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UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF LOUISIANA

IN RE: OIL SPILL BY THE OIL RIG * Docket 10-MD-2179
DEEPWATER HORIZON IN THE *
GULF OF MEXICO ON APRIL 20, 2010 * Section J

Applies to: * New Orleans, Louisiana
*
Docket 10-CV-02771, * October 9, 2013
IN RE: THE COMPLAINT AND *
PETITION OF TRITON ASSET *
LEASING GmbH, et al. *

Docket 10-CV-4536, *
UNITED STATES OF AMERICA v. *
BP EXPLORATION & PRODUCTION, *
INC., et al. *

* * * * *

DAY 7, AFTERNOON SESSION
TRANSCRIPT OF NONJURY TRIAL BEFORE
THE HONORABLE CARL J. BARBIER
UNITED STATES DISTRICT JUDGE

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24 Proceedings recorded by mechanical stenography using
25 computer-aided transcription software.

I N D E X

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TREVOR HILL	
Videotaped deposition	1958
MEHRAN POOLADI-DARVISH, PH.D.	
Voir Dire Examination Mr. Chakeres	1959
Direct Examination By Mr. Chakeres:	1960
Cross-Examination By Mr. Fields:	2018

1 **AFTERNOON SESSION**

2 **(October 9, 2013)**

3 * * * * *

01:12 4 **THE DEPUTY CLERK:** All rise.

01:28 5 **THE COURT:** All right. Everybody be seated, please.

01:28 6 All right. Any preliminary matters?

01:28 7 **MS. PENCAK:** Yes, Your Honor. Good afternoon. Erica
01:28 8 Pencak for the United States.

01:29 9 I have a list of the United States exhibits,
01:29 10 call-outs, and demonstratives used in yesterday's examinations
01:29 11 of Dr. Hsieh and Dr. Griffiths. We circulated those lists to
01:29 12 the parties yesterday and received no objections. We file,
01:29 13 offer, and introduce these exhibits, call-outs, and
01:29 14 demonstratives into evidence.

01:29 15 **THE COURT:** These are, you said, related to Dr. Hsieh
01:29 16 and Dr. Griffiths; correct?

01:29 17 **MS. PENCAK:** That's correct.

01:29 18 **THE COURT:** All right. Any objections?

01:29 19 Without objection, those are admitted.

01:29 20 **MS. PENCAK:** I also have the list of the
01:29 21 17 deposition bundles that the United States designated for the
01:29 22 Phase Two trial and a thumb drive for Stephanie that contains
01:29 23 those bundles.

01:29 24 We offer these bundles into evidence as well as
01:29 25 the designations made by the United States contained in the

01:29 1 deposition bundles previously offered by the aligned parties
01:29 2 and BP. By offering these bundles into evidence, we do not
01:29 3 waive but maintain our objections to portions of the
01:29 4 designations made by other parties in these bundles.

01:29 5 **THE COURT:** These contain the designations made by
01:30 6 the United States and BP?

01:30 7 **MS. PENCAK:** Yes. By all parties, Your Honor.

01:30 8 **THE COURT:** It's not just your designations.

01:30 9 **MS. PENCAK:** Correct.

01:30 10 **MR. FIELDS:** I think the only issue -- and I'm not,
01:30 11 perhaps, the best person on this, but I know there were some --

01:30 12 **THE COURT:** You need to identify yourself.

01:30 13 **MR. FIELDS:** Oh, I'm sorry. Sorry. Barry Fields
01:30 14 representing BP.

01:30 15 One issue I know that was in the mix was a
01:30 16 question about the deposition bundle for Dr. Bushnell. And, of
01:30 17 course, we had raised an objection about that. I believe
01:30 18 that's inconsistent with the Court's directive.

01:30 19 **MS. PENCAK:** We're not offering that at this time.

01:30 20 **MR. FIELDS:** Thank you.

01:30 21 **THE COURT:** With that understanding, those will be
01:30 22 admitted.

01:30 23 **MS. PENCAK:** Thank you, Your Honor.

01:30 24 And then one final matter. I also have with me
01:30 25 the list of the exhibits, demonstratives, and call-outs that

01:30 1 were used and offered in connection with the United States'
01:30 2 examination of Dr. Ronald Dykhuizen on Monday.

01:30 3 BP has raised objections to two of those
01:30 4 exhibits after the testimony. We responded to BP with a
01:31 5 response to those objections, but have not heard back. And I
01:31 6 was wondering if BP maintains them.

01:31 7 **MR. LANGAN:** Your Honor, Andy Langan for BP.

01:31 8 Can we reserve on this? I think the lawyer
01:31 9 responsible for that must be meeting with a witness or
01:31 10 something. We'd appreciate if the United States --

01:31 11 **THE COURT:** Okay. We can deal with this either later
01:31 12 today or tomorrow.

01:31 13 **MR. LANGAN:** I'm quite certain we haven't given up on
01:31 14 the objections that we've raised, but we'd ask for some time.

01:31 15 **THE COURT:** All right.

01:31 16 **MR. LANGAN:** Thank you.

01:31 17 **THE COURT:** Sure.

01:31 18 **MS. PENCAK:** Thank you, Your Honor.

01:31 19 **MS. HIMMELHOCH:** Your Honor, Sarah Himmelhoch for the
01:31 20 United States.

01:31 21 At this time we would call by video deposition
01:31 22 the witness Trevor Hill.

01:31 23 **THE COURT:** Trevor Hill by video.

01:31 24 **MS. HIMMELHOCH:** Yes.

01:31 25 **THE COURT:** How long is this going to last?

01:31 1 **MS. HIMMELHOCH:** 15 minutes, I believe, Your Honor.

01:31 2 **THE COURT:** Okay.

01:31 3 (WHEREUPON, the videotaped deposition of **Trevor Hill**
01:31 4 was played.)

01:46 5 * * * * *

01:46 6 **MS. KING:** Your Honor, Rachel King for the United
01:46 7 States. This is the conclusion of the three video clips that
01:46 8 the United States will be playing as part of its case in chief.
01:46 9 At this time we'd like to move in the video clips as well as
01:46 10 the transcripts from Mike Mason, David Barnett, and Trevor
01:46 11 Hill.

01:46 12 **THE COURT:** All right. Any objections?

01:46 13 Without objection, those are admitted.

01:46 14 **MS. KING:** Thank you, Your Honor.

01:46 15 **MR. CHAKERES:** Your Honor, Nat Chakeres on behalf of
01:46 16 the United States. At this time the United States would like
01:46 17 to call its final witness for its case in chief, Dr. Mehran
01:46 18 Pooladi-Darvish.

01:46 19 **THE COURT:** Okay.

01:46 20 (WHEREUPON, **MEHRAN POOLADI-DARVISH, PH.D.**, having
01:46 21 been duly sworn, testified as follows:)

01:47 22 **THE DEPUTY CLERK:** Please state your full name and
01:47 23 correct spelling for the record.

01:47 24 **THE WITNESS:** My name is Mehran Pooladi-Darvish.
01:47 25 That's spelled M-E-H-R-A-N. Last name is hyphenated, two

MEHRAN POOLADI-DARVISH, PH.D. - VOIR DIRE

01:47 1 words, P-O-O-L-A-D-I, hyphen, D-A-R-V-I-S-H.

01:47 2 **VOIR DIRE EXAMINATION**

01:47 3 **MR. CHAKERES:** May it please the Court?

01:47 4 **THE COURT:** Yes.

01:47 5 **BY MR. CHAKERES:**

01:47 6 **Q.** Dr. Pooladi-Darvish, do you intend to provide an expert
01:47 7 opinion in this case?

01:47 8 **A.** I do.

01:47 9 **Q.** Are the opinions and analysis you intend to provide to the
01:47 10 Court contained in expert reports?

01:47 11 **A.** They are, yes.

01:47 12 **MR. CHAKERES:** Could we bring up Exhibit 11653.

01:48 13 **BY MR. CHAKERES:**

01:48 14 **Q.** Is this your opening expert report?

01:48 15 **A.** Yes. This is the cover page for that report.

01:48 16 **MR. CHAKERES:** Could we bring up Exhibit 11654R.

01:48 17 **BY MR. CHAKERES:**

01:48 18 **Q.** Sir, is this the cover page of your rebuttal expert
01:48 19 report?

01:48 20 **A.** It is, yes.

01:48 21 **Q.** Are the opinions you intend to provide to the Court
01:48 22 summarized in these two reports?

01:48 23 **A.** They are.

01:48 24 **MR. CHAKERES:** Your Honor -- well...

25

MEHRAN POOLADI-DARVISH, PH.D. - VOIR DIRE

01:48 1 **BY MR. CHAKERES:**

01:48 2 **Q.** Do you adopt these opinions for your testimony to the
01:48 3 Court today?

01:48 4 **A.** I do, yes.

01:48 5 **MR. CHAKERES:** Your Honor, there are no Daubert
01:48 6 motions pending with respect to Dr. Pooladi-Darvish, and at
01:48 7 this time we'd like to tender him as an expert in reservoir
01:48 8 engineering.

01:48 9 **THE COURT:** All right. There are no Daubert motions
01:48 10 with respect to this witness; correct?

01:48 11 **MR. FIELDS:** Your Honor, Barry Fields on behalf of
01:48 12 BP. That's correct.

01:48 13 **THE COURT:** All right. So I'll accept him in the
01:48 14 field tendered and admit his reports, yes.

01:49 15 **MR. CHAKERES:** Yes, if you would.

01:49 16 Could we display demonstrative D-21810?

01:49 17 **DIRECT EXAMINATION**

01:49 18 **BY MR. CHAKERES:**

01:49 19 **Q.** Dr. Pooladi-Darvish, could you provide the Court briefly
01:49 20 with your professional, educational, and work background.

01:49 21 **A.** Sure. The education, I have a Bachelor's in chemical
01:49 22 engineering. Later I did a Master's in chemical and petroleum
01:49 23 engineering. Both of these were back in Iran. Then I did my
01:49 24 Ph.D. in Canada, at the University of Alberta, followed by a
01:49 25 postdoctorate fellowship in Palo Alto, California.

MEHRAN POOLADI-DARVISH, PH.D. - DIRECT

01:49 1 Q. Okay. Could we just slow down a little bit? The court
01:49 2 reporter will probably appreciate it.

01:49 3 What is your current --

01:49 4 **THE COURT:** And you can pull that microphone towards
01:49 5 you. You can pull it towards you, bend it any way. If you
01:49 6 stay about this far away, it's perfect usually. Yeah.

01:49 7 **THE WITNESS:** Thank you.

01:49 8 **BY MR. CHAKERES:**

01:49 9 Q. What is your current professional position?

01:49 10 A. I'm a senior director at IHS, which is the company that
01:50 11 purchased Fekete. That's where I was working when I wrote the
01:50 12 reports.

01:50 13 Q. Okay. What is your area of expertise at IHS?

01:50 14 A. Reservoir engineering. I do -- I'm particularly in charge
01:50 15 of what is called integrated reservoir studies.

01:50 16 Q. All right. Could you just -- we'll get into that in just
01:50 17 a moment. Could you describe what types of clients you work
01:50 18 for?

01:50 19 A. Sure. Clients are a wide range of them, from small
01:50 20 companies with a few people working in a few wells to much
01:50 21 larger companies, independents, international companies,
01:50 22 governments from all around the world.

01:50 23 Q. And what types of projects are you typically asked to
01:50 24 perform for those clients?

01:50 25 A. And the spectrum of the projects are similarly wide.

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01:50 1 There is -- but under the topic of reservoir engineering, these
01:50 2 reservoirs may be onshore or offshore. They may be very
01:50 3 developed, mature fields or they may be in the exploratory
01:51 4 phase of their development.

01:51 5 But generally we are asked in these cases to study
01:51 6 the past performance of the reservoir and the measurements that
01:51 7 have been done to characterize the reservoir and predict their
01:51 8 future performance, particularly their production of
01:51 9 hydrocarbons from the reservoir, as a function of time.

01:51 10 Q. Have you also worked as a professor?

01:51 11 A. Yes. For approximately 14 years, I was a professor at
01:51 12 University of Calgary in Canada.

01:51 13 Q. Have you received any professional honors?

01:51 14 A. Yes, I have. Most recently I was a Distinguished Lecturer
01:51 15 of SPE. Prior to that I was invited to be a member of the
01:51 16 expert panel of Council of Canadian Academies. And there have
01:51 17 been a number of other awards that I have received either by --
01:51 18 from my students or from professional associations. Yes, a few
01:51 19 of them are listed in this slide.

01:52 20 Q. Do you have any publications in the area of reservoir
01:52 21 engineering?

01:52 22 A. My peer-reviewed publication, journal publications, are
01:52 23 approximately 60 more than -- a few more than 60, I believe, at
01:52 24 this time. And if I were to consider conference papers, dozens
01:52 25 more.

MEHRAN POOLADI-DARVISH, PH.D. - DIRECT

01:52 1 Q. Have you worked on blowout studies previously?

01:52 2 A. I have done.

01:52 3 Q. In your day-to-day work for oil companies, do you have to
01:52 4 deal with uncertainty in the data, in the input data you
01:52 5 receive?

01:52 6 A. Very commonly. All data that we receive, whether it's
01:52 7 measurements of the pressure of production, which is typically
01:52 8 called the response of the reservoir, or whether it is
01:52 9 measurement of the fluid and rock properties, they always carry
01:52 10 uncertainties.

01:52 11 Q. How do you deal with uncertainty in the data that you need
01:52 12 to use to perform your job?

01:52 13 A. We try to account for it -- and particularly in that
01:52 14 accounting for uncertainty, two things become extremely
01:53 15 important to me. One is what is the range of uncertainty in my
01:53 16 data, and as importantly is which of these uncertainties might
01:53 17 affect my objective or my outcome.

01:53 18 Sometimes the data may exist that bears a large
01:53 19 uncertainty but doesn't impact my answers, so I try to find out
01:53 20 both aspects of it: What is the range of uncertainty, and how
01:53 21 much it might impact my answers.

01:53 22 Q. And is that something your clients expect you to do?

01:53 23 A. Yes, very often.

01:53 24 Q. Why?

01:53 25 A. They are also -- they are not only interested in our best

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01:53 1 estimate of the outcome, but they also want to know what may be
01:53 2 the range of uncertainty in our answers. If they are doing
01:53 3 investments for the development of the reservoir or otherwise,
01:53 4 they want to know the risk that they are carrying, how good do
01:53 5 we know our best answer. That is very important.

01:53 6 So a formal discipline of uncertainty assessment has
01:53 7 to be developed that we take into account in our work.

01:54 8 Q. Dr. Pooladi-Darvish, I'd like to --

01:54 9 THE COURT: Wait, wait. I have one question because
01:54 10 I thought I heard one thing, but the realtime came out
01:54 11 differently. I want to make sure what the witness' answer was.

01:54 12 You were asked, in terms of your background and
01:54 13 experience, have you worked on blowout studies previously. Did
01:54 14 you say you had or you have not?

01:54 15 THE WITNESS: I have.

01:54 16 THE COURT: You have. Okay.

01:54 17 All right. Go ahead.

01:54 18 BY MR. CHAKERES:

01:54 19 Q. Could you provide the Court just a brief description of
01:54 20 the other blowout work you've worked with.

01:54 21 A. Sure. There have been actually a couple of them. One of
01:54 22 them I have worked -- I was in charge -- the engineer in charge
01:54 23 of doing that study and presented the results to the client.
01:54 24 It was about a year and a half ago. A well blew out in
01:54 25 Alberta, and I was asked to assess the amount -- the rate of

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01:55 1 flow and the duration of the flow. At that time the duration
01:55 2 was also questioned. And, again, I was asked to estimate the
01:55 3 degree of uncertainty in my answers.

01:55 4 And then I have been associated with a couple of
01:55 5 other ones as well.

01:55 6 Q. And you weren't in charge on those other ones?

01:55 7 A. I was not in charge of the other ones, that's correct.

01:55 8 Q. I'd like at this time for you to provide the Court with an
01:55 9 overview of what you're going to present with your work.

01:55 10 MR. CHAKERES: If we could go to demonstrative
01:55 11 D-21811.

01:55 12 BY MR. CHAKERES:

01:55 13 Q. Could you describe to the Court what you intend to testify
01:55 14 about today.

01:55 15 A. Sure. I have -- I have divided my work into different
01:55 16 segments, particularly I would call them analytical study,
01:55 17 numerical study, and doing the uncertainty assessment. But
01:55 18 before getting into that, I want to just quickly present an
01:55 19 overview where I want to say what I did and why I chose the
01:55 20 methods that I used.

01:56 21 In particular, I want to -- I want to discuss why
01:56 22 some of the techniques that we commonly use in reservoir
01:56 23 engineering, such as material balance and well testing, are
01:56 24 not -- are not good methods to be used in this case because
01:56 25 of -- because of the uncertainties that existed.

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01:56 1 And then the -- the finding of a good calibration
01:56 2 point, the collection data that the Court has heard about, that
01:56 3 allowed me to narrow down -- to first to choose my methodology
01:56 4 and then narrow down my range of answers.

01:56 5 **MR. CHAKERES:** Let's go to demonstrative D-21812.

01:56 6 **BY MR. CHAKERES:**

01:56 7 **Q.** What question were you asked to answer in this case?

01:56 8 **A.** The key question was: What is the cumulative volume of
01:56 9 oil released?

01:56 10 **Q.** Were you asked to provide a precise estimate of reservoir
01:56 11 properties?

01:56 12 **A.** No. A lot of times when we want to estimate oil
01:56 13 production or, in this case, cumulative volume of oil
01:57 14 production, we need to, of course, try to find the reservoir
01:57 15 properties. In general, sometimes we can find some of them or
01:57 16 find a fairly accurate description of them and sometimes we
01:57 17 cannot.

