21 1487/14 1488/19 1489/15 1490/15 1493/17 1494/3 1494/4 1494/4 1498/11 1498/12 1499/1 1501/15 1502/3 1503/4 1503/12 1505/18	title [3] 1356/21 1365/9 1365/12 titled [2] 1350/8 1386/21 today [8] 1355/3 1436/6 1436/23 1437/6 1465/19 1466/19 1504/18 1504/22 together [11] 1316/25 1320/25 1333/11 1333/19 1333/22 1333/23 1339/5 1375/5 1379/2 1380/2 1404/20 told [19] 1320/17 1326/2 1326/5 1329/8 1338/13 1338/20 1338/25 1339/11	
thinks [1] 1320/1 third [9] 1310/23 1348/12 1373/8 1373/11 1375/6 1398/25 1409/9 1473/22 1484/1 this [322] Thomas [4] 1310/2 1311/11 1315/6 1315/10 those [87] 1318/1 1318/17 1319/23 1329/20 1329/21 1334/16 1335/9 1337/17 1347/25 1348/4 1348/15 1348/20 1349/16 1358/23 1359/8 1359/9 1359/10 1365/21 1367/8 1368/11 1368/15 1369/15 1373/22 1374/15 1383/4 1383/16 1383/25 1387/23 1392/21 1394/3 1397/8 1401/14 1401/19 1404/20 1407/4 1409/21 1413/4 1413/12 1413/13 1413/15 1417/7 1418/15 1419/19 1419/20 1419/25 1420/1 1420/2 1426/5 1441/24 1447/10 1451/13 1452/5 1452/10 1452/11 1453/11 1454/18 1454/19 1457/13 1458/6 1461/9 1461/10 1461/15 1465/5 1465/12 1465/23 1470/25 1471/1 1471/14 1476/25 1486/11 1486/12 1486/18 1486/25 1487/1 1494/8 1494/11 1496/8 1496/9 1499/17 1499/21 1499/22 1499/22 1500/10 1501/23 1504/11 1505/15 1505/17	tomorrow [3] 1504/3 1504/12 1504/14 too [9] 1326/16 1327/2 1342/12 1350/12 1353/22 1387/23 1429/22 1431/7 1454/2 took [11] 1334/15 1337/15 1337/16 1343/22 1343/24 1349/12 1407/4 1414/6 1416/17 1477/22 1488/11 Tooms [5] 1395/18 1395/19 1395/20 1396/9 1396/19 top [156] 1318/4 1318/6 1320/11 1321/22 1322/2 1322/9 1323/1 1323/6 1323/7 1323/13 1323/14 1324/2 1325/10 1325/12 1325/25 1326/1 1326/4 1326/9 1326/12 1326/13 1326/16 1326/16 1327/1 1332/12 1348/3 1350/20 1366/9 1366/10 1366/12 1366/13 1369/21 1390/18 1390/19 1390/22 1391/7 1391/8 1391/12 1391/17 1391/19 1391/22 1392/15 1393/16 1393/23 1394/18 1395/4 1395/5 1395/6 1395/11 1396/14 1396/21 1397/2 1397/5 1397/16 1397/17 1398/11 1398/14 1398/16 1398/24 1398/25 1399/1 1399/3 1399/18 1399/20 1399/24 1400/5 1400/10 1400/11 1400/13 1400/24 1401/1 1401/2 1401/4 1401/6 1401/9 1401/16 1401/16 1401/25 1402/13 1402/16 1402/20 1402/22 1402/25 1403/2 1403/2 1403/11 1403/12 1403/13 1403/15 1404/1 1404/5 1405/5 1424/2 1432/16 1432/20 1439/11 1439/12 1449/21 1451/16 1452/3 1452/12 1452/19 1452/22 1453/18 1453/20 1454/3 1454/8 1454/8 1457/9 1469/5 1469/6 1481/19 1481/21 1481/23 1482/8 1482/17 1483/4 1483/9 1483/10 1483/10 1483/14 1483/15 1483/16 1483/18 1483/20 1483/24 1484/16 1484/18 1484/21 1484/23 1485/3 1485/7 1485/9 1485/12 1486/7 1486/15 1486/23 1486/24 1489/16 1489/17 1491/14 1491/21 1492/5 1492/12 1492/20 1493/5 1493/17 1499/14 1500/23 1500/24 1501/10 1501/11 1502/9 1502/12 1502/15 1502/21 1502/22 Top Hat [29] 1400/24 1401/1 1401/2 1401/4 1401/6 1401/9 1401/16 1401/16 1401/25 1402/16 1402/20 1402/22 1402/25 1403/2 1403/15 1404/1 1405/5 1432/20 1485/12 1486/7 1486/23 1491/21 1492/5 1492/12 1492/20 1501/10 1501/11 1502/21 1502/22 Top Kill [22] 1321/22 1390/18 1390/19 1390/22 1391/7 1391/8 1391/12 1391/17 1391/22 1393/16 1393/23 1432/16 1439/12 1485/9 1486/15 1486/24 1491/14 1500/23 1500/24 1502/9 1502/12 1502/15 topic [8] 1316/22 1353/3 1356/10 1429/23 1430/16 1430/17 1431/9 1431/24 Torts [1] 1311/6 total [14] 1320/15 1326/1 1329/9 1334/14 1339/14 1353/18 1370/15 1414/19 1427/12 1453/4 1460/6	