01:57 18 In this particular case, I'm of the opinion that --
01:57 19 and I demonstrated that we could come up with a fairly defined
01:57 20 and fairly narrow range of cumulative volume of oil released
01:57 21 that is consistent with all of the available data.

01:57 22 However, to the end, some of the reservoir parameters
01:57 23 remains quite uncertain.

01:57 24 **Q.** What conclusion did you ultimately reach?

01:57 25 **A.** My best estimate of cumulative volume of oil released is

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01:57 1 between 5 and 5.3 million barrels, stock tank barrels.

01:57 2 Q. What were the challenges that you faced when you looked at
01:57 3 the data available in this case?

01:57 4 A. The key challenges I have been mentioning is the degree of
01:57 5 uncertainty that existed. This was a reservoir primarily at
01:57 6 the point of exploration. Only one well had been drilled into
01:58 7 it. Some data was obtained, which was good data, but some
01:58 8 other tests were left incomplete or maybe had not been planned
01:58 9 even. So it was early in the data collection, and the range of
01:58 10 uncertainty was large.

01:58 11 When I considered the objective of this study that
01:58 12 was finding cumulative volume of oil in place, I quickly went
01:58 13 through in my mind -- were a couple of different methods that I
01:58 14 might be able to use as a reservoir engineer to provide that
01:58 15 answer.

01:58 16 The first method that I thought was -- in fact, was
01:58 17 material balance method. It's a very simple method, as has
01:58 18 been discussed. The challenge that I had in using it was it
01:58 19 requires input data, such as oil in place, that bears a large
01:58 20 degree of uncertainty, and quickly talked to the counsel and
01:58 21 was informed that that degree of uncertainty in the answers is
01:58 22 probably not what you wanted. So I went further to other -- to
01:58 23 consider other techniques that might have less uncertainty in
01:59 24 them.

01:59 25 Q. And how did you ultimately arrive at a solution in this

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01:59 1 case?

01:59 2 A. Two things: One is that I -- the input -- I found that
01:59 3 the input data that would go into my models likely would bear a
01:59 4 large uncertainty, whether it's oil in place, whether it's
01:59 5 permeabilities, skin or otherwise. I needed to find response
01:59 6 of the reservoir such that I would calibrate my models to that
01:59 7 response.

01:59 8 And the witness -- or Dr. Kelkar referred to it as
01:59 9 dynamic data of the reservoir. That's response of the
01:59 10 reservoir. In particular, two sets of information. One was a
01:59 11 period of collection rate that was done prior to well being
01:59 12 shut in. That proved to be very useful. In addition to the
01:59 13 shut-in pressures after the well was shut in, the pressure
01:59 14 buildup that it had, I calibrated my model to these, and that
02:00 15 allowed me to narrow down my range of uncertainty in my
02:00 16 answers.

02:00 17 Q. Let's continue with how you set up your model. Let's turn
02:00 18 now to your analytical study.

02:00 19 MR. CHAKERES: If we could look at demonstrative
02:00 20 D-21815.

02:00 21 BY MR. CHAKERES:

02:00 22 Q. Can you briefly describe the analytical phase of your work
02:00 23 for the Court.

02:00 24 A. Yes. In the analytical phase of my work, I used the
02:00 25 information that was available during that collection time to

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02:00 1 estimate flow rate on July 14th and 15th. Once I did that,
02:00 2 then -- and this is similar to the technique that has been
02:00 3 discussed already by Dr. Ron Dykhuizen and Griffiths. But once
02:00 4 I did that, immediately I went underground. I went into --

02:00 5 **THE COURT:** I thought you said, "I went underground."

02:01 6 **THE WITNESS:** Yes. I went into where reservoir
02:01 7 engineers typically work, as a realm of my work. That would be
02:01 8 building now reservoir and wellbore models that are calibrated
02:01 9 with that collection rate that I had estimated.

02:01 10 And now that I had the wellbore and reservoir
02:01 11 model that not only matched the rate at the final day, I had
02:01 12 also sequence of flow rate as a function of time, and that
02:01 13 allowed me to find the cumulative volume of oil released.

02:01 14 **BY MR. CHAKERES:**

02:01 15 **Q.** Let's begin with the calibration point that you spoke of.

02:01 16 **MR. CHAKERES:** If we could look at demonstrative
02:01 17 D-21818.

02:01 18 **BY MR. CHAKERES:**

02:01 19 **Q.** Did you look at the accuracy of the collection rates?

02:01 20 **A.** Yes. The fluid that was being collected from the BOP on
02:01 21 July 15th was being collected on two ships on the surface,
02:01 22 *Q4000* and *Helix Producer*. I carefully reviewed that data that
02:02 23 was being measured actually using two different techniques on
02:02 24 their ship and assessed that the degree of uncertainty on that
02:02 25 measured volume of oil production was approximately plus or

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02:02 1 minus 600 stock tank barrel per day, which is about 3 percent
02:02 2 of what was being collected.

02:02 3 So that degree of uncertainty is much less than many
02:02 4 of the other measurements that we have.

02:02 5 Q. How did you use the collection rates as a calibration
02:02 6 point in your model? And we can split it up first for the
02:02 7 analytical and then the numerical.

02:02 8 A. Sure. Yes, I used them slightly different in -- different
02:02 9 in the two phases.

02:02 10 In the analytical phase of my work, when I have these
02:02 11 measured collection rates, use them along with wellhead
02:03 12 pressures, the pressures in the cap stack and the BOP and the
02:03 13 ambient pressure during the collection and no-collection time.
02:03 14 I wrote simple relationships of flow -- this is, again, similar
02:03 15 to what Dr. Ron Dykhuizen mentioned and Dr. Griffiths
02:03 16 mentioned -- to find the total volume of oil flow from the well
02:03 17 at that time. And then I -- I then calibrated my analytical
02:03 18 model to match that.

02:03 19 In my numerical model, I matched directly the
02:03 20 collection rates. I did a series of numerical model simulation
02:03 21 models, and I examined to see whether they do match the
02:03 22 collection rate or not. And I accept only the ones that match
02:03 23 collection rates. They would be only consistent with the
02:03 24 response of the reservoir.

02:03 25 Q. And we'll discuss your numerical model in a little bit

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02:03 1 more detail in a moment.

02:03 2 First, let's go through your analytical method. I
02:03 3 think the Court has heard a lot about the capping stack flow
02:04 4 calculations, so we won't repeat them here.

02:04 5 For the record, did you also provide your own
02:04 6 independent validation of those calculated flow rates on the
02:04 7 last day?

02:04 8 A. Yes. I did it in a couple of different ways, and they
02:04 9 have been described on my primary report, at least, and maybe
02:04 10 also in my rebuttal report.

02:04 11 **MR. CHAKERES:** Let's go to Demonstrative 21825.

02:04 12 **BY MR. CHAKERES:**

02:04 13 Q. So after you calibrated the flow rate for the final day,
02:04 14 could you walk through the remaining steps of your analytical
02:04 15 method.

02:04 16 A. Certainly. So this is a description of what I do in my
02:04 17 analytical work. As discussed, once I find the flow rate on
02:04 18 the final day, then now I can go underground and calculate
02:04 19 initially just the so-called discharge coefficients in the
02:04 20 wellbore and reservoir.

02:04 21 Now, immediately in the second bullet, I go and build
02:05 22 so-called wellbore and reservoir models, and by building
02:05 23 wellbore and reservoir models -- these are not physical models,
02:05 24 but these are -- now I'm using software programs that are
02:05 25 conventionally used by petroleum engineers that will

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02:05 1 incorporate things like actual dimension of the wellbore, the
02:05 2 diameter of the wellbore. For the reservoir, it would include
02:05 3 the size, permeability, skin, oil in place.

02:05 4 So all of the input parameters that are a lot of time
02:05 5 independently measured or we have an estimation of them, now
02:05 6 those inputs would go into these models, and that would allow
02:05 7 one to see whether I do not have any more -- just a constant
02:05 8 discharge factor; I have individual parameters that can be
02:05 9 checked against these independently measured parameters.

02:05 10 Q. And what did you find once you built your analytical model
02:05 11 for the cumulative volume of oil released?

02:05 12 A. In the analytical work, the wellbore and reservoir model,
02:06 13 now that we're flowing together over this 86 days' duration of
02:06 14 flow, gave a total volume of 5.2 million stock tank barrels of
02:06 15 oil.

02:06 16 Q. In your opinion, was that a unique answer to the problem
02:06 17 based on the data you had?

02:06 18 A. No. At this time certainly I didn't know whether that is
02:06 19 unique or not. In fact, I had a big question in my mind
02:06 20 whether this is unique or not.

02:06 21 And the reason that I had a big question is, by this
02:06 22 time I had come up with one description of wellbore and
02:06 23 reservoir, one particular permeability, one skin, one OIP, and
02:06 24 one wellbore description, that allowed matching of the
02:06 25 collection in the last -- that last day, allowed matching of

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02:06 1 the shut-in pressures. So the buildup pressures was consistent
02:06 2 with all measurements.

02:06 3 But this had only one description of wellbore and
02:07 4 reservoir, and I knew that I need to check to see whether --
02:07 5 are there other descriptions of wellbore and reservoir that
02:07 6 could still be consistent with the response of the reservoir,
02:07 7 and then what would be their volume of oil release.

02:07 8 Q. So what was the next phase of your analysis?

02:07 9 A. I step into uncertainty assessments.

02:07 10 MR. CHAKERES: Let's move now to Demonstrative
02:07 11 D-21826.

02:07 12 BY MR. CHAKERES:

02:07 13 Q. Could you describe what you accomplished in your
02:07 14 uncertainty assessment?

02:07 15 A. I basically answered the two questions that I had
02:07 16 mentioned before that I need to answer in uncertainty
02:07 17 assessment; that is, finding what parameters might have a big
02:07 18 impact on my answer and then what are the range of
02:07 19 uncertainties in these parameters.

02:07 20 Q. How did you go about determining which parameters were
02:07 21 important or which parameters had an impact on your results?

02:07 22 A. So initially I considered all reservoir parameters that
02:08 23 affect reservoir response. That would include -- and I have a
02:08 24 table in my reports -- from not only obvious things, such as
02:08 25 permeability, thickness, porosity, viscosity, but even things

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02:08 1 that initially I thought might have smaller effects, such as
02:08 2 even fluid properties, compressibility.

02:08 3 So I looked into -- I considered all of the
02:08 4 parameters, then started to look into what estimates of these
02:08 5 parameters exist, whether it was BP's estimates, whether it was
02:08 6 actual measurements performed by laboratories that were hired
02:08 7 by -- by BP, such as Schlumberger and Weatherford and others,
02:08 8 to -- all I did initially to find out what are the range of
02:08 9 parameters that might -- might be applicable to this reservoir
02:09 10 and fluid system.

02:09 11 Q. So what reservoir engineering concepts did you use to
02:09 12 assess the importance of these parameters?

02:09 13 A. For -- okay. Now that I had a list of parameters, I
02:09 14 needed to find out which ones are important. For reservoir
02:09 15 estimates, you have a graphical technique based on inflow
02:09 16 performance relationship, or IPR. Dr. Kelkar also referred to
02:09 17 it.

02:09 18 I have a demonstration that describes how IPR may be
02:09 19 used to find out which parameters might have the biggest impact
02:09 20 on reservoir performance.

02:09 21 MR. CHAKERES: Let's bring that up. Could we go to
02:09 22 Demonstrative D-21829.

02:09 23 BY MR. CHAKERES:

02:09 24 Q. Could you describe what's happening on this graph.

02:09 25 A. Yes. First, what I have on this graph -- it's on a

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02:09 1 vertical axis. I have bottom hole pressure rising upward, and
02:10 2 on the horizontal axis, I have flow rate.

02:10 3 The solid black line on top, that is the so-called
02:10 4 inflow performance relationship. What that intends to do is
02:10 5 describe the flow that might come from a reservoir if the
02:10 6 reservoir was acting independently, not coupled with the
02:10 7 wellbore.

02:10 8 It may be useful if I just quickly explain it. So
02:10 9 I'm considering I have a reservoir that is flowing against --
02:10 10 there is bottom hole pressure or a sandface pressure. If I
02:10 11 lower the sandface pressure, there is a larger driving force
02:10 12 pushing the fluid from the reservoir initial pressure toward
02:10 13 wellbore. So flow rate would go up. As pressure is reduced,
02:10 14 flow rate would go up.

02:10 15 So IPR curve would be a downward-trending curve. As
02:10 16 you go along it, you come across lower bottom hole pressures
02:10 17 and higher rates.

02:10 18 Q. What is a TPC curve?

02:11 19 A. TPC curve is an analogous curve that describes the
02:11 20 deliverability of a wellbore as opposed to a reservoir. So it
02:11 21 looks at what would be the flow capacity of wellbore
02:11 22 independent, decoupled from the reservoir.

02:11 23 Q. And you were talking about the downward slope --

02:11 24 THE COURT: What was the word you used? You said it
02:11 25 describes the --

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02:11 1 THE WITNESS: Deliverability.

02:11 2 THE COURT: Deliverability?

02:11 3 THE WITNESS: Yes. My apologies on the accent.

02:11 4 THE COURT: That's okay. I was trying to make sure I
02:11 5 understood what word you used there.

02:11 6 BY MR. CHAKERES:

02:11 7 Q. How do these -- how do you use these curves to access
02:11 8 input parameters?

02:11 9 Well, first, let's go to a point: What happens when
02:11 10 the two curves meet?

02:11 11 A. Yes. So TPC curve is an upward-trending curve, and IPR
02:11 12 curve is a downward-trending curve. This is kind of analogous
02:12 13 to the supply-and-demand curves against price in economics.

02:12 14 Where they hit each other is the -- we call it the
02:12 15 operating point. That's the only point where both the wellbore
02:12 16 and the reservoir together can work at. And, therefore, once
02:12 17 you have the IPR curve and the TPC curve, the cross point gives
02:12 18 you the actual flow rate from that combined, coupled wellbore
02:12 19 reservoir system.

02:12 20 BY MR. CHAKERES:

02:12 21 Q. With that description, how do you use these curves to
02:12 22 assess the importance of input parameters?

02:12 23 A. So what I look at now is to see, when my input parameters
02:12 24 change, how much that operating point might change. Operating
02:12 25 point is equal to the flow rates.

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02:12 1 So what I do, I go ahead and use the various input
02:12 2 parameters that I had identified that might impact my
02:12 3 reservoir; one by one, start changing them, and look at the
02:12 4 swing that it causes on my IPR curve, which then leads to a
02:13 5 change in flow rate.

02:13 6 Q. So what does a large swing represent?

02:13 7 A. A large swing then would intersect the TPC curve, and the
02:13 8 lower flow rate would mean a bigger impact. The parameter that
02:13 9 causes the larger swing will have a large impact potentially on
02:13 10 flow rate.

02:13 11 Q. And can you do this with both the IPR curve and the TPC
02:13 12 curve?

02:13 13 A. Yes. As part of my uncertainty assessment, I not only
02:13 14 looked at all parameters that impact reservoir, but I have
02:13 15 developed a similar table for all parameters that affect the
02:13 16 wellbore response.

02:13 17 I took those parameters, one by one, put it into the
02:13 18 TPC curve, and looked at which parameters gave me the larger
02:13 19 swing on the TPC curve.

02:13 20 MR. CHAKERES: Let's look at that. If we could go to
02:13 21 Demonstrative D-21830.

02:13 22 BY MR. CHAKERES:

02:13 23 Q. What is this showing?

02:13 24 A. So this plot is similar to the previous plot that -- on
02:14 25 the vertical axis, again, I have the bottom hole pressures, and

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02:14 1 on the horizontal axis I have the oil rate.

02:14 2 What are shown are the various IPR curves, and these
02:14 3 are various because I am changing the parameters in generating
02:14 4 these IPR curves.

02:14 5 **Q.** What did you -- which parameters did you find were most
02:14 6 important from the reservoir side?

02:14 7 **A.** So this plot clearly shows that skin, for example, has led
02:14 8 to oil and IPR curves that are farthest from the center. So
02:14 9 when I change skin to zero or 50, I change between these
02:14 10 parameters, it makes a big impact on IPR curve.

02:14 11 Similarly, when I change permeability over the degree
02:14 12 of uncertainty that I had assessed, it would have a big impact
02:14 13 on the IPR curve. And there are a couple of other parameters,
02:14 14 the net pay and oil viscosity that also similarly has a large
02:15 15 impact on IPR.

02:15 16 **Q.** Were there some parameters that you found did not have a
02:15 17 large impact on the IPR curves?

02:15 18 **A.** Yes. All of the ones that fall roughly close to middle,
02:15 19 close to so-called my "base case," although I had changed an
02:15 20 input parameter in generating these IPR curves, it didn't cause
02:15 21 a big impact.

02:15 22 These parameters included things like compressibility
02:15 23 as well as fluid properties.

02:15 24 **MR. CHAKERES:** If we could go to Demonstrative
02:15 25 D-21831.

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02:15 1 **BY MR. CHAKERES:**

02:15 2 **Q.** Is this an analogous graph for the wellbore system?

02:15 3 **A.** This is an analogous plot for the wellbore. So,
02:15 4 therefore, it shows the TPC curves. Once again, I'm plotting
02:15 5 the TPC curves when I change the many parameters that might
02:15 6 affect the TPC curve, and I'm observing that the biggest swing
02:16 7 is caused by changing, as expected, I think, the restriction in
02:16 8 the BOP. One of the key questions that always existed, what is
02:16 9 the restriction to the BOP?

02:16 10 So when I change that, I find out that it causes a
02:16 11 big swing in the TPC curve, as well as what here is called
02:16 12 "roughness." This is a measure of resistance in the wellbore
02:16 13 below the BOP.

02:16 14 Other parameters had a much smaller impact on TPC.

02:16 15 **Q.** So once you looked at these plots, which parameters do you
02:16 16 select for further study?