though [3] 1331/16 1331/23 1337/6 thought [20] 1326/15 1332/19 1336/6 1341/22 1346/5 1346/7 1346/22 1366/2 1391/24 1406/21 1430/23 1437/2 1451/24 1461/24 1466/15 1467/18 1488/22 1489/9 1495/16 1501/19 thoughts [1] 1362/12 thousand [1] 1412/24 thousandths [1] 1384/2		

<p>T</p> <p>total... [3] 1460/19 1463/15 1472/13</p> <p>totally [1] 1320/22</p> <p>tougher [1] 1371/4</p> <p>towards [2] 1348/25 1493/2</p> <p>track [3] 1330/1 1331/10 1358/13</p> <p>trading [1] 1362/12</p> <p>transcript [2] 1309/14 1506/7</p> <p>transcription [1] 1313/24</p> <p>transcripts [1] 1353/22</p> <p>transfer [3] 1422/21 1447/3 1479/19</p> <p>transition [1] 1339/9</p> <p>translate [1] 1360/11</p> <p>Transocean [10] 1312/12 1312/13 1312/14 1312/15 1312/16 1312/17 1312/18 1312/19 1312/20 1505/15</p> <p>travel [2] 1391/21 1391/22</p> <p>traveled [1] 1391/24</p> <p>traveling [1] 1355/21</p> <p>treated [4] 1406/14 1458/9 1458/11 1498/14</p> <p>treatment [1] 1480/20</p> <p>trend [1] 1351/24</p> <p>trends [1] 1441/24</p> <p>Trevor [6] 1385/23 1387/9 1389/21 1398/12 1398/14 1489/4</p> <p>TREX [36] 1316/20 1324/20 1332/9 1341/14 1348/3 1350/5 1351/17 1365/5 1365/10 1386/10 1386/18 1389/11 1395/12 1395/16 1398/3 1398/20 1427/3 1427/7 1442/9 1442/15 1442/23 1450/2 1451/12 1452/21 1453/2 1453/13 1454/25 1456/24 1460/10 1462/25 1463/19 1467/8 1474/17 1479/13 1480/7 1489/13</p> <p>TREX-10650 [1] 1427/3</p> <p>TREX-10650.1.1.US [1] 1427/7</p> <p>TREX-10650.2.1 [1] 1489/13</p> <p>TREX-11191 [1] 1389/11</p> <p>TREX-11436.2.1 [1] 1480/7</p> <p>TREX-11452 [1] 1365/5</p> <p>TREX-11453.12.1 [1] 1474/17</p> <p>TREX-11534.1 [1] 1452/21</p> <p>TREX-11534.16 [1] 1453/2</p> <p>TREX-5066 [1] 1395/12</p> <p>TREX-5066.1.1.US [1] 1395/16</p> <p>TREX-6196 [1] 1386/10</p> <p>TREX-6196.4.1.US [1] 1386/18</p> <p>TREX-8635.96.3 [1] 1460/10</p> <p>TREX-8809 [1] 1462/25</p> <p>TREX-8809.1.1 [1] 1463/19</p> <p>TREX-9361.24.1 [1] 1456/24</p> <p>TREX-9361.46 [1] 1348/3</p> <p>TREX-9361.49.1 [1] 1450/2</p> <p>TREX-9379.1.2 [1] 1467/8</p> <p>TREX-9388 [1] 1442/15</p> <p>TREX-9388.1.1 [1] 1442/9</p> <p>TREX-9389.2.1 [1] 1442/23</p> <p>TREX-9452 [1] 1398/3</p> <p>TREX-9452.2.1.US [1] 1398/20</p> <p>TREX-9671.1.1 [1] 1351/17</p> <p>TREX-9671.2.1 [1] 1350/5</p> <p>TREX-9692.3.2 [1] 1316/20</p> <p>TREX-9706 [1] 1451/12</p> <p>TREX-9706.1 [1] 1324/20</p> <p>TREX-9706.5 [1] 1453/13</p> <p>TREX-9725.2.1 [1] 1341/14</p> <p>TREX-9908 [1] 1332/9</p> <p>Tri [9] 1324/17 1325/3 1325/25 1327/7 1334/12 1336/13 1338/6 1453/16 1495/12</p> <p>Tri-Lab [6] 1324/17 1325/3 1325/25</p>	<p>1334/12 1336/13 1453/16</p> <p>Tri-Lab's [1] 1495/12</p> <p>Tri-Labs [2] 1327/7 1338/6</p> <p>trial [5] 1309/14 1418/2 1430/22 1483/22 1505/7</p> <p>tried [14] 1329/3 1347/20 1359/10 1368/16 1379/23 1384/21 1390/21 1402/2 1413/6 1417/20 1454/7 1481/15 1482/5 1489/25</p> <p>tries [2] 1422/17 1425/6</p> <p>TRITON [1] 1309/8</p> <p>true [12] 1320/22 1340/3 1349/7 1437/14 1440/9 1440/10 1454/14 1467/19 1471/6 1483/5 1484/5 1506/6</p> <p>trusted [1] 1455/25</p> <p>try [12] 1330/22 1337/24 1363/11 1368/9 1375/15 1381/8 1411/3 1417/16 1430/1 1449/18 1458/20 1490/20</p> <p>trying [15] 1318/4 1320/3 1323/7 1337/20 1358/16 1362/13 1371/9 1374/1 1418/2 1431/8 1441/9 1443/1 