02:16 17 **A.** I chose all of the parameters that I had identified to
02:16 18 have a large impact. In addition, I chose a few other
02:16 19 parameters that didn't appear to have a large impact, but
02:16 20 nevertheless I wanted to confirm this in my thorough numerical
02:16 21 simulation study.

02:16 22 **MR. CHAKERES:** Let's go to Demonstrative D-21832.

02:17 23 **BY MR. CHAKERES:**

02:17 24 **Q.** What does this table show?

02:17 25 **A.** So this table is divided into three categories and gives

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02:17 1 the list of the parameters that ultimately I chose to -- I
02:17 2 chose to vary. I chose to see what would happen if the
02:17 3 description of the reservoir or wellbore that I'm providing --
02:17 4 I have provided is different than what I had found in my
02:17 5 analytical case.

02:17 6 So on top I have the reservoir parameters, again,
02:17 7 obvious parameters such as permeability, thickness, and skin.
02:17 8 But I also looked at the effect of aquifer, rock
02:17 9 compressibility, the fact that the reservoir was layered and
02:17 10 not the single one and others. And I have wellbore parameters.

02:17 11 In addition, because in my methodology I'm
02:17 12 calibrating my models against the dynamic data -- and this
02:18 13 dynamic data are primarily pressures -- I examined the degree
02:18 14 of accuracy or certainty of that pressures -- those pressures,
02:18 15 and I bring that into my work process as well.

02:18 16 Q. And we're not going to go through all of them, but -- so
02:18 17 the Range column, where did you get the range of values that
02:18 18 you used?

02:18 19 A. This one --

02:18 20 Q. If we could just go through one example, we'll leave it at
02:18 21 that and move on.

02:18 22 A. Sure.

02:18 23 Generally, for the range, I think I mentioned I
02:18 24 review independent estimates that might exist. For some
02:18 25 parameters, such as permeability, the first row, estimates

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02:18 1 exist from core and MDT that we look at. But for some other
02:18 2 parameters, such as skin, no estimate existed, so I just
02:18 3 considered a wide range to see -- I didn't want to be
02:18 4 short-sighted by what I had assumed.

02:18 5 Q. Let's talk a little bit more about permeability. What
02:18 6 sources of information did you look at for permeability?

02:18 7 A. I looked at various measurements that were available. I
02:19 8 have prepared a couple of demonstratives that specifically just
02:19 9 talks to permeability from core, but I looked at whatever was
02:19 10 available.

02:19 11 Q. Let's look at those demonstratives.

02:19 12 MR. CHAKERES: If we could bring up Demonstrative
02:19 13 D-21834.

02:19 14 BY MR. CHAKERES:

02:19 15 Q. I want to look at MDT data first. What is this document
02:19 16 that you looked at?

02:19 17 A. This is the so-called "Post-Drill Technical Memorandum" of
02:19 18 BP.

02:19 19 Q. And what was contained in that memorandum?

02:19 20 A. So basically, it was a very cohesive inputs of document
02:19 21 that I reviewed. I enjoyed it. It had a compilation of all --
02:19 22 a lot of the data that was acquired by BP either prior to the
02:20 23 drilling or based on the data that I had obtained after the
02:20 24 drilling, and provided in one document a description of the
02:20 25 available data and, to some extent, interpretations of BP on

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02:20 1 that data.

02:20 2 Q. Was there a discussion in that document about BP's --
02:20 3 about permeability estimates from MDT?

02:20 4 A. Yes. As prior to blowout, MDT tests were run. These are
02:20 5 a tool that primarily tries to measure the pressure of the
02:20 6 formation and collect fluids, but also it provides some
02:20 7 information that may be used to find an estimate of
02:20 8 permeability.

02:20 9 In this particular case, it seemed to me that BP's
02:20 10 assessment is that -- just this is a high-permeability
02:20 11 formation in the hundreds of millidarcy. Clearly, to me, it
02:20 12 couldn't make an accurate assessment of what the permeability
02:21 13 of the formation would be.

02:21 14 Q. Is that consistent with your experience?

02:21 15 A. Absolutely. Permeability -- first, from my own experience
02:21 16 with MDT, as well as looking at MDT results of this particular
02:21 17 case, and in general, my experience about permeability,
02:21 18 permeability remains a very uncertain parameter even under best
02:21 19 circumstances when we do well tests.

02:21 20 Q. And the Court just heard a little bit about well tests
02:21 21 already, but could you just describe for the Court, what is a
02:21 22 well test?

02:21 23 A. A well test, it's -- what we do in a well test, we flow
02:21 24 the well under controlled conditions, we flow it and measure
02:21 25 the flow rate, and then shut in the well and observe the rise

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02:21 1 in pressure, or we observe the pressure buildup and analyze
02:21 2 that pressure buildup.

02:21 3 Over many decades, this discipline has been developed
02:21 4 in petroleum engineering to allow analysis of pressure buildup
02:22 5 for the purpose of finding permeability. Because permeability
02:22 6 remains uncertain, this technique has been developed
02:22 7 significantly over many decades.

02:22 8 So that is a well test. You shut-in the well after
02:22 9 measuring the wellbore and the flow rates and analyze the
02:22 10 pressure data. Unfortunately, in this case, the flow rate was
02:22 11 unknown and quite variable before shut-in. So a conventional,
02:22 12 proper well test analysis could not have been done.

02:22 13 Q. And even had one been done, from your experience, what is
02:22 14 the degree of uncertainty remaining in permeability, even after
02:22 15 well tests?

02:22 16 A. Well tests, it's what Fekete was built upon. Fekete is
02:22 17 the name of the company that I work with. And it's basically
02:22 18 our bread and butter, one can say.

02:22 19 And we pride ourselves in trying to estimate
02:23 20 permeability fairly accurately. However, in my experience,
02:23 21 when the analysis of well tests is incorporated into and
02:23 22 integrated into a study, into a reservoir model that now tries
02:23 23 to predict future performance, it bears uncertainty of at least
02:23 24 tens of percents. It varies, but I would say more than
02:23 25 50 percent uncertainty on permeability, for prediction of flow

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02:23 1 rate from a reservoir, it's very common.

02:23 2 **MR. CHAKERES:** Let's go to Demonstrative D-21833.

02:23 3 **BY MR. CHAKERES:**

02:23 4 **Q.** Did you also look at data with respect to permeability
02:23 5 from air blown through cores?

02:23 6 **A.** That is correct. This is one measure of permeability that
02:23 7 was obtained. These are core samples, the side wall cores that
02:23 8 Dr. Kelkar also referred to. Sixteen core samples had been
02:24 9 obtained. They had been sent to the laboratory under
02:24 10 controlled conditions, flow, and in this particular case, air
02:24 11 was blown through the core.

02:24 12 Some corrections need to be done on air permeability,
02:24 13 and that is incorporated in this. This is basically the data I
02:24 14 believe that Dr. Blunt also has referred to, so I used the very
02:24 15 same set of data.

02:24 16 But basically what it shows, we see that from the
02:24 17 16 samples, we have values that over by more than 10 times.
02:24 18 Even we talk about using averages and whether you use two --
02:24 19 and here I have shown two different methods for finding
02:24 20 averages, arithmetic versus geometric average. Again, the
02:24 21 difference between them is more than 30 percent.

02:24 22 In fact, if we look at just these samples, more than
02:24 23 half of them have a permeability of more than 500, and lesser
02:25 24 than half have less than 500. So one might say that, okay, a
02:25 25 permeability of 500 is reasonable, 400 is reasonable, 600 is

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02:25 1 reasonable.

02:25 2 To me, all it says is that there is a large degree of
02:25 3 uncertainty in permeability, and I would like to develop a
02:25 4 methodology that doesn't rely on this uncertainty or accounts
02:25 5 for that uncertainty.

02:25 6 Q. Let's go back really briefly to Demonstrative D-21832.

02:25 7 So, again, these are the parameters that you wanted to examine
02:25 8 in your numerical analysis?

02:25 9 A. That is correct. For example, for permeability, I thought
02:25 10 it's probably not as low as 170, probably not as high as 850,
02:25 11 but the data existed. And, in fact, I realized that we are
02:25 12 measuring all of this data from a wellbore that is less than a
02:25 13 foot square, and we want to apply it to a reservoir that is
02:25 14 miles wide and long.

02:26 15 I wouldn't know how the rock properties vary as I go
02:26 16 away from the wellbore. So I wanted just to consider a larger
02:26 17 degree of uncertainty and see what impact it might have on my
02:26 18 answers.

02:26 19 Q. And we won't go through that again for the Court, but did
02:26 20 you perform a similar type of investigation with respect to the
02:26 21 rest of these parameters?

02:26 22 A. That is correct. I looked at the independent measured
02:26 23 data and assessed what could be the degree of uncertainty in
02:26 24 these parameters.

02:26 25 Q. Let's move on now to the numerical phase of your work.

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02:26 1 **MR. CHAKERES:** If we could go to Demonstrative
02:26 2 D-21836.

02:26 3 **BY MR. CHAKERES:**

02:26 4 **Q.** First, briefly, what did you do in the numerical phase of
02:26 5 your work?

02:26 6 **A.** So the first thing that I needed to do was to confirm
02:26 7 and -- or examine whether -- the answer and the parameters that
02:26 8 I had found in my analytical work, are they valid in numerical
02:26 9 or not. These are just two different techniques that we use.
02:27 10 So the results have to be confirmed one by the other. I
02:27 11 confirmed that.

02:27 12 And then I move to examine -- to do an uncertainty
02:27 13 assessment, to examine to find out what would happen if I
02:27 14 varied one of my reservoir parameters. Can I have still a
02:27 15 reservoir model or wellbore model that matches my response, my
02:27 16 shut-in pressures and collection rates?

02:27 17 And then if I can find the model or various models,
02:27 18 then what would be its cumulative volume of oil released?

02:27 19 **Q.** Can you briefly describe for the Court, what is the
02:27 20 concept behind numerical simulators? What are the concepts?

02:27 21 **A.** Sure. I have a demonstrative to describe that.

02:27 22 **MR. CHAKERES:** Let's go to Demonstrative D-21837.

02:27 23 **BY MR. CHAKERES:**

02:27 24 **Q.** Go ahead.

02:27 25 **A.** Thank you.

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02:27 1 So this is just a graphical description of what the
02:27 2 reservoir would look into -- in a reservoir simulator. It has
02:28 3 the dimensions, of course, shown in here for one of the
02:28 4 examples.

02:28 5 But the key distinction between numerical and
02:28 6 analytical is, in analytical work, we use one single equation
02:28 7 to describe the behavior of the full extent of the reservoir.
02:28 8 In numerical work, we give it a bit more accuracy. We divide
02:28 9 the reservoir into small boxes, and we solve the equations of
02:28 10 flow in individual boxes. And, therefore, as properties change
02:28 11 across the reservoir, that change in properties is accounted
02:28 12 for in the numerical simulation.

02:28 13 In addition to that, there are other assumptions that
02:28 14 one makes using analytical techniques. They are basically
02:28 15 simplified techniques, and those assumptions are removed, or I
02:28 16 call them -- they are "relaxed" by the time you move to
02:28 17 numerical simulation.

02:29 18 Q. What software did you use for your numerical simulation?

02:29 19 A. I used IMEX, I-M-E-X, from Computer Modeling Group. It's
02:29 20 one of the industry-standard numerical simulators that is used.
02:29 21 We used the same.

02:29 22 MR. CHAKERES: Let's go to Demonstrative D-21838.

02:29 23 BY MR. CHAKERES:

02:29 24 Q. Can you provide the Court with an overview of the steps in
02:29 25 your numerical method?

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02:29 1 A. Yes, certainly. So the first thing that I needed to do,
02:29 2 as I mentioned, was to confirm that the case that I had found
02:29 3 in analytical work also is consistent in my numerical work.
02:29 4 And then there are four steps, 2 to 5 here describe the
02:29 5 uncertainty assessment.

02:29 6 And what I do in there is I go and change one of the
02:29 7 parameters, for example, permeability. In Step 3 I examine to
02:29 8 see whether now that I have changed the parameter, does it
02:30 9 match the shut-in pressures.

02:30 10 Typically, if I have -- I had them all, the base
02:30 11 model that matched. If I change a parameter, it doesn't match
02:30 12 the shut-in pressures anymore.

02:30 13 So in Step 4, I do what is called history matching
02:30 14 reservoir engineering. I vary other parameters within their
02:30 15 degree of uncertainty to find a model that is consistent with
02:30 16 the shut-in pressures. This is -- this is, as I mentioned,
02:30 17 again, a well-known discipline in reservoir engineering called
02:30 18 history matching, to obtain models that are consistent always
02:30 19 with measurements.

02:30 20 Once I have done -- I have found a model -- if and
02:30 21 once I have been able to find a model that is consistent with
02:30 22 the shut-in pressures, then I examine whether it provides a
02:30 23 good, bad, or mediocre match of the second piece of data, the
02:30 24 collection rates.

02:30 25 Q. Now, before we move on, you said in Step 1 you developed a

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02:30 1 base case. Is that the same thing as a best estimate?

02:31 2 A. Generally, in our practice, we choose our best estimates
02:31 3 and put it in the case that we call the base case, and that --
02:31 4 for some of the parameters, that is the case in here for me.
02:31 5 For some others, I did not have an estimate at all or an
02:31 6 opinion of what is a good estimate of the parameter.

02:31 7 So a parameter like compressibility or some other
02:31 8 parameters where I may have a measurement, but really I know
02:31 9 that is not certain, I might have chosen a parameter in my
02:31 10 model and I have just called it my "starting point" or "base
02:31 11 parameter."

02:31 12 In my report, actually, and in my primary report, I
02:31 13 have been careful not to call my base estimate the best
02:31 14 estimate, and I think that was misrepresented in the opening
02:31 15 statement earlier this week.

02:31 16 Q. And I would like, if you could, to just take one example
02:32 17 of the 25 cases you ran in your numerical case and walk the
02:32 18 Court through an example of what you did.

02:32 19 MR. CHAKERES: Could we go to Demonstrative D-21839A?

02:32 20 BY MR. CHAKERES:

02:32 21 Q. Could you describe, first, what is the parameter that's
02:32 22 being investigated here?

02:32 23 A. Certainly. So by this time, I have already developed a
02:32 24 base case that matches the shut-in pressures. And in here,
02:32 25 what I'm doing, I have varied one of the input parameters. In

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02:32 1 this particular case, in the legend of the graph, I've written
02:32 2 "BOP ID equal 3.5 inches."

02:32 3 By that, what I mean is I have increased the internal
02:32 4 diameter, ID 4, internal diameter of the BOP, and enlarged it.
02:32 5 In my base case I have found that to be about 2.6 inches.

02:33 6 Here, I'm saying, Okay, what if I was wrong? And
02:33 7 what if my restriction in the BOP was not as tight as I
02:33 8 thought? I'm enlarging it to 3.5 inches, and I'm examining
02:33 9 what happens in my model. Is it now consistent with the
02:33 10 dynamic data or not?

02:33 11 Q. So what are the black belts on this graph?

02:33 12 A. So this is a plot of shut-in pressure as a function of
02:33 13 time. So pressures after shut-in as a function of time. The
02:33 14 dots, the solid circles, are the measured shut-in pressures
02:33 15 corrected to bottom hole conditions, to the sandface
02:33 16 conditions.

02:33 17 Q. What is the red line?

02:33 18 A. The red line is the result of the model in which now I
02:33 19 have changed one of the input parameters. I opened up the BOP
02:33 20 restriction, so more flow came out of this reservoir. And
02:34 21 therefore, it's -- the pressure during the shut-in falls below
02:34 22 what was measured. More flow has come out of it, so the
02:34 23 reservoir gets more depleted, and pressures fall below their
02:34 24 measurements.

02:34 25 A model like this is not acceptable to me. I go and

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02:34 1 do what is called history matching, change some of the other
02:34 2 input parameters within their range of uncertainty to develop,
02:34 3 to obtain a model that matches the shut-in pressures.

02:34 4 Q. Let's look at that.

02:34 5 MR. CHAKERES: Could we bring up Demonstrative
02:34 6 D-21840A?

02:34 7 BY MR. CHAKERES:

02:34 8 Q. What do you have here?

02:34 9 A. Here, not only I show the results of the model before
02:34 10 history match, but also I show the results of the model after
02:34 11 history match. And also on the bottom, I have a dotted line
02:34 12 that shows the so-called error, the degree of difference
02:34 13 between the model after match as compared to the measured
02:35 14 values.

02:35 15 Q. Does this show an acceptable match to the data?

02:35 16 A. Yes. I basically developed the criterion that I said, If
02:35 17 I am able to develop a model, the solid upper line, that agrees
02:35 18 with the measurements, those are the circles, to within
02:35 19 .1 percent in average, .1 percent -- and this is in terms of
02:35 20 pressure -- then I have developed a model that is a good match.

02:35 21 And that degree of error is shown on the right-hand
02:35 22 side vertical axis, and we see that generally that degree of
02:35 23 error is -- it's low. And, therefore, to me, this was a model
02:35 24 that matched one piece of the data. It matched the shut-in
02:35 25 pressures.

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02:35 1 Q. What was the next step in your assessment of this
02:35 2 parameter?

02:35 3 A. Now I needed to see whether this model is consistent with
02:36 4 the second piece of dimension data. Is it consistent with the
02:36 5 collection rates as well or not?

02:36 6 MR. CHAKERES: Let's go to Demonstrative D-21841.

02:36 7 BY MR. CHAKERES:

02:36 8 Q. Could you describe your process for comparing your cases
02:36 9 to the collection rates?

02:36 10 A. Certainly. So this plot on the vertical axis, I have
02:36 11 collection rates between approximately 18,000 and
02:36 12 25,000 barrels per day. This was the collection rates on
02:36 13 July 15th. So I plotted the values using, again, solid circles
02:36 14 as a function of the 9 or 10 hours of the collection on
02:36 15 July 19th.