1446/7 1463/9 1482/21</p> <p>Ts [1] 1381/13</p> <p>turn [15] 1325/20 1338/5 1339/11 1341/14 1341/25 1372/7 1372/13 1420/9 1420/11 1439/17 1442/22 1445/15 1451/5 1451/12 1476/10</p> <p>turned [1] 1363/16</p> <p>turning [3] 1363/5 1363/6 1365/24</p> <p>turns [3] 1420/3 1420/18 1420/19</p> <p>two [62] 1315/24 1316/4 1317/24 1319/23 1320/4 1320/24 1324/10 1327/15 1328/8 1334/6 1339/15 1347/11 1348/7 1348/20 1348/20 1357/23 1368/4 1368/11 1370/13 1373/24 1374/7 1374/8 1374/9 1374/13 1374/13 1374/15 1389/2 1404/20 1406/18 1408/11 1409/8 1409/11 1415/24 1416/1 1417/7 1418/12 1418/15 1418/18 1420/1 1425/2 1425/17 1425/23 1443/5 1444/24 1445/2 1445/11 1445/13 1457/8 1457/24 1461/9 1461/10 1461/15 1471/21 1473/22 1474/12 1474/25 1477/12 1481/9 1481/9 1486/25 1504/11 1505/6</p> <p>two-phase [2] 1347/11 1357/23</p> <p>type [4] 1419/13 1456/8 1458/21 1469/19</p> <p>types [6] 1316/23 1358/23 1359/16 1370/13 1419/14 1447/6</p> <p>typically [5] 1355/16 1357/21 1361/18 1376/16 1500/3</p> <p>U</p> <p>U.S [7] 1311/6 1311/9 1333/7 1371/7 1377/4 1412/8 1412/12</p> <p>Uh [1] 1331/22</p> <p>Uh-huh [1] 1331/22</p> <p>ultimately [4] 1333/12 1333/19 1372/5 1443/14</p> <p>uncalibrated [5] 1384/9 1384/12 1434/14 1456/3 1466/25</p> <p>uncertain [3] 1337/7 1393/24 1445/7</p> <p>uncertainties [13] 1337/5 1337/6 1337/11 1337/13 1412/10 1437/23 1447/16 1449/20 1450/19 1454/2 1466/24 1496/9 1497/9</p> <p>uncertainty [93] 1318/8 1323/6 1323/8 1325/17 1326/3 1326/3 1326/6 1326/8 1326/20 1326/23 1326/24 1327/2 1327/3 1338/22 1338/25 1339/13 1341/8 1341/18 1343/9 1343/19</p>	<p>1345/12 1345/16 1345/17 1345/22 1346/3 1346/5 1346/16 1346/18 1346/21 1346/23 1346/25 1347/5 1347/16 1347/20 1348/2 1349/3 1349/8 1349/10 1352/8 1373/7 1384/6 1384/8 1384/13 1384/14 1384/21 1384/21 1385/3 1385/17 1385/21 1402/11 1404/7 1411/8 1411/23 1411/24 1412/7 1412/8 1434/6 1435/22 1438/1 1438/5 1442/15 1442/23 1445/16 1448/3 1457/15 1459/22 1460/5 1460/18 1460/23 1461/3 1461/11 1461/13 1461/17 1461/19 1461/20 1462/4 1462/8 1462/15 1462/17 1462/19 1462/20 1462/21 1463/6 1463/14 1463/22 1463/24 1466/23 1466/24 1475/1 1484/10 1493/24 1495/23 1496/4</p> <p>unchanging [2] 1392/8 1392/9</p> <p>unclear [1] 1491/3</p> <p>under [2] 1376/24 1439/3</p> <p>undergraduate [2] 1369/8 1456/8</p> <p>underground [1] 1369/19</p> <p>underneath [3] 1402/24 1437/20 1439/4</p> <p>understand [17] 1320/3 1360/12 1413/14 1423/7 1424/22 1430/16 1436/9 1446/9 1446/10 1448/12 1448/15 1448/17 1467/5 1475/22 1476/17 1479/2 1498/4</p> <p>understanding [9] 1322/14 1333/5 1344/19 1344/21 1435/21 1448/4 1448/6 1494/2 1506/8</p> <p>understated [1] 1472/20</p> <p>understood [3] 1318/6 1342/4 1399/8</p> <p>unexpected [1] 1372/19</p> <p>unexplained [1] 1396/15</p> <p>unfair [1] 1472/11</p> <p>unfortunately [2] 1358/17 1498/21</p> <p>uniform [1] 1330/21</p> <p>unique [2] 1421/12 1461/25</p> <p>UNITED [17] 1309/1 1309/10 1309/15 1311/6 1311/9 1342/23 1353/14 1354/24 1364/14 1365/16 1377/11 1378/6 1430/19 1432/3 1494/19 1495/15 1506/5</p> <p>unknown [6] 1320/4 1382/24 1444/8 1444/21 1480/24 1481/5</p> <p>unless [3] 1396/15 1415/11 1490/2</p> <p>unlikely [4] 1330/2 1331/10 1472/19 1494/5</p> <p>unnamed [2] 1410/10 1410/11</p> <p>unnecessary [1] 1339/17</p> <p>unquantifiable [3] 1323/21 1323/22 1345/19</p> <p>unreliable [2] 1373/5 1384/18</p> <p>unstable [7] 1420/4 1420/7 1420/9 1420/11 1420/12 1420/18 1420/19</p> <p>unsuccessful [1] 1391/22</p> <p>unsymmetric [1] 1411/22</p> <p>until [2] 1349/23 1420/15</p> <p>up [112] 1315/19 1316/20 1319/1 1322/4 1322/20 1322/23 1324/20 1330/21 1331/4 1332/9 1334/16 1336/9 1336/12 1339/6 1339/15 1342/17 1349/16 1350/5 1350/17 1353/3 1363/5 1363/6 1364/20 1368/22 1369/21 1370/18 1370/21 1371/1 1371/22 1373/19 1374/1 1377/8 1379/21 1380/21 1380/24 1385/19 1390/8 1392/3 1392/10 1392/11 1394/1 1394/5 1398/17 1403/6 1404/5 1413/20 1414/12 1414/20 1414/21 1417/3 1417/4 1417/10 1417/13 1417/13</p>
---	---	---

U	1486/12 1486/15 1488/5 1490/6 1490/21 1491/10 1502/22 1502/23 Usually [1] 1361/13	videos [1] 1353/18 videotaped [2] 1353/23 1485/13 view [13] 1320/17 1320/18 1321/15 1323/20 1326/5 1326/6 1343/11 1343/17 1345/16 1352/15 1404/24 1461/2 1492/18 viewed [1] 1320/19 viewgraph [3] 1328/5 1335/4 1460/22 viewgraphs [1] 1339/18 virtually [2] 1326/24 1328/18 viscosity [2] 1360/20 1448/9 visual [5] 1324/1 1402/5 1485/12 1485/22 1486/10 visualization [3] 1321/11 1334/3 1334/4 visually [1] 1323/24 voice [2] 1461/22 1462/1 voiced [3] 1461/2 1462/6 1464/1 VOIR [1] 1355/5 volumes [2] 1381/15 1496/25 vote [1] 1461/17
up... [58] 1417/18 1424/8 1424/13 1425/15 1427/13 1432/8 1434/21 1437/21 1438/11 1438/13 1438/13 1438/14 1439/4 1440/18 1441/1 1441/2 1441/5 1441/7 1441/8 1441/12 1441/17 1441/18 1441/19 1441/22 1442/8 1449/17 1455/18 1455/21 1457/6 1458/3 1466/17 1470/8 1472/7 1472/8 1472/13 1472/14 1474/17 1476/11 1477/19 1479/13 1482/5 1482/6 1486/18 1486/21 1488/25 1489/1 1489/2 1489/12 1496/22 1497/10 1499/25 1501/6 1502/14 1502/15 1503/7 1503/7 1504/11 1504/23 upon [11] 1344/18 1376/24 1377/12 1377/14 1377/16 1378/3 1379/12 1404/4 1470/1 1491/1 1494/24 upper [10] 1424/9 1466/20 1467/3 1467/14 1467/19 1468/4 1468/6 1468/9 1481/4 1502/13 upstream [9] 1319/21 1368/3 1368/20 1370/8 1371/20 1444/3 1476/16 1476/25 1477/8 us [12] 1318/23 1360/25 1361/15 1371/23 1372/21 1373/2 1383/8 1383/18 1430/2 1463/13 1466/14 1504/19 use [58] 1346/15 1348/13 1352/5 1360/17 1364/2 1369/23 1370/23 1371/5 1373/6 1373/8 1375/22 1380/3 1380/22 1381/1 1382/19 1382/22 1383/2 1386/25 1391/7 1397/20 1397/25 1398/23 1403/12 1404/22 1405/1 1419/8 1419/9 1419/11 1420/5 1426/8 1428/5 1428/6 1428/12 1429/14 1431/8 1440/4 1440/4 1447/2 1447/14 1449/15 1457/18 1467/18 1469/19 1469/23 1470/4 1470/10 1476/16 1476/20 1481/2 1484/15 1487/18 1493/23 1495/2 1496/21 1497/3 1497/6 1500/1 1502/13 used [78] 1320/22 1326/14 1359/16 1359/21 1359/23 1359/24 1360/12 1363/2 1366/6 1368/17 1370/25 1371/6 1371/8 1372/7 1372/13 1372/17 1373/7 1373/11 1373/15 1379/10 1379/24 1380/4 1383/6 1384/1 1384/11 1386/23 1390/10 1393/8 1393/11 1394/22 1394/23 1395/1 1395/2 1397/21 1398/25 1400/8 1402/13 1403/14 1403/16 1407/25 1421/17 1426/3 1428/23 1430/20 1440/14 1440/24 1453/23 1453/25 1454/21 1456/21 1457/3 1458/25 1468/5 1469/8 1469/24 1470/6 1470/14 1471/15 1471/17 1487/19 1487/24 1488/2 1490/1 1490/4 1490/5 1490/14 1490/14 1490/15 1490/16 1490/16 1490/20 1496/12 1496/15 1496/16 1496/23 1497/5 1498/21 1500/16 useless [1] 1402/22 uses [6] 1422/15 1423/21 1425/18 1429/4 1431/23 1490/23 using [39] 1313/23 1317/23 1323/7 1324/1 1342/20 1359/25 1362/25 