02:36 16 And I'm comparing my model results against the
02:36 17 measurements. The model results are shown with the solid line.
02:36 18 And I'm examining the quality of the match between the model
02:36 19 response and the measurements.

02:36 20 Q. And what are the arrows in that plot?

02:37 21 A. The arrow in this case, I have shown a value of about
02:37 22 600 barrels per day. 600 was the degree of uncertainty that
02:37 23 earlier I had assessed to be the degree of uncertainty of
02:37 24 collection rates. After evaluating the two ships, I said
02:37 25 600 barrels per day is the degree of uncertainty.

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02:37 1 So if a model matched the measurements to within
02:37 2 600 barrels per day, I called it a good match. Here, in this
02:37 3 particular example, we see that the degree of mismatch, the
02:37 4 difference between the model and the solid dots, is generally
02:37 5 more than the size of the arrow. And the size of the arrow, as
02:37 6 I explained, in this plot I have chosen to be 600.

02:37 7 So this is not a good match.

02:37 8 **MR. CHAKERES:** If we could go to demonstrative
02:37 9 D-21842.

02:37 10 **BY MR. CHAKERES:**

02:38 11 **Q.** Did you do any further assessment of the cases after you
02:38 12 determined whether they were good or bad -- or whether they
02:38 13 were good or not?

02:38 14 **A.** Yes. I didn't want to have just two categories of models,
02:38 15 anything that is better and matches better than 600 is good,
02:38 16 and anything that is more than 600 is bad. I knew that
02:38 17 assessment of 600, it may not be fully exact.

02:38 18 Therefore, I developed a second threshold or
02:38 19 criteria. And that was, I said, if the degree of difference
02:38 20 between the model and the measurements is more than 2500 -- so
02:38 21 I went from 600 to 2500 -- is more than 2500, then it's a bad
02:38 22 match, remembering that 2500 is about 12 percent of the values.

02:38 23 If it was something between 600 and 2500, then I
02:38 24 called it a mediocre match. In this particular case, we are
02:39 25 seeing that this case provides a mediocre match. It's not as

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02:39 1 good as 600, but also it is not as bad as 2500.

02:39 2 Q. And did you repeat this process for every single one of
02:39 3 the 24 parameters you described earlier?

02:39 4 A. Yes. In each case, I changed the primary parameter. It
02:39 5 didn't match the shut-in pressures. I did a history matching
02:39 6 to match the shut-in parameters -- the shut-in pressures, then
02:39 7 examined whether it provides a good match of collection rates
02:39 8 or not.

02:39 9 MR. CHAKERES: Let's go to demonstrative D-21843.

02:39 10 BY MR. CHAKERES:

02:39 11 Q. I'd like to go through this for a little bit.

02:39 12 Does this table represent the results from your
02:39 13 numerical history-matching process?

02:39 14 A. It does. All 25 cases are shown here.

02:39 15 Q. Okay. What's in the first column?

02:39 16 A. So in the first column is -- I'm showing the parameter
02:39 17 that I'm changing. For example, on the top case, very first
02:40 18 case, I'm saying, what would have happened if I -- diameter of
02:40 19 the restriction of the BOP was now choked further back, was
02:40 20 made smaller than what I had found in my initial case. I
02:40 21 reduced it to 2-inch.

02:40 22 In the next case I look at if the skin was the
02:40 23 largest possible value that I thought possible, 50 -- a value
02:40 24 of 50. And the other cases are also shown on the first column.

02:40 25 Q. What's the second column?

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02:40 1 A. The second column is basically showing, after my history
02:40 2 match, whether I have been able to develop a model that
02:40 3 incorporated the parameter on the first column and still
02:40 4 provided a match of the shut-in pressures.

02:40 5 Q. What's the third column?

02:40 6 A. The third column examines the quality of the match as
02:40 7 compared to the collection data. Again, I'm saying -- and here
02:40 8 I'm using colors as well to distinguish. Models that provide a
02:41 9 good match of the collection rates, I have put them in green.
02:41 10 And models that did not provide a good match of the collection
02:41 11 rates, which are either higher or lower in this table, they
02:41 12 either provide a mediocre match of the collection rates or a
02:41 13 bad match of the collection rates.

02:41 14 Q. And what is the fourth column?

02:41 15 A. The fourth column is the cumulative volume of oil released
02:41 16 from all of these, and it's ordered from low to high values.
02:41 17 And I observe from --

02:41 18 Q. Go ahead.

02:41 19 A. Sorry. And I observe from this that the models -- the
02:41 20 green models, the models that are consistent with both shut-in
02:41 21 pressures and collection rates, they -- they provide cumulative
02:42 22 volume of oil discharge of within 5 to 5.3.

02:42 23 Also, this table tells me that the farther I am from
02:42 24 that middle range, either I go to models that give me lower
02:42 25 values or higher values, they do not provide a match of the

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02:42 1 dynamic response of this reservoir.

02:42 2 Q. So the farther from the midpoint, what happens to the
02:42 3 quality of the match?

02:42 4 A. It gets worse, and gradually it gets worse. It goes from
02:42 5 good to -- between good and mediocre, then goes to mediocre and
02:42 6 then towards bad.

02:42 7 Q. I'd like to look at one case down here, rock
02:42 8 compressibility equals 12 microsips. When you vary from your
02:42 9 base case of 6 microsips to a value of 12 microsips, what
02:42 10 happens in your model?

02:42 11 A. Okay. So first, in my base case, as my starting point, I
02:42 12 have used the rock compressibility of 6 microsips. Then I
02:43 13 said, what -- and I knew that value cannot be certain, just
02:43 14 knowing heterogeneity that exists in reservoirs.

02:43 15 So I said, what if the compressibility was not
02:43 16 6 microsips, it was 12? So when I change to 12, now this
02:43 17 reservoir has more -- it's more compressible, it can keep the
02:43 18 pressure more.

02:43 19 What happens when I -- the model gives me a
02:43 20 pressure -- shut-in pressure that is higher than the measured
02:43 21 values? That is not acceptable to me.

02:43 22 I go through a history-matching process, a
02:43 23 calibration process, to -- that will change some of the
02:43 24 parameters in my reservoir within the range of uncertainty to
02:43 25 obtain a match.

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02:43 1 Once I obtain a match, I see that that model, in
02:43 2 fact, provides a good match of collection rates. And then I
02:43 3 just go ahead and read what volume of oil did it release; and
02:44 4 in this particular case, I see that it gave me a volume of oil
02:44 5 released of 5.15.

02:44 6 So I think the key point in here is if -- that you
02:44 7 had a methodology that allowed you to calibrate, then the
02:44 8 degree of uncertainty in the input parameters, such as
02:44 9 compressibility, doesn't reflect itself on the output. In the
02:44 10 beginning, I had mentioned why I thought a method like material
02:44 11 balance, I cannot use it, because it doesn't allow a
02:44 12 calibration against dynamic data such as collection rates.

02:44 13 And it is true, this calibration that I find, that
02:44 14 once you do the calibration, some of the parameters, although
02:44 15 the degree of uncertainty and compressibility still is large,
02:44 16 but it doesn't reflect itself in the answers on the volume of
02:44 17 oil released.

02:44 18 **Q.** Without a calibration point, what is the range that a
02:45 19 material balance method can provide for you?

02:45 20 **A.** It just depends on the degree of uncertainty in the input
02:45 21 parameters. So if my compressibility -- and allow me now to
02:45 22 talk about total compressibility. Rock is one component of it.

02:45 23 If the compressibility varied by a factor of 2,
02:45 24 equally the cumulative volume of oil released would vary by a
02:45 25 factor of 2.

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02:45 1 Alternatively, if your estimate of oil in place,
02:45 2 which in my experience is very uncertain, if that varied by a
02:45 3 factor of 2 or it was uncertain by a factor of 2, your estimate
02:45 4 of cumulative volume of oil released found from use of just
02:45 5 that equation, material balance equation, would be uncertain by
02:45 6 a factor of 2.

02:45 7 **Q.** Now, in the opening statement, you saw a spreadsheet where
02:45 8 you had various input parameters for yourself, and a button got
02:46 9 pushed and the parameter moved, and then it said your
02:46 10 cumulative volume of oil discharge would move in relation to
02:46 11 the degree of change in those parameters.

02:46 12 Do you remember that?

02:46 13 **A.** Yes. BP had a slide where they presented how my results
02:46 14 would have changed in a material balance equation if my
02:46 15 parameters changed.

02:46 16 **Q.** Do you believe that's an appropriate representation of how
02:46 17 your results change with the change of the input parameters?

02:46 18 **A.** I do not agree with that. It was given in, I believe,
02:46 19 Dr. Blunt's primary report. I had rebutted that and explained
02:46 20 why that methodology was not appropriate the way it was
02:46 21 demonstrated and it still was represented.

02:46 22 **Q.** Could you provide that explanation here?

02:46 23 **A.** Yes. Because the way it was demonstrated in that
02:46 24 equation, it was that, hey, I go and change one input
02:46 25 parameter, compressibility, and the output changes.

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02:46 1 In my methodology I have a calibration technique. If
02:47 2 I change a parameter, I check to see whether it provides a
02:47 3 match or not. And I go through the history-matching process,
02:47 4 and then ultimately I see examples sitting in front of us that
02:47 5 change of compressibility doesn't impact the cumulative volume
02:47 6 of oil released to any large degree.

02:47 7 Q. In your rebuttal report, did you provide a range of
02:47 8 possible cumulative discharges that could match the shut-in
02:47 9 pressure data without a calibration point?

02:47 10 A. Yes. It exists partially on this table as well as a
02:47 11 larger range exists in my report.

02:47 12 For example, in this table what we see, if we look at
02:47 13 the second column, virtually all of the cases, with the
02:47 14 exception of one of them, match the shut-in pressures. So if I
02:47 15 were just to match the shut-in pressures, I could have models
02:47 16 that gave me from 3.3 million barrels of oil released to 7.8.

02:48 17 And I -- in my rebuttal report, I examined this range
02:48 18 even further, that if I had to match only shut-in pressures,
02:48 19 can I find even a wider range? And there I show that we can
02:48 20 easily go between 3 to 7 million stock tank barrels of oil, if
02:48 21 you want to adjust, to calibrate your model against the shut-in
02:48 22 pressures.

02:48 23 Q. Were all of those cases you just mentioned on a material
02:48 24 balance?

02:48 25 A. All of those cases were on a material balance with their

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02:48 1 input parameters.

02:48 2 Q. I'd like to move on now.

02:48 3 MR. CHAKERES: If we could go to demonstrative
02:48 4 D-21847.

02:48 5 BY MR. CHAKERES:

02:48 6 Q. If you would slow down a little bit for the sake of the
02:48 7 court reporter.

02:48 8 Did you do anything to assess whether erosion over
02:48 9 time would impact your results?

02:48 10 A. Yes, I did. All of the cases that so far I had considered
02:48 11 had ignored the erosion in the BOP. And so I dedicated a
02:49 12 section of my work to examine what if erosion was an issue.

02:49 13 Q. And how did you attempt to do that?

02:49 14 A. The way I did it is that -- it is not in my expertise to
02:49 15 carefully model or incorporate the changes of erosion that
02:49 16 happens directly in the BOP. So I again chose a methodology
02:49 17 that doesn't make me dependent on such description.

02:49 18 I used -- I have a reservoir model and a wellbore
02:49 19 model, that now I chose it to flow against the BOP pressure.
02:49 20 If -- once I choose the BOP pressure as a back pressure against
02:49 21 which the reservoir and wellbore flows, then anything that
02:49 22 happens downstream of the BOP -- if any erosion happens, for
02:49 23 example -- it's accounted for because my system is flowing the
02:49 24 BOP pressure.

02:49 25 MR. CHAKERES: Could we go to demonstrative D-21848A.

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02:50 1 **BY MR. CHAKERES:**

02:50 2 **Q.** And is this -- first, before we look at the results, the
02:50 3 Court heard a great deal during Dr. Griffiths' examination
02:50 4 about this concept, so I'd like to not subject everyone to it
02:50 5 again. But is it a similar principle in terms of flowing
02:50 6 against the BOP pressures as was described by him?

02:50 7 **A.** That's correct. The first line just says now that I used
02:50 8 the BOP pressures, erosion in the BOP is included. And then I
02:50 9 use various trend lines for representing the BOP pressure, and
02:50 10 they would then represent various scenarios of erosion in the
02:50 11 BOP. I examined what would happen to that model, would it be
02:50 12 consistent with the dynamic data, and then what kind of
02:50 13 cumulative volume of oil released would it give.

02:50 14 **Q.** Let's go through your results really briefly. These first
02:50 15 two cases here have "Restricted BOP" in the title. Can you
02:51 16 describe what those are?

02:51 17 **A.** Yes. What I have called restricted BOP, it -- it is a
02:51 18 very extreme case that I have assumed. I have assumed a BOP
02:51 19 that was so restricted right after the explosion that it didn't
02:51 20 allow any oil to come out. Of course, oil was coming out, so
02:51 21 it was extreme.

02:51 22 And then further, I assumed that it -- linearly the
02:51 23 pressure of the BOP slowly, slowly drops or slowly, slowly
02:51 24 erosion happens until May 8th, when BOP pressures exist and I
02:51 25 am forced to use it. That BOP pressures, all of us are forced.

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02:51 1 It's real data.

02:51 2 And then suddenly in -- this was an extreme scenario,
02:51 3 because suddenly I had allowed a kink in the pressures to
02:51 4 happen at that time. So I -- so those, the restricted cases,
02:52 5 the top two cases look at that extreme scenario.

02:52 6 Q. And do you believe that that scenario is the most likely
02:52 7 scenario for what happened between April 20th and May 8th at
02:52 8 the BOP?

02:52 9 A. No, it is not.

02:52 10 Q. Why then did you include these cases?

02:52 11 A. I wanted to have -- to have the biggest impact -- to
02:52 12 assess the biggest impact that the erosion could have. I could
02:52 13 have -- I wanted to have a lower bound on the cumulative volume
02:52 14 of oil released that is not likely, but I just wanted to have
02:52 15 that boundary available.

02:52 16 Q. And what were the results of your restricted BOP cases?

02:52 17 A. I had two cases where considered is extreme scenario. One
02:52 18 used the BOP pressures as corrected by Dr. Trusler. That case
02:52 19 was consistent with the dynamic data, with the pressures and
02:53 20 the collection rate; therefore, it's a good model. And it gave
02:53 21 me a 4.4. The only issue with it is that it's assuming an
02:53 22 extreme scenario.

02:53 23 The second case, I called it restricted BOP. That
02:53 24 was before I had Dr. Trusler's BOP pressures. I had made my
02:53 25 own assessment of what the BOP pressures might have been, then

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02:53 1 imposed this extreme scenario on top of that. That also was a
02:53 2 good model and gave me a cumulative volume of oil released of
02:53 3 4.7.

02:53 4 Q. Did you also run cases flowing against the BOP where you
02:53 5 did not have that extreme assumption?

02:53 6 A. That is correct. The other three cases did not assume
02:53 7 that extreme case but was flowed against the BOP pressure.

02:53 8 Q. What were the results of those cases?

02:53 9 A. Generally, the cumulative volume of oil released is within
02:53 10 the range that I had found. The exact numbers are different,
02:53 11 4.9 and 5.26.

02:53 12 Q. Dr. Pooladi-Darvish, I'd like to move now to the rebuttal
02:54 13 portion of your testimony.

02:54 14 MR. CHAKERES: Could we go to demonstrative D-21849.

02:54 15 BY MR. CHAKERES:

02:54 16 Q. First I'd like to ask, when you received the defense
02:54 17 expert reports, what did you do in terms of assessing their
02:54 18 opinions regarding input parameters?

02:54 19 A. Generally, the defendants' experts have suggested
02:54 20 alternative interpretations either for the type of the fluid or
02:54 21 for the reservoir properties or for wellbore properties. And
02:54 22 so I again remained open. I said, what if this were
02:54 23 applicable? In other words, the methodology that I had
02:54 24 developed was supposed to allow me to check what if somebody
02:54 25 said the interpretation input parameters shall be different.

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02:54 1 So I incorporated those into my work, went through
02:55 2 the same history-matching process that I explained, and saw
02:55 3 that I have models that ultimately are consistent with the
02:55 4 measured -- with the dynamic response of the reservoir. And
02:55 5 then I looked to see what is the cumulative volume of oil
02:55 6 released from those cases that match.

02:55 7 **MR. CHAKERES:** Let's go through some of these.

02:55 8 If we could go to demonstrative D-21850.

02:55 9 **BY MR. CHAKERES:**

02:55 10 **Q.** I'd like to start -- you've testified at some length about
02:55 11 your views on permeability. Did you attempt to incorporate
02:55 12 Dr. Gringarten's permeability into your model?

02:55 13 **A.** Yes. Dr. Gringarten has suggested a value of permeability
02:55 14 of 238 millidarcy. And when I incorporated that into a model,
02:55 15 it did not allow me a good match of the collection rates;
02:55 16 therefore, I called it among the red group.

02:55 17 **Q.** Just for context for the Court, what was the range of
02:56 18 permeabilities that you found could match all of the data and
02:56 19 calibration points?

02:56 20 **A.** Among the full range of cases that had allowed a good
02:56 21 match of the shut-in pressures, I had a range of between
02:56 22 360 millidarcy to 850 millidarcy. So that was my range.

02:56 23 But, however, I want to emphasize, my objective was
02:56 24 not to explore and find out accurately or specifically what is
02:56 25 the range of permeability. What can it be -- can I have a case

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02:56 1 that would have value less than 360 and still matches the
02:56 2 collected -- matches the dynamic response? Maybe.

02:56 3 What I assessed is that all of the models that
02:56 4 matched the dynamic response provided a narrow range of
02:56 5 cumulative volume of oil released.