1363/11 1363/18 1375/19 1378/4 1382/21 1384/3 1398/15 1400/12 1400/25 1401/9 1403/17 1406/18 1418/21 1429/15 1429/25 1434/20 1440/13 1443/14 1457/22 1467/23 1468/23 1470/13 1470/14 1480/25	V vague [2] 1464/9 1468/7 validate [2] 1420/17 1421/1 validated [7] 1420/16 1420/21 1421/16 1423/14 1423/15 1487/18 1494/4 validates [2] 1420/16 1422/4 validation [1] 1422/3 validity [3] 1348/25 1349/2 1478/20 value [22] 1371/4 1374/1 1392/8 1392/24 1393/1 1395/11 1403/11 1403/16 1428/2 1431/23 1437/13 1437/13 1437/17 1437/17 1437/19 1437/20 1437/22 1471/7 1483/19 1499/13 1500/5 1503/6 values [13] 1361/3 1376/9 1376/19 1376/19 1390/8 1397/3 1431/24 1452/10 1457/12 1461/11 1461/17 1490/7 1490/16 valve [14] 1333/4 1339/6 1372/5 1372/7 1372/9 1372/14 1372/15 1372/18 1372/20 1372/24 1459/15 1459/16 1466/9 1466/13 valves [5] 1370/9 1373/20 1376/14 1397/7 1403/2 variables [2] 1338/4 1466/22 variation [1] 1326/18 variations [2] 1478/16 1483/18 variety [8] 1327/18 1327/19 1334/1 1442/7 1443/18 1444/1 1444/4 1497/8 various [8] 1323/4 1323/4 1335/17 1422/16 1422/18 1446/2 1446/5 1496/3 velocities [5] 1409/15 1409/16 1415/10 1415/10 1459/2 velocity [10] 1334/9 1368/25 1369/1 1369/2 1369/4 1381/19 1415/12 1419/4 1419/5 1429/5 vent [2] 1406/14 1407/2 vents [7] 1403/12 1403/18 1404/8 1404/14 1404/20 1405/12 1492/17 verbatim [1] 1421/2 verified [2] 1389/7 1390/13 versus [3] 1408/10 1442/2 1482/18 vertical [2] 1417/22 1417/23 vertically [1] 1477/23 very [87] 1319/3 1352/11 1353/8 1354/20 1357/19 1358/8 1361/1 1361/4 1362/23 1363/16 1364/21 1369/16 1374/16 1375/1 1376/15 1378/24 1380/1 1380/21 1380/24 1384/2 1385/11 1392/17 1392/24 1393/18 1393/18 1393/19 1394/9 1394/23 1400/5 1402/19 1403/6 1404/2 1404/3 1404/22 1405/6 1407/1 1408/10 1409/4 1409/19 1410/2 1412/14 1412/25 1413/6 1413/13 1415/23 1416/16 1416/16 1416/22 1417/20 1418/3 1419/5 1419/17 1426/8 1441/21 1441/22 1447/20 1449/21 1450/1 1452/13 1452/14 1455/6 1455/11 1457/8 1457/9 1459/24 1469/5 1469/6 1472/19 1479/5 1479/25 1480/4 1482/9 1485/17 1485/19 1486/8 1486/20 1486/21 1487/1 1487/15 1488/24 1491/18 1492/2 1494/9 1498/13 1498/18 1499/16 1505/23 vessel [1] 1387/4 via [1] 1351/25 vice [2] 1353/16 1387/25 video [3] 1353/15 1405/18 1425/7	W wait [1] 1340/19 waiting [1] 1340/21 walk [3] 1318/23 1367/10 1443/13 walked [1] 1325/4 want [10] 1315/19 1372/11 1402/20 1437/5 1467/20 1472/10 1475/7 1489/8 1503/11 1505/18 wanted [13] 1317/23 1328/9 1328/15 1328/16 1343/16 1351/18 1377/1 1382/8 1383/8 1409/25 1410/2 1410/22 1447/25 wants [2] 1343/12 1404/12 WARREN [1] 1313/15 was [506] washed [1] 1491/10 Washington [6] 1311/8 1311/16 1312/7 1312/11 1313/16 1463/4 wasn't [7] 1341/2 1341/24 1351/15 1352/3 1423/5 1423/11 1505/2 watch [1] 1381/16 water [17] 1357/20 1357/21 1357/22 1357/22 1358/9 1358/9 1358/10 1358/11 1358/12 1358/13 1359/24 1359/25 1402/20 1402/21 1402/23 1402/25 1403/10 wave [3] 1474/13 1474/15 1474/16 way [35] 1315/20 1315/25 1318/5 1320/9 1321/10 1329/16 1337/24 1338/17 1344/25 1347/4 1349/5 1352/22 1359/11 1369/22 1371/23 1376/18 1407/3 1412/11 1415/21 1416/4 1419/19 1420/5 1427/21 1441/17 1443/14 1446/23 1458/21 1463/18 1469/25 1470/9 1471/20 1475/12 1495/16 1503/14 1503/15 ways [5] 1376/17 1406/23 1419/21 1464/24 1472/12 we [363] we'll [12] 1318/13 1324/22 1355/3 1401/5 1428/8 1429/1 1433/10 1456/6 1489/12 1504/2 1504/2 1504/19 we're [19] 1318/3 1331/19 1353/18 1358/12 1358/16 1368/3 1375/3 1391/18 1404/5 1405/14 1405/18 1408/8 1410/11 1413/20 1413/21 1430/18 1433/10 1446/22 1486/22 we've [7] 1328/24 1353/21 1405/19 1412/7 1442/15 1448/3 1491/10 Wednesday [5] 1328/8 1328/13 1329/7 1329/13 1499/19 Wednesdaynightrush.XLS [1] 1455/2

W	1379/2 1379/24 1379/25 1380/3 1380/12 1380/15 1380/15 1382/5 1383/1 1384/2 1384/4 1392/20 1392/21 1395/5 1396/13 1397/4 1399/6 1399/8 1402/5 1402/13 1402/19 1402/24 1404/17 1407/1 1409/21 1409/22 1410/1 1410/4 1410/20 1410/23 1413/14 1417/5 1417/7 1418/14 1426/15 1426/23 1428/18 1430/6 1430/10 1430/21 1430/24 1434/16 1442/24 1446/15 1450/1 1450/6 1450/17 1452/8 1452/9 1452/16 1453/16 1454/2 1454/11 1456/18 1457/19 1457/20 1458/6 1458/16 1461/17 1464/16 1464/25 1465/14 1465/17 1467/11 1467/22 1470/3 1470/11 1474/12 1478/20 1479/6 1479/6 1483/9 1483/14 1486/9 1486/23 1489/16 1489/18 1490/12 1490/13 1490/20 1493/16 1494/21 1495/4 1496/3 1496/11 1497/8 1497/16 1497/17 1497/19 1498/5 1499/21 1500/10 1500/12 1500/19 1501/19 1501/22 1502/18 1505/8 1506/1 weren't [3] 1358/18 1435/5 1499/22 what [186] 1315/24 1317/9 1318/1 1318/4 1319/10 1319/24 1320/1 1322/9 1322/18 1324/23 1325/5 1326/15 1326/24 1327/11 1328/2 1328/6 1329/9 1331/20 1333/15 1334/25 1336/6 1337/15 1337/15 1339/2 1339/7 1340/3 1340/17 1340/17 1342/14 1343/15 1343/15 1343/16 1343/18 1345/16 1346/22 1347/10 1348/1 1349/3 1350/20 1351/12 1351/25 1352/5 1352/23 1352/23 1355/2 1355/7 1355/15 1356/19 1356/24 1359/9 1360/18 1360/19 1360/19 1362/13 1363/14 1364/18 1365/25 1368/16 1371/2 1371/5 1372/3 1372/7 1372/13 1374/15 1374/16 1375/10 1375/15 1376/19 1377/8 1378/17 1378/18 1378/18 1378/19 1379/14 1379/17 1379/17 1379/20 1381/11 1381/17 1381/22 1383/6 1384/17 1385/3 1386/5 1387/2 1387/6 1388/24 1389/1 1390/1 1390/6 1390/10 1390/19 1390/23 1392/22 1393/14 1393/14 1395/8 1396/25 1399/2 1400/25 1402/15 1403/4 1405/14 1407/7 1407/13 1407/23 1410/6 1413/17 1415/16 1416/1 1416/15 1417/17 1418/25 1419/16 1420/9 1420/18 1421/19 1421/21 1424/12 1424/15 1424/15 1425/7 1426/15 1426/15 1427/18 1427/20 1427/23 1428/1 1428/3 1429/25 1430/2 1431/7 1431/19 1432/18 1432/22 1432/24 1434/13 1434/14 1435/2 1437/6 1441/25 1442/2 1442/24 1443/22 1444/2 1444/11 1444/16 1445/5 1445/6 1447/7 1447/13 1451/23 1452/7 1452/12 1452/13 1452/16 1457/19 1458/11 1461/3 1462/19 1462/23 1464/9 1467/5 1468/6 1469/11 1469/23 1470/3 1471/5 1474/2 1477/3 1480/1 1483/20 1486/6 1487/13 1488/5 1490/16 1490/20 1492/20 1493/16 1494/7 1497/6 1498/11 1498/17 1499/3 1501/10 1501/22 what's [9] 1319/25 1343/5 1397/22 1425/14 1427/13 1429/2 1448/25 1477/4 1477/4 whatever [5] 1319/25 1337/22 1439/1	1446/14 1492/6 whatsoever [1] 1406/22 when [70] 1317/12 1320/12 1322/20 1323/3 1323/6 1329/15 1336/1 1339/4 1346/15 1361/16 1368/10 1369/9 1383/3 1385/16 1392/22 1393/2 1397/4 1401/2 1401/14 1402/13 1405/20 1405/24 1405/24 1407/10 1408/13 1408/16 1409/23 1410/22 1414/25 1415/10 1417/11 1417/12 1417/14 1419/13 1419/17 1420/3 1420/6 1420/10 1420/19 1421/9 1421/11 1434/24 1435/4 1435/15 1435/21 1438/1 1442/6 1451/25 1459/8 1459/15 1466/9 1470/2 1470/11 1470/19 1471/9 1471/12 1474/11 1474/11 1475/8 1481/10 1481/11 1481/18 1482/17 1483/8 1483/9 1483/14 1490/20 