02:56 6 Q. I'd like to move now to the second case, defendants' OOIP
02:57 7 equals 100. Is OOIP "original oil in place"?

02:57 8 A. It is the same as we mentioned today, STOIIP, or OIP,
02:57 9 these are "original oil in place."

02:57 10 Q. Now, in your experience, what is the degree of uncertainty
02:57 11 in this parameter using seismic data and logging data from one
02:57 12 well?

02:57 13 A. Seismic data and geophysical work is not my expertise, but
02:57 14 I integrated reservoir studies that I have done. I have worked
02:57 15 with geoscientists who provide an assessment of the volume of
02:57 16 oil in place.

02:57 17 And in my experience, the degree of uncertainty on it
02:57 18 is a few times, so between 2 to 6, 7, 8 times. That's -- so
02:57 19 200 to 7, 6 -- upwards of 500 percent. It's very large.

02:57 20 Even after you have collected some information -- you
02:57 21 have drilled wells, you have done well tests, you have done
02:57 22 history matching -- the degree of uncertainty on oil in place
02:58 23 remains large, and it is reflected in many, many books and
02:58 24 documents.

02:58 25 Q. Now, what were the range of oil in places that matched

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02:58 1 your -- again, not that you're trying to estimate that
02:58 2 parameter, but what were the range of original oil in place
02:58 3 that were part of cases that were good matches for you?

02:58 4 A. So the cases that provided a good match of the -- both of
02:58 5 the dynamic set of data, I believe the lowest value was around
02:58 6 105 or 106 million barrels in place. That was a case that had
02:58 7 an aquifer, or maybe had the larger compressibility, either
02:58 8 way, between 106 and, if I remember correctly, close to 140 to
02:58 9 150 million barrels. So within, let's say, 110 to 150.

02:58 10 Q. Here, did you attempt to incorporate a smaller original
02:59 11 oil in place into your model?

02:59 12 A. Yes. That is basically what I did in this case.
02:59 13 Defendants' experts generally have suggested oil in place
02:59 14 values that were smaller than mine. There were many different
02:59 15 numbers. I don't go explore them one by one. I chose one of
02:59 16 the ones that was lower than mine, and I tried the value of
02:59 17 100 stock tank barrels.

02:59 18 Q. Did that provide a good match to both the shut-in
02:59 19 pressures and the collection rates?

02:59 20 A. It provided a good match of the shut-in pressures but did
02:59 21 not provide a good match of the collection rates and,
02:59 22 therefore, I called it red again.

02:59 23 Q. I'd like to move now to the final case we're going to talk
02:59 24 about here, Dr. Blunt's shut-in pressures.

02:59 25 First, could you describe what you understand

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02:59 1 Dr. Blunt did with respect to the shut-in pressures?

02:59 2 A. Yes. The shut-in pressures that were available in this
02:59 3 case, that is, after the well was closed, are the so-called
03:00 4 wellhead pressures or measured in the capping stack. For
03:00 5 reservoir engineering purposes, one needs to translate this to
03:00 6 bottom hole pressures.

03:00 7 Dr. Blunt went through a process of correcting for
03:00 8 this hydrostatic pressure. It was discussed -- he incorporated
03:00 9 the effect of cooling: As the fluid cools down, the density
03:00 10 goes up and, therefore, the bottom hole pressure goes up.

03:00 11 That process has a large number of assumptions.
03:00 12 Dr. Blunt himself has referred to them in his report. So
03:00 13 that -- the values that Dr. Blunt had suggested to be the
03:00 14 corrected bottom hole pressures, I examined whether that would
03:00 15 provide good -- can I have models that would match that shut-in
03:00 16 pressure.

03:00 17 Q. Did you agree with Dr. Blunt's correction to the
03:01 18 pressures?

03:01 19 A. Not necessarily, no. We -- in our practice, that's one of
03:01 20 the first rules of well testing: When possible, obtain bottom
03:01 21 hole pressures. Sometimes it's not possible, such as this
03:01 22 case, and we are faced with it in the practice.

03:01 23 Generally, it's very problematic to correct the
03:01 24 wellhead pressures to bottom hole pressures, accounting for
03:01 25 cooling effects. Because of the difficulties that I believe

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03:01 1 also Dr. Blunt faced, that there are a large number of
03:01 2 assumptions involved in that correction.

03:01 3 Q. Did you identify any potential issues with the calculation
03:01 4 Dr. Blunt actually performed?

03:01 5 A. Nothing of specific, other than, as I mentioned, there
03:01 6 were a large number of correction assumptions.

03:01 7 There was one particular thing -- no. I think I
03:01 8 mentioned it in my rebuttal report.

03:01 9 For the correction from wellhead to the bottom hole,
03:01 10 one needs, of course, the densities of the fluid to correct for
03:01 11 the weight of the fluids. Dr. Blunt used -- I think he
03:01 12 mentions that he has referred use of so-called lookup table
03:02 13 that gives the density values. And I believe maybe that was
03:02 14 provided by Dr. Whitson. That lookup table, or spreadsheet,
03:02 15 was provided to us as well.

03:02 16 When I used that lookup table, the values of density
03:02 17 that that table was giving was larger than any measurements of
03:02 18 density that was available. So it is possible that there was
03:02 19 an overestimation of this correction to model.

03:02 20 Q. And setting that aside, did you attempt to incorporate
03:02 21 Dr. Blunt's shut-in pressures into your model?

03:02 22 A. I did, yes.

03:02 23 Q. And what did you find?

03:02 24 A. I went through the same process of history matching.

03:02 25 Actually, I took a couple of shots at it. I tried it once. It

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03:02 1 didn't give me a good match of the collection rates.

03:02 2 And then I pushed further. I tried other models,
03:02 3 other input parameters. I obtained a second model, which
03:02 4 provided a good match of the collection rates and the shut-in
03:02 5 pressures, and its cumulative volume of oil discharge was
03:03 6 exactly in the range that I had earlier estimated.

03:03 7 Q. So these are all individual input parameters that were
03:03 8 suggested that you attempted to match. Is that what you're
03:03 9 describing here?

03:03 10 A. Yes. Basically, I would start with my own base case, and
03:03 11 I change only one of the parameters to what is suggested in
03:03 12 here. And then I examine whether a model can be found that
03:03 13 matches the dynamic data.

03:03 14 MR. CHAKERES: Let's go to demonstrative D-21851.

03:03 15 BY MR. CHAKERES:

03:03 16 Q. Did you also attempt to match all of the parameters that
03:03 17 were suggested by defendants' experts?

03:03 18 A. Yes. I define two so-called combined cases in which I
03:03 19 tried to include all of the suggestions that were provided by
03:03 20 the defendants' experts.

03:03 21 Q. And the first line is Dr. Johnson's wellbore model. I'd
03:04 22 like to ask a little bit more about that.

03:04 23 MR. CHAKERES: Let's go to demonstrative D-21852A.

03:04 24 BY MR. CHAKERES:

03:04 25 Q. What are you describing when you speak of Dr. Johnson's

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03:04 1 wellbore model?

03:04 2 A. So this -- what this plot is is basically a series of the
03:04 3 TPC curves that we talked about before. So what I have on the
03:04 4 vertical axis is again bottom hole pressure, and on the
03:04 5 horizontal axis I have rate. This is a demonstration of how
03:04 6 much the well can produce.

03:04 7 There are a series of TPC curves in here. These are
03:04 8 when I changed the wellhead pressure. So I'm -- I am --
03:04 9 basically, from 3,000 to 8,000, I'm imposing larger and larger
03:04 10 back pressures against the wellbore.

03:04 11 And the same way that these pressures are
03:04 12 incremental, you would expect that the TPC curves also should
03:05 13 be incremental and they should not cross each other.

03:05 14 Q. So I just want to stop you and make sure we're following.

03:05 15 So each different colored line has a different
03:05 16 imposed wellhead pressure?

03:05 17 A. That is correct.

03:05 18 Q. And what did you find when you examined these curves?

03:05 19 A. Basically, these TPC curve demonstrates some unphysical
03:05 20 behavior. Again, like a couple of -- if you saw these cases,
03:05 21 as you increase the back pressure, you are imposing more
03:05 22 pressure against the wellbore, more flow happens through the
03:05 23 wellbore. So that is -- the crossing of the curves, that is
03:05 24 its implication.

03:05 25 In a few of these cases, there were -- these curves

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03:05 1 are crossing.

03:05 2 Q. Did Dr. Johnson produce two different wellbore models?

03:05 3 A. He had two wellbore models. That is correct.

03:05 4 Q. Okay. Which wellbore model is this one?

03:06 5 A. This is the so-called drill pipe -- drill pipe high. So
03:06 6 Dr. Johnson had looked at two scenarios, in one of which the
03:06 7 drill pipe was still hanging from the BOP, and the other one
03:06 8 where he had considered that maybe the drill pipe had dropped
03:06 9 and had blocked the flow further.

03:06 10 The latter case, the drill pipe low, Dr. Gringarten
03:06 11 had come across irregularities in that model and, therefore, I
03:06 12 didn't pursue that model any further.

03:06 13 This is the so-called drill pipe high, which is the
03:06 14 case that was later on used also by Dr. Gringarten.

03:06 15 MR. CHAKERES: Let's go to demonstrative D-21854.

03:06 16 BY MR. CHAKERES:

03:06 17 Q. What were your results when you tried to build a model
03:06 18 incorporating all of the input parameters suggested by defense
03:06 19 experts?

03:06 20 A. So, again, I tried it a couple of different times. This
03:06 21 being a history-matching process, it's nonunique. You can
03:07 22 change input parameters to see whether you can find a match or
03:07 23 not.

03:07 24 In my first attempt, we find a model that matched the
03:07 25 shut-in pressures, but it did not provide a match of the

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03:07 1 collection rates. Therefore, I called it red.

03:07 2 And then I pushed further again. I said, Okay, can I
03:07 3 find a model that would match also the collection rates? I saw
03:07 4 that I needed to push some of the input parameters to
03:07 5 unreasonable amounts. I needed to choose an oil in place of a
03:07 6 billion barrels and I needed to reduce skin to zero. And only
03:07 7 then I found only a mediocre match of the collection rates, and
03:07 8 it fell exactly within the range of my mediocre cases as well
03:07 9 in terms of cumulative volume of oil released.

03:07 10 Q. After you ran these cases, did that change your opinion of
03:08 11 how much oil you think was discharged from the well?

03:08 12 A. No, it did not.

03:08 13 Q. And what is that opinion?

03:08 14 A. I'm sorry?

03:08 15 Q. What is the opinion that you hold?

03:08 16 A. So that they're -- my most likely estimate of cumulative
03:08 17 volume of oil released is between 5 and 5.3 stock tank --
03:08 18 million stock tank barrels.

03:08 19 **BY MR. CHAKERES:**

03:08 20 Q. In your rebuttal report, do you provide additional
03:08 21 opinions regarding the work of Drs. Blunt and Gringarten?

03:08 22 A. Yes, I do.

03:08 23 Q. All right. Let's briefly look at the highlights of that
03:08 24 report.

03:08 25 **MR. CHAKERES:** If we could go to demonstrative

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03:08 1 D-21856.

03:08 2 **BY MR. CHAKERES:**

03:08 3 **Q.** Are these some of the criticisms that you have of
03:08 4 Dr. Blunt's work?

03:08 5 **A.** It is a summary, and I have already mentioned some of
03:08 6 them. The very first one, again, is the fact that the
03:08 7 methodology that he used, either he should not have used it or
03:09 8 should have calibrated his final answers.

03:09 9 The way he used it, it carries a large amount of
03:09 10 uncertainty, material balance, requires knowledge of oil in
03:09 11 place and compressibility. Both of those are uncertain,
03:09 12 leading to a large range of uncertainty in the output. And
03:09 13 Dr. Blunt, in my opinion, did not account for that range of
03:09 14 uncertainty.

03:09 15 **Q.** What uncertainty range did you find in Dr. Blunt's work
03:09 16 with respect to oil in place?

03:09 17 **A.** In various sections of his work, Dr. Blunt carries
03:09 18 different degrees of uncertainty in oil in place, but in his
03:09 19 final opinion, I believe it's only about 4 percent, if I'm not
03:09 20 wrong. It's between -- yeah, 109 and 116 or something in that
03:09 21 range. Very narrow -- regardless, very narrow range of
03:10 22 uncertainty associated to estimate of oil in place.

03:10 23 **Q.** What is the degree of uncertainty his answer carries with
03:10 24 respect to compressibility?

03:10 25 **A.** I believe he has none.

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03:10 1 Q. And I believe you've testified previously about the second
03:10 2 point, the calibration to known data points. We won't repeat
03:10 3 that point. Could you briefly describe what you mean by
03:10 4 inconsistencies in his analysis?

03:10 5 A. Yes. There are a few uncertainties that some of which I
03:10 6 have identified in my rebuttal report. I just mentioned one of
03:10 7 them in here is as he goes through his analysis, some of the
03:10 8 parameters does change from one step to the next -- of one --
03:10 9 of one cohesive analysis in one base on one case.

03:10 10 For example, he finds an estimate of permeability,
03:10 11 then later on he chooses to use an estimate of permeability
03:11 12 from Dr. Gringarten and he doesn't use the best estimate of
03:11 13 Dr. Gringarten, what Dr. Gringarten had suggested would be the
03:11 14 best estimate. And so there are changes that happen within one
03:11 15 path.

03:11 16 I think one key thing is that use of the numerical
03:11 17 simulator coupled with the wellbore allows everything to remain
03:11 18 consistent from -- in one loop from input parameters to match
03:11 19 of all dynamic data and that consistently leaves -- consistency
03:11 20 is not preserved in Dr. Blunt's work.

03:11 21 Q. I'd like, if we could then, to move along to your opinions
03:11 22 with respect to Dr. Gringarten's work.

03:11 23 MR. CHAKERES: If we could go to demonstrative
03:11 24 D-21857.

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03:11 1 **BY MR. CHAKERES:**

03:11 2 **Q.** If you could briefly provide the Court with a summary of
03:11 3 highlights of your opinions with respect to Dr. Gringarten's
03:11 4 work.

03:12 5 **A.** Again, there are quite a few of them. In here I have
03:12 6 listed some of them. Dr. Gringarten uses -- well, what one can
03:12 7 call the well-testing technique to estimate the cumulative
03:12 8 volume of oil released.

03:12 9 And for his analysis, he needs to make an assumption
03:12 10 about oil flow rates. And then through his methodology, he
03:12 11 tries to correct for that oil flow and, finally, find the oil
03:12 12 flow, which is our objective in here.

03:12 13 Because he doesn't know what the oil flow is to start
03:12 14 with, he makes a couple of different assumptions, and that is
03:12 15 very reasonable. However, depending on what he assumes the
03:12 16 oil -- oil rates might be, he finds different estimates of
03:12 17 cumulative volume of oil released, and significantly different.
03:13 18 And that -- so his answers depends on his assumptions. That's
03:13 19 what I've tried to show in the first bullet.

03:13 20 And secondly, in the techniques that he uses, such
03:13 21 as -- it's called deconvolution, that doesn't resolve this
03:13 22 nonuniqueness. I have, in fact, in my rebuttal report,
03:13 23 Appendix III of it, I have provided my assessment of the
03:13 24 deconvolution. I'm not going to go through any of that detail
03:13 25 here.

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03:13 1 Q. Okay. If you could move along. You say you chose a
03:13 2 method that is directly proportional to permeability. Did you
03:13 3 describe that technique?

03:13 4 A. Yes. Once again, like in my very first slide when I
03:13 5 started this work, when I was reading what techniques can one
03:13 6 use to find -- to solve this problem, I thought about methods
03:13 7 that rely on flow rates based on permeability and skin. This
03:13 8 is the technique that is used in here by Dr. Gringarten. He
03:14 9 himself expresses that his method provides volume of oil
03:14 10 released that is directly proportional to permeability.

03:14 11 Permeability is a very uncertain parameter.
03:14 12 Therefore, in my opinion, the choice of methodology was -- was
03:14 13 not appropriate in the sense that it provided a very uncertain
03:14 14 answer.

03:14 15 Q. All right. I think you've testified about -- that his
03:14 16 estimate of permeability is too low, so we'll skip over that
03:14 17 one.

03:14 18 His pressure assumption for April 20th to May 8th,
03:14 19 what was that assumption?

03:14 20 A. So it was similar to my extreme case that -- that that was
03:14 21 the only scenario that Dr. Gringarten used that seems to be his
03:14 22 most likely value, but that is a very unrealistic, very extreme
03:14 23 case. That should not be considered as a realistic scenario.
03:14 24 That assumes no flow after the explosion, right after the
03:14 25 explosion.

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03:14 1 Q. What uncertainty does Dr. Gringarten ascribe as to that
03:15 2 initial pressure slope assumption?

03:15 3 A. None. That's why I am concerned -- as far as I remember,
03:15 4 he just uses a straight line for changes of BOP pressure where
03:15 5 no data exists and that's -- that's what he uses for the rest
03:15 6 of his analysis, only that case.

03:15 7 Q. All right. Can you summarize, Dr. Pooladi-Darvish, what
03:15 8 is your opinion in this case?

03:15 9 A. That the cumulative volume of oil released from the
03:15 10 Macondo reservoir and wellbore is between 5 to 5.3 million
03:15 11 stock tank barrels.

03:15 12 Q. Why do you have confidence in that opinion?

03:15 13 A. Because there are -- one can develop other models that are
03:15 14 have reasonable input parameters and they are even match the
03:15 15 shut-in pressures and they may provide either higher or lower
03:16 16 volumes of cumulative oil released, but they would be
03:16 17 inconsistent with part of the dynamic response of this
03:16 18 reservoir.

03:16 19 They cannot match the collection rates. And so the
03:16 20 farther, in fact, you go from that range of 5 to 5.3, you see
03:16 21 that it gets worse and worse in terms of the ability of those
03:16 22 models matching this important calibration point.