1496/22 1498/2 1504/19 whenever [2] 1325/16 1353/3 where [47] 1322/13 1322/16 1341/7 1347/19 1347/21 1355/17 1355/20 1356/17 1361/14 1370/17 1373/17 1376/20 1379/4 1379/25 1380/12 1408/12 1408/15 1410/21 1412/23 1417/20 1424/18 1425/19 1426/1 1427/14 1428/13 1430/17 1433/21 1435/25 1439/15 1446/4 1451/8 1456/2 1457/18 1466/8 1473/10 1475/15 1478/4 1478/8 1479/19 1499/9 1499/10 1499/10 1500/21 1500/23 1502/16 1503/9 1503/9 whereas [1] 1359/12 WHEREUPON [5] 1315/6 1353/23 1354/1 1414/6 1506/1 wherever [1] 1428/14 whether [10] 1316/13 1361/19 1387/9 1399/6 1402/9 1423/14 1485/9 1487/23 1488/4 1503/22 which [64] 1317/19 1318/3 1323/10 1325/4 1325/20 1333/10 1337/3 1341/14 1344/18 1346/9 1347/4 1349/4 1349/15 1349/17 1350/22 1351/9 1351/10 1365/17 1371/6 1375/10 1379/21 1380/2 1380/17 1390/3 1397/25 1398/25 1400/12 1403/16 1403/18 1404/21 1404/21 1407/3 1408/10 1417/2 1424/10 1425/25 1427/16 1427/20 1434/14 1439/11 1439/13 1443/13 1448/6 1453/16 1455/18 1457/6 1458/25 1461/5 1461/9 1461/16 1464/3 1465/5 1465/24 1467/19 1470/15 1471/6 1474/17 1485/25 1486/7 1490/11 1491/22 1498/14 1499/15 1504/18 while [12] 1358/10 1359/3 1361/19 1361/21 1402/18 1416/20 1416/24 1421/13 1450/15 1455/21 1477/7 1477/22 Whiteley [1] 1311/2 who [16] 1335/17 1336/13 1337/15 1343/22 1343/24 1344/5 1362/20 1377/12 1386/1 1395/23 1398/13 1410/17 1430/15 1430/19 1431/25 1462/7 who's [1] 1412/12 whoever [1] 1337/16 whole [5] 1352/11 1354/7 1463/8 1472/6 1472/8 whose [1] 1341/22 why [16] 1358/13 1369/15 1382/22 1406/23 1411/22 1412/24 1415/8 1424/22 1428/14 1430/9 1431/23
----------	--	---

W
 why... [5] 1437/18 1438/13 1447/13
 1467/14 1504/23
 widely [1] 1380/23
 widen [1] 1415/11
 widening [1] 1351/10
 will [18] 1326/16 1330/9 1333/6 1365/21
 1394/9 1419/15 1424/14 1428/18
 1438/12 1438/13 1439/24 1446/18
 1460/14 1476/7 1478/1 1504/11
 1504/12 1505/22
 willing [1] 1435/5
 WINFIELD [1] 1310/19
 within [10] 1317/18 1326/17 1347/17
 1369/14 1384/2 1385/20 1418/15
 1429/13 1443/7 1481/3
 without [7] 1342/21 1363/14 1378/18
 1401/16 1422/5 1426/18 1457/22
 witness [15] 1342/23 1342/24 1353/12
 1353/15 1377/8 1378/17 1389/19
 1428/6 1430/2 1430/15 1431/5 1431/25
 1433/11 1504/6 1505/10
 witnessed [1] 1383/24
 witnesses [2] 1504/3 1504/18
 Woods [1] 1334/9
 word [6] 1342/14 1351/19 1453/23
 1454/17 1460/14 1488/11
 wording [2] 1317/8 1468/8
 words [4] 1406/19 1446/25 1470/25
 1471/1
 work [72] 1329/20 1331/1 1331/23
 1332/3 1345/1 1350/1 1350/3 1350/24
 1355/10 1355/12 1356/6 1356/13
 1357/7 1357/10 1358/21 1359/3 1359/4
 1360/3 1361/5 1361/18 1362/2 1362/11
 1362/23 1367/3 1378/8 1381/9 1381/10
 1382/4 1382/9 1384/13 1402/1 1413/15
 1413/17 1413/18 1413/18 1415/19
 1417/20 1422/1 1423/4 1423/8 1433/23
 1436/6 1436/7 1436/11 1436/14
 1436/17 1436/18 1438/8 1441/17
 1441/18 1457/24 1467/23 1468/18
 1470/1 1479/2 1479/7 1479/9 1479/12
 1480/10 1495/12 1497/16 1497/20
 1497/25 1498/3 1498/4 1498/5 1498/7
 1498/9 1498/11 1498/12 1501/15
 1503/3
 worked [9] 1333/22 1336/15 1336/20
 1355/13 1355/22 1357/18 1362/12
 1442/7 1455/6
 working [10] 1331/8 1331/12 1351/15
 1361/16 1367/7 1441/12 1442/11
 1467/14 1467/18 1505/20
 works [1] 1423/1
 worry [1] 1411/18
 worse [1] 1369/20
 would [153] 1317/11 1317/14 1318/5
 1319/10 1320/5 1321/10 1321/10