03:16 23 **MR. CHAKERES:** Dr. Pooladi-Darvish, thank you for
03:16 24 your time. I have no further questions at this time.

03:16 25 **THE COURT:** All right. Let's take about a 15-minute

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03:16 1 recess.

03:16 2 **THE DEPUTY CLERK:** All rise.

03:16 3 (WHEREUPON, the Court took a recess.)

03:40 4 **THE DEPUTY CLERK:** All rise.

03:40 5 **THE COURT:** All right. Please be seated, everyone.

03:40 6 All right.

03:40 7 **MR. FIELDS:** May I proceed, Your Honor?

03:40 8 **THE COURT:** Yes.

03:40 9 **MR. FIELDS:** Your Honor, Barry Fields on --

03:40 10 conducting the cross-examination of Dr. Pooladi-Darvish on

03:40 11 behalf of BP and Anadarko.

03:40 12 **CROSS-EXAMINATION**

03:40 13 **BY MR. FIELDS:**

03:40 14 **Q.** Doctor, in your analysis you indicated that you used two
03:40 15 methods, an analytical method and a numerical method?

03:41 16 **A.** Correct.

03:41 17 **Q.** I want to first talk about your analytical method. Using
03:41 18 that analytical method, you came up with an estimate of
03:41 19 approximately 5.2 million stock tank barrels that you believe
03:41 20 came out of the Macondo reservoir?

03:41 21 **A.** That is correct.

03:41 22 **Q.** And to arrive at this conclusion, you first estimated the
03:41 23 flow rate on the final day of the spill?

03:41 24 **A.** Yes.

03:41 25 **Q.** And in other words, you began estimating the flow on

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- 03:41 1 approximately July 15, 2010?
- 03:41 2 A. July 14th and 15th, that's correct.
- 03:41 3 Q. You then projected that -- projected or extrapolated that
- 03:41 4 rate back in time to April 20th, 2010?
- 03:41 5 A. No, that is not correct.
- 03:41 6 Q. Did you extrapolate back the final day rate in time?
- 03:41 7 A. I did not extrapolate the flow rate back in time.
- 03:41 8 Q. How did you -- how did you determine the flow rate over
- 03:41 9 time in your analytical model?
- 03:41 10 A. I developed wellbore and reservoir models that move
- 03:42 11 forward in time; however, those models' response is that it's
- 03:42 12 their -- their rate on the final day of flow is consistent or
- 03:42 13 is calibrated to what I had found earlier. So the models
- 03:42 14 themselves start with an initial pressure and then flow forward
- 03:42 15 in time.
- 03:42 16 Q. Are you talking about the numerical method or the
- 03:42 17 analytical?
- 03:42 18 A. Analytical.
- 03:42 19 **MR. FIELDS:** Will you pull up TREC-11653.3.1.
- 03:42 20 **BY MR. FIELDS:**
- 03:42 21 Q. This is from your expert witness report?
- 03:42 22 A. Yes, it is.
- 03:42 23 Q. And you say -- and this is discussing your analytical
- 03:42 24 method?
- 03:42 25 A. That is correct.

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03:42 1 Q. And you say: "First I began with an analytical method
03:43 2 that estimates the flow rate on the final day before the
03:43 3 capping stack was closed."

03:43 4 A. That is correct.

03:43 5 Q. And the capping stack was closed on July 15th, 2010?

03:43 6 A. Correct.

03:43 7 Q. Then you say: "I project this rate backwards in time to
03:43 8 the date of explosion."

03:43 9 A. That is correct. The word "project" here doesn't mean
03:43 10 extrapolate or it doesn't mean that I'm assuming anything back.
03:43 11 This is in my, I believe, summary or executive summary where I
03:43 12 have very -- in a crisp way I want to differentiate in a sense
03:43 13 between my analytical and numerical. But that -- so it's -- if
03:43 14 I wanted to provide a full explanation of many steps of
03:43 15 analytical, it would take time or space in here and I didn't
03:43 16 want to provide that space.

03:43 17 So I think the word "project back," this -- "project
03:43 18 this rate backwards," it is through use of models that the
03:43 19 models that are calibrated to this final rate, I find flow rate
03:44 20 at all other times.

03:44 21 Q. And one of the things you were trying to do in your
03:44 22 analytical model was to extrapolate back and estimate and
03:44 23 quantify the amount of oil that may have flowed from the
03:44 24 Macondo reservoir?

03:44 25 A. Once again, I disagree with extrapolation of flow rates

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03:44 1 backward; but, yes, my objective was to find the cumulative
03:44 2 volume of oil that was -- came out throughout all of that time
03:44 3 period.

03:44 4 Q. Let's take a look at your deposition on page 250, lines 19
03:44 5 through 24. At your deposition, were you asked this question
03:44 6 and did you give this answer:

03:44 7 "Question: So to be able to -- one of the things you
03:44 8 were trying to do in your analytical model was to extrapolate
03:44 9 back and estimate and quantify the amount of oil that may have
03:44 10 flowed from the Macondo reservoir?

03:44 11 "Answer: That is correct, yes."

03:45 12 A. Yes, that -- you read it correctly.

03:45 13 Q. Now, your ability to extrapolate the final day flow rates
03:45 14 back in time depends on knowing the Macondo reservoir pressure?

03:45 15 A. Yes.

03:45 16 Q. You agree that the reservoir's pressure decreased from
03:45 17 April 20th, 2010 to July 15th, 2010?

03:45 18 A. Yes.

03:45 19 Q. And the pressure decrease was caused by hydrocarbons
03:45 20 flowing from the reservoir?

03:45 21 A. Yes.

03:45 22 Q. You use a linear trend between the initial reservoir
03:45 23 pressure and the reservoir pressure at the time of the well
03:45 24 integrity test?

03:45 25 A. Yes and no. May I explain, if necessary?

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03:45 1 Q. You may explain.

03:45 2 A. Thank you.

03:45 3 My analytical work has a number of steps, and each
03:45 4 step builds on the previous step by removing some of its
03:46 5 assumptions and making corrections to it. In one of the
03:46 6 intermediary steps of my analytical work, I make such an
03:46 7 assumption of linear pressure change for the reservoir of
03:46 8 Macondo.

03:46 9 In the subsequent steps of that analytical work, the
03:46 10 model that is built that itself calculates the change in
03:46 11 averages of oil pressure and that is not linear and that
03:46 12 projects forward in time.

03:46 13 Q. One of the things that you did in your analytical model
03:46 14 was to consider the various flow paths that the hydrocarbons
03:46 15 took as they were leaving the reservoir and moved to the sea?

03:46 16 A. I'm sorry, can you repeat the beginning of that sentence?

03:46 17 Q. Sure. In your analytical method you considered the flow
03:46 18 paths that the hydrocarbons would take from the reservoir to
03:47 19 the sea?

03:47 20 A. I did consider that flow path, yes.

03:47 21 Q. First the fluids would flow from the reservoir to the
03:47 22 bottom of the wellbore?

03:47 23 A. Correct.

03:47 24 Q. Then the fluids would flow from the bottom of the wellbore
03:47 25 to the top of the wellhead or just below the BOP?

- 03:47 1 A. Again, in analytical work I have a step which flows to the
03:47 2 upstream of the BOP and I have a subsequent step in my
03:47 3 analytical work that flows to the ocean, correct.
- 03:47 4 Q. When we say upstream of the BOP, that means just below the
03:47 5 BOP?
- 03:47 6 A. That is correct.
- 03:47 7 Q. And then there is also a pathway where the fluid flows
03:47 8 from the bottom of the BOP, through the BOP, and out to the
03:47 9 sea?
- 03:47 10 A. Again, depending on which step you're talking about, there
03:47 11 is in particular a step that flowed to the sea as fully
03:47 12 modeled, that is correct.
- 03:48 13 Q. And you would agree that there can be resistances in the
03:48 14 reservoir?
- 03:48 15 A. For sure.
- 03:48 16 Q. There can be resistances in the wellbore?
- 03:48 17 A. Yes, sir.
- 03:48 18 Q. And there can be resistances in the BOP?
- 03:48 19 A. Yes, sir.
- 03:48 20 Q. And there can be resistances downstream of the BOP such as
03:48 21 in the *Deepwater Horizon's* riser?
- 03:48 22 A. Sure, yes.
- 03:48 23 Q. These various resistances such as the resistances in the
03:48 24 reservoir, the wellbore, the BOP, and the riser can affect the
03:48 25 flow rate through these pathways?

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03:48 1 A. Yes.

03:48 2 MR. FIELDS: Would you please display D-24551.1.

03:48 3 BY MR. FIELDS:

03:48 4 Q. This may look familiar to you, Doctor. This is just sort
03:48 5 of a diagram of your resistance coefficients that you use in at
03:48 6 least a portion of your analytical method, but I want to just
03:48 7 walk through this very quickly.

03:49 8 First of all, you have these resistance coefficients,
03:49 9 including something on the bottom called K-RES, R-E-S. Do you
03:49 10 see that?

03:49 11 A. Yes.

03:49 12 Q. And K-RES is the same as the Productivity Index?

03:49 13 A. Yes.

03:49 14 Q. You also have something called K-well, which is the
03:49 15 resistance coefficients for the wellbore?

03:49 16 A. That's correct.

03:49 17 Q. You have a resistance coefficient for the BOP called
03:49 18 K-BOP. Do you see that?

03:49 19 A. Yes.

03:49 20 Q. Now, if you had cement in the bottom of the wellbore, that
03:49 21 would be considered part of K-RES?

03:49 22 A. In my work any resistance that may be caused by cement at
03:49 23 the bottom of the wellbore, yes, would be incorporated as part
03:49 24 of K-RES.

03:49 25 Q. And if cement was eroding from the wellbore or somehow

03:50 1 leaving the wellbore, that would result in a change of K-RES
03:50 2 over time?

03:50 3 A. Under that hypothetical scenario, yes.

03:50 4 Q. Now, in the real world, resistances in the reservoir can
03:50 5 vary over time?

03:50 6 A. It can, and generally resistances increase.

03:50 7 Q. As part of your analytical method work, you did not
03:50 8 perform any analyses in which you varied K-RES over time?

03:50 9 A. I did not.

03:50 10 Q. So that means you did not vary the resistance in the
03:50 11 reservoir over time?

03:50 12 A. That is correct.

03:50 13 Q. As part of your work, you also looked at resistance to
03:50 14 flow in the wellbore or what you call K-well; correct? Let me
03:50 15 ask a slightly different question.

03:51 16 A. Sure.

03:51 17 Q. As part of your work, you calculated a resistance
03:51 18 coefficient for the wellbore called K-well?

03:51 19 A. Correct. Only in the first couple of steps of my
03:51 20 analytical work. So the first three or four pages of my work,
03:51 21 that is one method used, correct.

03:51 22 Q. And in your analytical work, you did not change the K-well
03:51 23 over time?

03:51 24 A. That is correct.

03:51 25 Q. You also evaluated resistance in the BOP?

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- 03:51 1 A. Yes, I did.
- 03:51 2 Q. And that is reflected, at least on D-24551.1, as K-BOP?
- 03:51 3 A. Again, in a particular step in my analytical work, it is
- 03:52 4 represented as K-BOP and later on it's basically a multiphase
- 03:52 5 flow model simulator that models the BOP as well as the
- 03:52 6 wellbores.
- 03:52 7 Q. And in that subsequent step, as I recall, you modeled the
- 03:52 8 BOP as a 50-foot pipe?
- 03:52 9 A. A 55-foot pipe -- restricted pipe, that is correct.
- 03:52 10 Q. In your analytical work -- analytical method work, did you
- 03:52 11 vary K-BOP over time?
- 03:52 12 A. Again, particular notion of K-BOP, it's only at Step 2 and
- 03:52 13 at that time I do not believe that I estimated the volume of
- 03:52 14 oil released, but at that particular step there is a K-BOP.
- 03:52 15 Q. With respect to the restricted -- with respect to the pipe
- 03:52 16 that you used to model the BOP in your subsequent work in the
- 03:53 17 analytical method, did you vary the size of the pipe over time?
- 03:53 18 A. No. Its diameter doesn't change, but the reason that I
- 03:53 19 was distinguishing between the two is that when pressures
- 03:53 20 change -- and that changes with time as we are producing from
- 03:53 21 this reservoir, that pressure changes in the BOP, then there --
- 03:53 22 there is a multiphase flow as it changes, that change is
- 03:53 23 incorporated in the multiphase flow.
- 03:53 24 Q. As part of your work in the analytical -- as part of your
- 03:53 25 analytical method work, did you take into account erosion that

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03:53 1 may have taken place over time in the bottom of the Macondo
03:53 2 wellbore?

03:53 3 A. If, a hypothetical case, erosion occurred at the bottom of
03:53 4 the wellbore, it is not accounted in my analytical work.

03:53 5 Q. As part of your analytical method work, did you take into
03:54 6 account any erosion that may have occurred in the *Deepwater*
03:54 7 *Horizon's* BOP?

03:54 8 A. Yes. At least in one step of it, I have accounted for it.

03:54 9 Q. And in what way have you accounted for erosion?

03:54 10 A. I have to look. It's either Step 3 or 4 of my analytical
03:54 11 where I use BOP pressures for calculation of the cumulative
03:54 12 volume of oil flow. Using a BOP pressure for such calculation
03:54 13 accounts for any erosion that would occur in the BOP or
03:54 14 downstream of the BOP.

03:54 15 Q. And was the amount of erosion that you incorporated into
03:54 16 your model varied over time?

03:54 17 A. Any erosion that would have occurred is accounted for by
03:54 18 just mere fact that I'm flowing against the back pressure of
03:54 19 the BOP. Whether fast or small, large or negligible, it was
03:55 20 accounted for.

03:55 21 Q. And you're only flowing against the pressures of the BOP
03:55 22 for a certain period of time during the spill?

03:55 23 A. For a majority of the time of the spill, that is correct.

03:55 24 Q. You're not flowing against the BOP pressures at any point
03:55 25 prior to May 8th, 2010?

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03:55 1 A. I'm flowing against an estimate or -- an estimate of the
03:55 2 BOP pressure. So I'm still flowing against the BOP pressure;
03:55 3 however, because no measurement of BOP pressure exists, I have
03:55 4 just considered a trend line for it, and I flow against that.

03:55 5 Q. Okay. So with respect to trying to incorporate erosion
03:55 6 into your analytical method, you made an assumption about what
03:55 7 the BOP pressure might be prior to May 8th, 2010?

03:55 8 A. Correct. For the few weeks where no measurements of the
03:56 9 BOP exist -- and I believe the Court has heard many times about
03:56 10 that lack of information -- then in my analytical work I assume
03:56 11 a particular trend line and in that way I accounted for any
03:56 12 erosion that might have occurred in the BOP.

03:56 13 Q. Let's talk about your numerical method. Your -- your
03:56 14 report contains 24 -- or one base case and 24 sensitivity
03:56 15 cases?

03:56 16 A. And plus if you were to say other cases as well, the
03:56 17 what-if cases.

03:56 18 Q. Right. Let's focus on the non -- the non-what-if cases.
03:56 19 We'll get to the what-if cases.

03:56 20 So with respect to the cases that you put up on the
03:56 21 board, the first set of cases, that was one base case and
03:56 22 24 sensitivity studies?

03:56 23 A. Again, knowing what-if cases that account for erosion,
03:56 24 then I have, yes, 25 cases that you're referring to, correct.

03:56 25 Q. Now, you say these 25 cases are based on a wide range of

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03:57 1 reservoir, wellbore, and BOP parameters?

03:57 2 A. Correct.

03:57 3 Q. In addition, in your original report, you also had some
03:57 4 what you call what-if cases?

03:57 5 A. Yes.

03:57 6 Q. And how many what-if cases did you have in your original
03:57 7 report?

03:57 8 A. I believe four.

03:57 9 Q. In addition, you have some additional sensitivity studies
03:57 10 that you -- that you present in your rebuttal report?

03:57 11 A. Thank you. Yes.

03:57 12 Q. And I believe that there are seven of those -- of those
03:58 13 cases?

03:58 14 A. Seven plus the what-ifs of the rebuttal, I believe.

03:58 15 Q. There were two additional what-ifs in the rebuttal report?

03:58 16 A. Three likely: The flat, the extrapolated, and the
03:58 17 extreme, likely.

03:58 18 **MR. FIELDS:** Why don't we put up D-24545.3.