 1324/4 1325/12 1325/15 1326/23
 1326/23 1327/3 1328/13 1331/6
 1331/13 1335/20 1338/3 1338/17
 1338/17 1338/19 1345/5 1346/8
 1346/24 1348/13 1348/19 1349/9
 1349/12 1349/15 1349/16 1349/17
 1349/17 1350/11 1351/21 1352/6
 1353/1 1353/1 1353/2 1357/23 1357/25
 1360/12 1360/21 1361/20 1363/12
 1365/17 1368/9 1369/22 1370/6
 1370/15 1370/18 1371/17 1372/11
 1373/3 1376/11 1377/21 1377/24
 1378/11 1381/14 1381/16 1381/17
 1381/18 1382/20 1383/2 1383/2

1384/13 1384/13 1384/14 1385/6
 1385/7 1385/8 1385/9 1385/18 1386/6
 1387/13 1388/12 1390/9 1391/3
 1394/10 1400/23 1402/3 1402/10
 1403/9 1408/20 1409/25 1410/4
 1410/23 1413/24 1414/1 1415/21
 1415/25 1417/17 1417/19 1417/21
 1418/11 1419/2 1419/16 1419/23
 1420/6 1424/19 1426/2 1428/4 1430/25
 1431/1 1431/1 1431/2 1434/3 1436/7
 1436/15 1437/9 1439/13 1440/13
 1440/24 1446/24 1447/20 1447/25
 1449/17 1452/18 1458/22 1459/14
 1462/13 1463/6 1464/7 1465/16
 1465/24 1467/23 1468/19 1468/22
 1468/22 1469/9 1471/7 1471/24
 1475/23 1476/4 1476/21 1477/14
 1477/17 1478/5 1478/9 1478/16 1482/2
 1488/22 1491/22 1493/23 1493/25
 1496/24 1497/10 1499/8 1499/11
 1500/4 1501/23 1502/7 1504/22 1505/4
 wouldn't [6] 1344/17 1349/2 1403/10
 1434/11 1434/14 1502/5
 wrap [1] 1432/8
 wrapping [1] 1413/20
 Wright [1] 1309/21
 write [9] 1365/2 1398/17 1399/14
 1414/24 1446/18 1470/25 1480/10
 1481/7 1481/9
 write-up [1] 1398/17
 writes [5] 1386/20 1387/3 1396/9
 1421/12 1467/12
 writing [3] 1415/2 1426/18 1451/25
 written [5] 1332/21 1341/21 1430/25
 1431/2 1453/25
 wrong [8] 1384/18 1406/18 1406/23
 1426/15 1426/15 1429/7 1440/8
 1490/12
 wrote [20] 1330/11 1331/9 1335/5
 1335/14 1351/12 1352/6 1379/6
 1399/17 1444/16 1445/5 1450/7 1470/2
 1471/1 1471/2 1479/16 1480/1 1480/15
 1481/10 1481/18 1497/13

Y
 yeah [3] 1325/12 1333/15 1477/22
 year [3] 1369/8 1456/7 1479/8
 years [4] 1355/13 1356/23 1412/14
 1435/9
 yes [327]
 yet [2] 1426/3 1504/17
 yield [3] 1390/9 1443/19 1452/20
 yielded [1] 1395/10
 York [3] 1310/11 1310/11 1313/8
 you [795]
 you'd [4] 1317/25 1326/24 1355/20
 1369/7
 you'll [1] 1488/1
 you're [32] 1316/14 1317/9 1318/3
 1337/19 1337/23 1340/22 1349/14
 1353/11 1410/17 1410/24 1437/21
 1439/7 1443/22 1444/1 1444/17
 1444/19 1445/11 1446/7 1446/13
 1446/23 1448/22 1475/25 1482/12
 1482/21 1488/5 1489/21 1491/17
 1491/25 1493/11 1503/21 1504/4
 1504/23
 you've [6] 1326/20 1334/25 1354/7
 1355/22 1403/24 1494/8
 your [323]
 Your Honor [2] 1315/12 1380/7
 yours [1] 1390/16
 yourself [2] 1328/14 1385/16

Z
 Zaldivar [45] 1416/10 1416/11 1416/12
 1416/15 1418/13 1418/19 1418/21
 1418/25 1419/7 1420/8 1420/20
 1420/25 1421/12 1421/14 1422/1
 1422/13 1423/6 1423/8 1423/13
 1423/21 1424/7 1425/16 1425/22
 1426/12 1427/17 1427/18 1427/19
 1427/22 1428/1 1428/21 1429/4 1431/1
 1431/2 1431/11 1431/13 1431/18
 1431/20 1487/17 1488/20 1490/8
 1490/15 1490/19 1490/23 1494/1
 1502/7
 Zaldivar's [22] 1417/24 1423/1 1423/15
 1423/25 1424/6 1425/16 1426/9
 1426/15 1429/19 1430/6 1430/9
 1430/11 1430/24 1487/14 1488/11
 1488/17 1489/25 1490/9 1490/12
 1493/11 1494/3 1501/19
 zero [19] 1319/11 1323/23 1342/17
 1344/18 1345/5 1373/1 1392/7 1392/18
 1392/23 1403/9 1404/21 1408/12
 1409/7 1409/11 1439/20 1439/24
 1471/21 1484/10 1493/2
 Zick [4] 1470/1 1470/3 1504/12 1504/14
 Ziegler's [1] 1505/21