03:58 19 **BY MR. FIELDS:**

03:58 20 Q. And you can correct me if I'm wrong, but when I went
03:58 21 through, I determined that there were 25 base and numerical
03:58 22 cases -- I'm sorry, sensitivity cases in your original report,
03:58 23 there were seven sensitivity studies in your rebuttal report,
03:59 24 and there were a grand total of six what-if cases in your
03:59 25 original and your rebuttal reports. Does that sound about

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- 03:59 1 right?
- 03:59 2 A. Do you need exact numbers? Then I need to check them.
- 03:59 3 There may be one more missing from this table, but if you don't
- 03:59 4 need exact numbers, you have it right.
- 03:59 5 Q. All right. Well, we're going to go through the first 25
- 03:59 6 and then we'll take it from there.
- 03:59 7 A. Please.
- 03:59 8 Q. So I want to set aside the six -- the what-if cases.
- 03:59 9 A. The erosion cases?
- 03:59 10 Q. The six what-if cases and we want to talk about the
- 03:59 11 non-what-if cases.
- 03:59 12 A. Sure.
- 03:59 13 Q. Now, you believe the numerical method provides a
- 03:59 14 significant advantage over the analytical method because it
- 03:59 15 allows you to deal with uncertainties?
- 03:59 16 A. The way I use my numerical method allowed me to deal with
- 03:59 17 uncertainties. That is one of the advantages in the
- 03:59 18 methodology that I use in numerical. Others might or might not
- 03:59 19 be able to incorporate uncertainty assessment in their
- 04:00 20 analytical work as well.
- 04:00 21 Q. You agree that uncertainties must be taken into account to
- 04:00 22 estimate the most likely volume of oil that came from the
- 04:00 23 Macondo reservoir?
- 04:00 24 A. Thank you, yes. That's the key.
- 04:00 25 Q. And you believe that these -- there are uncertainties

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- 04:00 1 associated with various reservoir parameters?
- 04:00 2 A. Yes. And --
- 04:00 3 Q. The largest uncertainties are associated with resistances
- 04:00 4 to flow?
- 04:00 5 A. Yes, whether those resistances are in the wellbore, BOP,
- 04:00 6 or reservoir, that's correct.
- 04:00 7 Q. So these include resistances in the reservoir, resistances
- 04:00 8 in the wellbore, and resistances from the BOP?
- 04:00 9 A. Correct.
- 04:00 10 Q. You believe the largest uncertainties are associated with
- 04:00 11 the resistances in the reservoir, wellbore, and the BOP?
- 04:00 12 A. Yes, and by resistances, it includes a wide range of
- 04:00 13 parameters.
- 04:01 14 Q. Now, at one point, the *Deepwater Horizon* --
- 04:01 15 **MR. FIELDS:** You can take down, I'm sorry, D-2420 --
- 04:01 16 the demonstrative for right now. I didn't read it fast enough.
- 04:01 17 **BY MR. FIELDS:**
- 04:01 18 Q. At one point the *Deepwater Horizon* was connected to the
- 04:01 19 blowout preventer through a riser?
- 04:01 20 A. Yes.
- 04:01 21 Q. The riser was several thousand feet long?
- 04:01 22 A. Correct.
- 04:01 23 Q. When the *Deepwater Horizon* sank on April 22nd, 2010, the
- 04:01 24 riser collapsed to the seafloor?
- 04:01 25 A. Correct.

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04:01 1 Q. And the riser at one end was still connected to the
04:01 2 *Deepwater Horizon's* BOP?

04:01 3 A. Yes.

04:01 4 Q. The other end of the riser had become disconnected from
04:01 5 the rig?

04:01 6 A. Yes.

04:01 7 Q. There were several thousand feet of riser that remained
04:01 8 connected to the *Deepwater Horizon's* blowout preventer until
04:01 9 the riser was cut?

04:02 10 A. Approximately it's 5,000 feet, probably.

04:02 11 Q. Okay. There were approximately 5,000 feet of riser
04:02 12 connected to the *Deepwater Horizon's* BOP until it was cut on
04:02 13 June 3rd, 2010?

04:02 14 A. Yes.

04:02 15 Q. So hydrocarbons flowed through the riser for approximately
04:02 16 half of the entire period in which oil was leaving the Macondo
04:02 17 reservoir and exiting into the Gulf of Mexico?

04:02 18 A. Yes. So that length is about one-third -- less than
04:02 19 one-third of total length and diameter of the riser and,
04:02 20 therefore, the resistance of it is much smaller than anywhere
04:02 21 else. But, please, yes, the length is correct.

04:02 22 Q. You agree that there was evidence of erosion in the riser?

04:02 23 A. There was, in the kink of the riser, holes, if that is
04:02 24 what you're referring to.

04:02 25 Q. You saw pictures or images showing that erosion was

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04:02 1 happening in the riser?

04:02 2 A. Yes.

04:02 3 Q. You believe that erosion in the riser likely continued
04:03 4 during the entire time the riser was connected to the BOP?

04:03 5 A. Yes. I believe you're referring to a question during my
04:03 6 deposition and I explained that in my opinion, I said probably,
04:03 7 molecular level, or tiny amounts of erosion, would have
04:03 8 continued for a long time, which likely had no impact on the
04:03 9 total flow.

04:03 10 Q. You also know that a kink -- a hole developed in the riser
04:03 11 as late of May 19th, 2010?

04:03 12 A. I do not recall the exact date of the last hole, but --
04:03 13 that's right, I don't recall it.

04:03 14 Q. So some erosion likely happened in the *Deepwater Horizon's*
04:03 15 riser from April 22nd until at least June 3rd, 2010?

04:03 16 A. Again, some tiny amounts of erosion, particular in terms
04:03 17 of their effect on flow rate, because that's what matters to
04:03 18 me, might have occurred for a long time.

04:04 19 Q. And the rate of erosion, you believe, would have declined
04:04 20 over time?

04:04 21 A. Generally, that is my understanding of erosion, starts
04:04 22 fast and then declines sharply.

04:04 23 Q. The rate -- I'm sorry. The erosion in the riser would
04:04 24 have affected the resistance of -- the resistance to flow in
04:04 25 the riser?

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- 04:04 1 A. Yes.
- 04:04 2 Q. And you believe that the resistance to flow in the riser
- 04:04 3 likely changed over time?
- 04:04 4 A. Likely to a small amount. And as I mentioned, it's
- 04:04 5 incorporated in the calculations that I have done.
- 04:04 6 Q. In your base and sensitivity cases, you do not analyze
- 04:04 7 resistance through the riser?
- 04:04 8 A. I'm sorry, you are talking numerical now; correct?
- 04:04 9 Q. That's correct.
- 04:04 10 A. Can you repeat the question? Sorry.
- 04:04 11 Q. Sure. In your base and sensitivity cases, you do not
- 04:05 12 analyze resistance through the riser?
- 04:05 13 A. For the base and sensitivity cases we are comparing, with
- 04:05 14 the exception of the what-ifs, that is correct.
- 04:05 15 Q. You did not try to model how the resistance in the riser
- 04:05 16 changed over time?
- 04:05 17 A. I did not, but through my analytical work also, I already
- 04:05 18 had a sense of how big its impact might be, and I found it to
- 04:05 19 be small.
- 04:05 20 Q. But regardless, sir, you did not try to model how the
- 04:05 21 resistance in the riser changed over time as part of your
- 04:05 22 numerical work in your base and sensitivity studies?
- 04:05 23 A. That is correct. Inconsistent with my methodology and I
- 04:05 24 felt I needed to take care of what impacted the flow to a
- 04:05 25 larger degree.

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04:05 1 Q. In your base and sensitivity cases, you did not take into
04:05 2 consideration the erosion that was occurring in the riser over
04:06 3 time?

04:06 4 A. That is correct. Subject to the answer -- explanation
04:06 5 that I provided, I believe it was the same question that you
04:06 6 asked me earlier.

04:06 7 Q. Let's continue focusing on the 32 base and sensitivity
04:06 8 cases and now discuss erosion in the *Deepwater Horizon's*
04:06 9 blowout preventer.

04:06 10 A. Sure.

04:06 11 Q. You agree that the restriction to flow caused by the BOP
04:06 12 was not well known?

04:06 13 A. Correct.

04:06 14 Q. The uncertainty in the degree of restriction within the
04:06 15 BOP, in your view, was large?

04:06 16 A. That is correct.

04:06 17 Q. The uncertainty could have a potentially large impact on
04:06 18 the estimates of flow rate?

04:06 19 A. Large, I guess, I feel I have always needed to put it in
04:07 20 perspective in terms of pressure drop that the BOP caused of
04:07 21 somewhere about 1500 psi pressure drop it imposed against flow
04:07 22 approximately, and that should not be ignored, and cannot be
04:07 23 ignored.

04:07 24 MR. FIELDS: TREX-11653.8.3.
25

04:07 1 BY MR. FIELDS:

04:07 2 Q. In your expert report, your original report, you wrote,
04:07 3 sir: "The uncertainty in the degree of restriction within the
04:07 4 BOP is large, with a potentially large impact on the estimates
04:07 5 of flow rate."

04:07 6 A. The potential for them are large, and I evaluated it,
04:07 7 that's correct. That's exactly what I was saying. One needs
04:07 8 to evaluate them, and I did.

04:07 9 Q. You knew there was erosion in the BOP during the spill?

04:07 10 A. The images of various components of the BOP showed that
04:08 11 the erosion is there.

04:08 12 Q. And in your base and sensitivity cases, the 25 plus
04:08 13 7 cases, you did not take into consideration erosion occurring
04:08 14 in the BOP over time?

04:08 15 A. That is correct. Already through my analytical I had a
04:08 16 sense that its impact is -- needs to be taken into account, but
04:08 17 it's not huge. So it's probably in a few percent or --

04:08 18 Q. I'm sorry. Were you finished?

04:08 19 A. I'm finished. Yes. Thank you.

04:08 20 Q. I was just simply asking you whether or not, in your base
04:08 21 and sensitivity cases, you took into consideration erosion
04:08 22 occurring in the BOP over time.

04:08 23 A. I did not.

04:09 24 Q. In your direct examination there was a chart that was put
04:09 25 up -- and let me see if I can find the number. I believe it

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04:09 1 was D-21843.

04:09 2 This was a demonstrative used by the United States in
04:09 3 your direct examination testimony. Do you recall this?

04:09 4 A. Yes.

04:09 5 Q. With respect to all of these cases that are set forth on
04:09 6 D-21843, you did not take into consideration erosion in the BOP
04:09 7 in any of these cases, did you?

04:09 8 A. That is correct, I did not.

04:09 9 Q. With respect to all of these cases that are set forth on
04:09 10 D-21843, you did not take into consideration any possible
04:10 11 erosion of cement from the bottom of the wellbore?

04:10 12 A. Again, if such a hypothetical case existed, these do not
04:10 13 account for that.

04:10 14 Q. Let's turn to -- start talking about your what-if cases.
04:10 15 You performed a number of what-if cases; correct?

04:10 16 A. Yes.

04:10 17 Q. Give me one second to get back to my spot here.

04:10 18 I want to first talk about a what-if case called --

04:11 19 **MR. FIELDS:** If we can put up D-24546.1.

04:11 20 **BY MR. FIELDS:**

04:11 21 Q. At least according to when I went through your reports, I
04:11 22 identified these six what-if cases. Are those correct?

04:11 23 A. If you allow me now, we are talking about those six.

04:11 24 These six are certainly correct. There may be one
04:11 25 more, but let's proceed, please.

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04:11 1 Q. As you sit here, do you recall if there was one more?

04:11 2 A. I'm sorry?

04:11 3 Q. As you sit here, do you recall if there was one more?

04:11 4 A. I'm wondering whether as part of the rebuttal there was a
04:11 5 flat one as well, but -- and which is not here. The flat that
04:12 6 is in here is -- I'm not sure which one it is. There's a
04:12 7 little bit of information here.

04:12 8 If I could use my reports, I would be able to --

04:12 9 Q. If you have it up there.

04:12 10 Let me just ask a couple of additional questions.

04:12 11 A. Sure.

04:12 12 Q. As I recall, there were some what-if cases that you had in
04:12 13 your original report, and you had to correct those what-if
04:12 14 cases and put those in your rebuttal report?

04:12 15 A. That, and then do additional what-ifs in the rebuttal.

04:12 16 Q. Let's just sort of walk through these what-if cases.

04:12 17 A. Please.

04:12 18 Q. Let's first talk about the what-if case called
04:12 19 "Extrapolated BOP Plus 966."

04:12 20 A. Okay.

04:12 21 Q. As part of your work in this case, did you come to learn
04:12 22 that some people believe that the BOP pressure readings prior
04:13 23 to the well integrity test might not be accurate?

04:13 24 A. Yes.

04:13 25 Q. And there were some who suggested that there was a need

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04:13 1 for a pre-July 13th BOP pressure reading adjustment of
04:13 2 approximately 966-psi?

04:13 3 A. That was suggested as an alternative in some documents,
04:13 4 yes.

04:13 5 Q. And in this simulated case, this simulated what-if case,
04:13 6 what you did was you adjusted the pre-July 13th BOP readings by
04:13 7 adding 966 psi to the reading?

04:13 8 A. That is correct.

04:13 9 Q. And this particular what-if case resulted in a cumulative
04:13 10 release estimate --

04:13 11 **MR. FIELDS:** If we do TREN-11653.302.1.

04:14 12 **BY MR. FIELDS:**

04:14 13 Q. -- this particular extrapolated plus-966 psi case resulted
04:14 14 in a cumulative estimate of 4.53 million stock tank barrels?

04:14 15 A. That is correct.

04:14 16 Q. And you rated this -- or based on your analysis, you
04:14 17 believed that the collection -- it had a mediocre match to the
04:14 18 collection on July 15th?

04:14 19 A. It had a mediocre match-up to the collection, and it had
04:14 20 other unusual behavior that I discounted, therefore, in this
04:14 21 case, yes.

04:14 22 Q. Right. So you did not believe that the plus-966
04:14 23 correction before July 13th was reasonable.

04:14 24 A. Again, that was not my primary objective, but along the
04:14 25 line, it appeared to me that this is unlikely to be a correct

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04:15 1 correction to the BOP pressures.

04:15 2 Q. Because you thought it would result in an unreasonable
04:15 3 pressure trend?

04:15 4 A. Unreasonable pressure trend and leading to an unreasonable
04:15 5 flow trend, yes.

04:15 6 Q. With respect to this particular what-if case, does it take
04:15 7 into consideration any erosion that occurred in the BOP before
04:15 8 May 8th, 2010?

04:15 9 A. Yes. Any time -- if an explanation is needed -- yes.

04:15 10 MR. FIELDS: Will you pull up 11653.318.2.

04:15 11 BY MR. FIELDS:

04:15 12 Q. Doctor, this is from your report, and it's basically --
04:16 13 this is an output showing a cumulative oil release under this
04:16 14 particular case. Do you see that?

04:16 15 A. Yes.

04:16 16 Q. Okay. If we go back to TREX 11653.318.1, this is a chart
04:16 17 that shows what the model simulation predicted as far as a flow
04:16 18 rate history from April 20th, 2010, through July 2010; correct?

04:16 19 A. Yes. When you say "this," there are three lines in here,
04:16 20 and one of them is the particular case of our interest.

04:16 21 Q. And that is the one with the short dotted line -- dashed
04:16 22 line?

04:16 23 A. Or -- the long dashed line. Because the short one is
04:17 24 before history matching; the long one is after history
04:17 25 matching.

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04:17 1 Q. And in any event, in both cases, the rates start high and
04:17 2 trend down until you get to July 2010?

04:17 3 A. That is correct. But there could be erosion cases in the
04:17 4 BOP that would also result in this behavior.

04:17 5 Q. What BOP pressure did you use to flow against in the
04:17 6 extrapolated BOP plus-966 correction?

04:17 7 A. It is identified in my report, but if you wanted to know,
04:17 8 it basically uses a trend line of the BOP extrapolated backward
04:17 9 to time of explosion plus 966.

04:18 10 Q. Let's look at what-if case called "Flat BOP."

04:18 11 **MR. FIELDS:** If you'd put up D-24546-2 again.

04:18 12 **BY MR. FIELDS:**

04:18 13 Q. I want to talk about something called the "flat BOP." Do
04:18 14 you see that?

04:18 15 A. Yes.

04:18 16 Q. And in this what-if case, you assume that the BOP pressure
04:18 17 remained constant throughout the entire spill?

04:18 18 A. That is correct.

04:18 19 Q. You estimated that the BOP's pressure reading on
04:18 20 July 13th was 3,511 psi?

04:19 21 A. I do not exactly recall.

04:19 22 **MR. FIELDS:** Why don't we put up TRES-11653.294.1.

04:19 23 **THE WITNESS:** I thought for the flat I might have
04:19 24 assumed a constant value of 3800.

25

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04:19 1 **BY MR. FIELDS:**

04:19 2 **Q.** This is from your report. It says: "The flat BOP case
04:19 3 assumes that the BOP pressure during the period April 20th to
04:19 4 July 13th is 3,511 psi, which is corrected -- which is the
04:19 5 corrected BOP pressure." Do you see that?

04:19 6 **A.** Correct. Yes. Thank you.

04:19 7 **Q.** So in the flat BOP case, you assume that the BOP pressure
04:19 8 did not change at all from April 20th to July 13th?

04:19 9 **A.** That is correct.

04:19 10 **Q.** You assume that the BOP pressure remained at 3,511 psi for
04:20 11 the entire period?

04:20 12 **A.** That is correct.

04:20 13 **Q.** But you would agree that the BOP pressure did -- did not
04:20 14 stay constant from April 20th to July 13th?

04:20 15 **A.** It certainly varied, and I'm trying to make reasonable --
04:20 16 or various trend lines through the BOP pressure because I know
04:20 17 there is uncertainty -- larger uncertainty associated with BOP
04:20 18 pressures.

04:20 19 **Q.** So if you look at --

04:20 20 **MR. FIELDS:** If we could pull up D-24549.

04:20 21 **BY MR. FIELDS:**

04:20 22 **Q.** This is a demonstrative based on your flat BOP case.

04:20 23 The triangles on the demonstrative are the BOP
04:21 24 pressures?

04:21 25 **A.** At this time there is no flat BOP on this slide shown. It

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04:21 1 is just the measured values that we are already looking at.

04:21 2 Q. Just the measured values.

04:21 3 A. Correct.

04:21 4 Q. And in the flat BOP what you did was you drew a line
04:21 5 across, and you assumed that the pressure on the BOP was 3,511
04:21 6 for the entire time period?

04:21 7 A. Yes. Basically, I considered a flat line going through
04:21 8 the data.

04:21 9 Q. But, again, you can see that during the period, most of
04:21 10 the time the BOP pressures were either above or below that?

04:21 11 A. That is correct.

04:21 12 Q. So your flat BOP case uses an assumption about the BOP
04:21 13 pressure that is inconsistent with what was actually occurring
04:21 14 in the field?

04:21 15 A. For the purposes of calculation of cumulative oil release,
04:22 16 which accounts for the total flow over the 86 days, this is
04:22 17 one -- I suggest this is one reasonable suggestion for the BOP
04:22 18 pressures, especially when we know they are uncertain.

04:22 19 Q. And despite the -- despite the fact that your pressure
04:22 20 line, or pressure trend line that you used in the flat BOP case
04:22 21 is inconsistent with what was being observed in the field, you
04:22 22 actually were able to get a good match to the collection?

04:22 23 A. That is correct.

04:22 24 MR. FIELDS: So if you pull up TREN-11653.302.2.
04:22 25

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04:22 1 BY MR. FIELDS:

04:22 2 Q. You can see for the flat BOP, which uses a BOP -- a BOP
04:22 3 pressure trend line that is inconsistent with the actual BOP
04:23 4 pressures, you actually received or estimated a cumulative oil
04:23 5 release of 5.2 million stock tank barrels?

04:23 6 A. Correct.

04:23 7 Q. And you were able to use this case to actually match the
04:23 8 collection rate on July 15th?

04:23 9 A. Not only the collection rates but even the shut-in
04:23 10 pressures. That is correct.

04:23 11 Q. Does the flat BOP case make an assumption that there was
04:23 12 erosion in the BOP?

04:23 13 A. It doesn't explicitly make any assumption whether it
04:23 14 exists, any erosion in the BOP, or not. It just says that if
04:24 15 an erosion existed, it would have resulted in the BOP pressures
04:24 16 that would be consistent with the flat line.

04:24 17 Q. As part of the flat BOP case, were you trying to
04:24 18 accurately reflect the erosion that may have occurred in the
04:24 19 *Deepwater Horizon* blowout preventer?

04:24 20 A. I never tried to accurately model erosion; I tried to find
04:24 21 out how big its impact could be. Therefore, I considered
04:24 22 extreme scenarios, from one end to the other, to see how large
04:24 23 of an impact a potential erosion could have on the estimate of
04:24 24 cumulative volume of oil released. Therefore, I went from flat
04:24 25 to extrapolated to extreme.

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04:24 1 Q. You also looked at what you called -- there were two
04:24 2 extrapolated cases. Do you recall those?

04:25 3 A. We are -- sorry. You're referring to primary report or
04:25 4 ultimately together?

04:25 5 Q. Ultimately together.

04:25 6 A. There are two extrapolated cases. That is correct.

04:25 7 Q. There's an extrapolated case, and there's something called
04:25 8 a "Trusler extrapolated case." Do you recall that?

04:25 9 A. Yes.

04:25 10 **MR. FIELDS:** If you pull up TREX-11654R.23.2.

04:25 11 **BY MR. FIELDS:**

04:25 12 Q. You indicated in the extrapolated BOP case, you have a
04:25 13 cumulative estimate of 5.12 million stock tank barrels?

04:25 14 A. Yes.

04:25 15 Q. And in the Trusler extrapolated BOP, it gave you a
04:25 16 slightly lower cumulative estimate of about 4.9 million?

04:25 17 A. That's correct.

04:25 18 Q. And the difference between the two was that in one of them
04:26 19 you used pressure readings -- corrected pressure readings
04:26 20 suggested by Dr. Martin Trusler?

04:26 21 A. Yes, Dr. Trusler.

04:26 22 Q. Dr. Trusler was a BP-retained expert who provided some
04:26 23 what he proposed corrections to the BOP pressure readings?

04:26 24 A. Correct.

04:26 25 Q. If you take a look at the process that you used, just to

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04:26 1 give the Court an idea on the extrapolated BOP -- and this
04:26 2 would be true for both the extrapolated and the Trusler
04:26 3 extrapolated -- if we go back to D-24550.

04:26 4 So, again, to start, we have the BOP pressure
04:26 5 readings that were recorded. And in the extrapolated case,
04:26 6 what you first do is you draw a line from the BOP pressure
04:26 7 reading on May 8th to July 13th?

04:27 8 A. That is correct.

04:27 9 Q. And that is the pressure line that -- pressure trend line
04:27 10 that you used in this particular case?

04:27 11 A. The line is shown on this plot. You are correct.

04:27 12 Q. In this particular case you don't actually use the actual
04:27 13 BOP readings that occurred from May 8th, 2010, to July 13th,
04:27 14 2010?

04:27 15 A. I considered something that is somewhat above most of the
04:27 16 readings and, therefore, would impose more back pressure
04:27 17 against the system. It gives less flow, yes.

04:27 18 Q. So my question was simply that you didn't use the actual
04:27 19 BOP pressures in this particular case.

04:27 20 A. Yes, subject to the explanation, that is correct. Yes.

04:27 21 Q. Now, one of the things you did was you then extrapolated
04:27 22 the line back from May 8th to the beginning of the incident on
04:28 23 April 20th?

04:28 24 A. That is correct.

04:28 25 Q. And so any erosional processes that had been taking place

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04:28 1 post-May 8th you believe would be captured by this particular
04:28 2 case?

04:28 3 A. That is correct.

04:28 4 It requires a bit of an explanation. So if we
04:28 5 consider that the straight line that is drawn is a
04:28 6 representation of the BOP pressure after May 8th, then all of
04:28 7 the erosion that would be -- if it were to be up here, is
04:28 8 accounted for.

04:28 9 This also applies to before May 8th. There are
04:28 10 some -- that if that line is a reasonable representation of the
04:28 11 BOP pressure prior to May 8th, then this trend line would
04:28 12 account for such erosion.

04:28 13 Q. It was your view, however, that the BOP pressure readings
04:28 14 between May 8th, 2010, and July 13th, 2010, did not indicate
04:29 15 evidence of significant erosion during that period; correct?

04:29 16 A. It doesn't -- that data doesn't exist. I don't make -- I
04:29 17 don't develop an opinion based on pressures that don't exist.

04:29 18 Q. Maybe I was confusing. I was actually talking about after
04:29 19 May 8th. So let me ask the question again. Maybe I said it
04:29 20 incorrectly.

04:29 21 Your view is that between May 8th and July 13th, the
04:29 22 BOP pressure readings do not provide evidence of significant
04:29 23 erosion in the BOP?

04:29 24 A. That is correct. And that is really by comparison of this
04:29 25 case with my base case in the sense that this would account for

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04:29 1 any erosion that would be occurring in the BOP post-May 8.

04:29 2 I have models that do not make -- assume there was no
04:30 3 erosion, that there is very little difference between their
04:30 4 cumulative volume of oil released.

04:30 5 This analogy tells me that likely there was an -- if
04:30 6 there was any erosion, molecular level or otherwise, wouldn't
04:30 7 impact the resistances to the level that would have impact
04:30 8 cumulative volume of oil released.

04:30 9 Q. So by extrapolating this line back from May 8th to the
04:30 10 beginning of time, you're assuming whatever rate of erosion
04:30 11 that existed post-May 8th also occurred pre-May 8th?

04:30 12 A. Rate of erosion is probably not the correct way of
04:30 13 characterizing it, given the rate of erosion would be the same;
04:30 14 its impact on resistance changes.

04:30 15 All this is -- again, so all I -- these are --
04:30 16 what-ifs are an attempt to bracket the effect of erosion. I
04:30 17 consider various scenarios for what the BOP pressure might have
04:31 18 been if there was small or large erosion -- and I make no
04:31 19 judgment about it -- and observe their effect on the cumulative
04:31 20 volume of oil release.

04:31 21 Q. Now, you talked about on direct examination that you
04:31 22 actually considered two BOP cases or two what-if cases called
04:31 23 "restricted BOP cases." Do you recall that?

04:31 24 A. Yes.

04:31 25 Q. There was a -- there was a restricted BOP case and a

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04:31 1 Trusler restricted BOP case. Do you recall that?

04:31 2 A. Correct. Yes.

04:31 3 Q. And in those two cases, the difference -- primary
04:31 4 difference between them was that one was using BOP data
04:31 5 corrected using Dr. Trusler's formula?

04:31 6 A. That is correct.

04:31 7 Q. And in both of those instances, both in the restricted BOP
04:31 8 case and the extrapolated BOP case, both of those cases -- oh,
04:31 9 sorry.

04:31 10 In both the restricted BOP case and the Trusler
04:32 11 restricted BOP case, both of those matched buildup pressure?

04:32 12 A. Yes. You could find combination of reservoir parameters
04:32 13 and wellbore parameters that would allow you a match of the
04:32 14 shut-in pressures.

04:32 15 Q. And both of those cases also match your collection rate
04:32 16 data?

04:32 17 A. Correct.

04:32 18 Q. And the cumulative estimates from those two cases --
04:32 19 what-if cases were 4.4 million stock tank barrels and
04:32 20 4.7 million.

04:32 21 A. Yes. These are the extreme cases that would be unreal.
04:32 22 Yes.

04:32 23 Q. Now, with respect to any of your cases, I wanted to talk
04:32 24 about a different type of erosion, and that's cement erosion.

04:32 25 At some point in time you learned that cement had

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04:32 1 been pumped down into the bottom of the Macondo well?

04:32 2 A. You mean for --

04:32 3 Q. During operations?

04:32 4 A. For setting of the casing pressure? Yes.

04:33 5 Q. And when you looked at the PT-B pressure after May 8th,

04:33 6 you cannot rule out the existence of downhole erosion, can you?

04:33 7 A. Again, discussion of erosion really doesn't matter me.

04:33 8 What matters me and what I just consider is the impact of

04:33 9 resistances or erosion and those resistances to the level that

04:33 10 it affect flow.

04:33 11 For me, it's generally a skin factor and a pressure

04:33 12 drop that may be associated with skin factor, yes.

04:33 13 And then I -- I'm sorry. That's the way I would

04:33 14 consider -- I wouldn't call it whether erosion exists or not;

04:33 15 its impact on flow rate.

04:33 16 Q. Let me ask you this: By looking at the PT-B pressures or

04:33 17 the BOP pressures after May 8th, can you rule out that cement

04:33 18 was leaving the well at any point in time while the well was

04:33 19 flowing?

04:34 20 A. My assessment of that behavior of the BOP pressure is that

04:34 21 if there was any changes happening, it had very little impact

04:34 22 on flow rate.

04:34 23 Q. You did not analyze or evaluate whether cement at the

04:34 24 bottom of the well eroded over time while the well was flowing,

04:34 25 did you?

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- 04:34 1 A. I was not asked to evaluate cement erosion, per se.
- 04:34 2 Q. I'm sorry.
- 04:34 3 A. Sorry.
- 04:34 4 Q. You did not reach any conclusions about over what periods
04:34 5 of time cement erosion may have occurred?
- 04:34 6 A. Again, for the purposes of its impact on flow, I provide
04:34 7 an opinion that is in my reports. But, again, whether erosion
04:34 8 happened or not, that's not what I have been asked to provide
04:34 9 an opinion.
- 04:34 10 Q. Let me just ask the question again so we're all clear.
04:34 11 You did not reach any conclusions about over what
04:34 12 periods of time cement erosion may have occurred during the
04:35 13 spill?
- 04:35 14 A. That was not within --
- 04:35 15 **MR. CHAKERES:** Asked and answered, Your Honor. I
04:35 16 think the witness has been clear on this point. It's been
04:35 17 asked several times now.
- 04:35 18 **THE COURT:** I think he answered that. I really do.
04:35 19 Okay. I'll sustain the objection.
- 04:35 20 **BY MR. FIELDS:**
- 04:35 21 Q. I wanted to talk about the process that you used to
04:35 22 determine what you called a good match.
- 04:35 23 A. Yes.
- 04:35 24 Q. You talked a little bit about that on direct examination.
- 04:35 25 A. Yes.

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04:35 1 Q. So you developed and ran a series of models that represent
04:35 2 variations on the reservoir, the wellbore, and the BOP system?

04:35 3 A. Correct.

04:35 4 Q. And you first developed what you call a base model?

04:35 5 A. Yes.

04:35 6 Q. And then what you -- and you chose certain parameters to
04:36 7 use in that base model?

04:36 8 A. Yes. These have come out of -- they've had -- chose --
04:36 9 that was based on a previous analysis. I did an analytical
04:36 10 phase of the study. It provided a starting point for my input
04:36 11 parameters. I used those into the numerical base case. I
04:36 12 needed to go through a step of history matching right there,
04:36 13 and that made my basis. That's right.

04:36 14 Q. And one of the parameters that you used in your base case
04:36 15 was rock compressibility?

04:36 16 A. Correct.

04:36 17 Q. And for rock compressibility in your base case, you used
04:36 18 6 microsips?

04:36 19 A. In my base case numeric model, I have used a base value,
04:36 20 or a starting point, of 6, that's correct, microsips.

04:36 21 Q. Now, in addition, you varied a wide range of input
04:36 22 parameters that could impact the cumulative volume of oil
04:36 23 release?

04:36 24 A. Yes, some of them. Found out that it had a large impact;
04:37 25 some had less.

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04:37 1 Q. After you ran each simulated case with the varying inputs,
04:37 2 you then perform a process that you called history matching?

04:37 3 A. Yes.

04:37 4 Q. Now, history matching is a commonly used method, according
04:37 5 to you, in modeling?

04:37 6 A. In reservoir modeling and simulation, it's commonly used,
04:37 7 yes.

04:37 8 Q. History matching involves comparing results generated by
04:37 9 your simulation with, you know, field or actual measured data?

04:37 10 A. And especially dynamic reservoir response. That is
04:37 11 correct.

04:37 12 Q. Now, here you chose to match your simulation cases against
04:37 13 measurements obtained during the well integrity test?

04:37 14 A. During and just before the integrity test, that's correct.
04:37 15 Collection rates, I believe, are just before the integrity
04:37 16 test, yes.

04:37 17 Q. So the capping stack was installed on July 13th?

04:37 18 A. Or slightly before. Yes, about that.

04:38 19 Q. So you were looking at data that was either around
04:38 20 July 15th and later as part of your history-matching exercise?

04:38 21 A. When I was comparing the shut-in pressures and history
04:38 22 matching to shut-in pressures, I'm talking about pressures that
04:38 23 are measured after July 15th. That's correct.

04:38 24 Q. Now, you used two sets of measurements from the well
04:38 25 integrity test for history matching. The first was the

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- 04:38 1 pressure buildup data?
- 04:38 2 A. Correct.
- 04:38 3 Q. The second was the collection rate data?
- 04:38 4 A. Thank you. Yes.
- 04:38 5 Q. Now, let's discuss the first type of measurements you used
- 04:38 6 for history matching, which is the pressure buildup data.
- 04:38 7 A. Okay.
- 04:38 8 Q. Now, as part of the well integrity test, the capping stack
- 04:38 9 was closed on July 15th, 2010?
- 04:38 10 A. Correct.
- 04:38 11 Q. After the capping stack was closed on July 15th, 2010, the
- 04:38 12 pressure began to build?
- 04:38 13 A. Correct.
- 04:38 14 Q. And the measured pressure -- I'm sorry -- the pressure
- 04:38 15 increases were measured over time?
- 04:38 16 A. Correct.
- 04:38 17 Q. And you actually had pressure data from approximately
- 04:39 18 July 15th through about August 3rd?
- 04:39 19 A. Correct.
- 04:39 20 **MR. FIELDS:** So if you pull up TREN-11653.3.1.
- 04:39 21 It must be the wrong one. I'm sorry. I have
- 04:39 22 the wrong one. My apologies.
- 04:39 23 **BY MR. FIELDS:**
- 04:39 24 Q. In any event, you used this pressure buildup data as part
- 04:39 25 of your history-matching exercise?

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- 04:39 1 A. Yes.
- 04:39 2 Q. And you determined whether a given model case would
- 04:39 3 closely match this buildup pressure data?
- 04:40 4 A. Correct.
- 04:40 5 Q. And I think you said on direct examination that there was
- 04:40 6 a certain metric you used to decide whether or not the
- 04:40 7 simulated case provided a good match to the actual measured
- 04:40 8 data?
- 04:40 9 A. Correct.
- 04:40 10 Q. As part of your work in this case, you found that there
- 04:40 11 were many different models or cases that could match the
- 04:40 12 buildup pressure?
- 04:40 13 A. That is correct.
- 04:40 14 Q. If you look at -- let's look at 2 -- D-24543.
- 04:40 15 This is, again, your original case plus your
- 04:40 16 sensitivity cases. It's similar to the chart that you used in
- 04:40 17 direct examination, but you have this column that shows match
- 04:40 18 of pressure. Do you see that?
- 04:40 19 A. Yes.
- 04:40 20 Q. And on these 25 cases that are set forth here, all the
- 04:40 21 cases except for one was able to match the buildup pressure?
- 04:40 22 A. That is correct.
- 04:41 23 Q. And so with respect to just your original and base cases,
- 04:41 24 you saw that cumulative flows as low as 3.3 million could
- 04:41 25 actually match the buildup pressure?

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- 04:41 1 A. Correct.
- 04:41 2 Q. And a cumulative oil release up to 5.8 million stock tank
04:41 3 barrels could also match the buildup pressure?
- 04:41 4 A. Correct. And later on I confirmed that even this range
04:41 5 could be much wider.
- 04:41 6 Q. And, in fact, in some of your other work, you found that
04:41 7 models yielding a cumulative flow estimate ranging from
04:41 8 3 million to 7 million barrels or greater could match the
04:41 9 buildup pressure post-well shutting?
- 04:41 10 A. Correct. Thank you.
- 04:41 11 Q. And if you didn't find another way to constrain the range,
04:41 12 that would be your range, just using pressure buildup data?
- 04:42 13 A. If I wanted just to use the shut-in pressures to accept --
04:42 14 choose my acceptable models, then I would have ended up with a
04:42 15 range of at least between 3- and 7 million stock tank barrels
04:42 16 of oil released. That's been my answers.
- 04:42 17 Q. With respect to the number of days of data that you had
04:42 18 for pressure buildup data, you had about 18 days of pressure
04:42 19 data?
- 04:42 20 A. Between July 15th, 2:24 p.m., and August 10th, that's
04:42 21 correct.
- 04:42 22 Q. Now, let's talk about the second dataset from the well
04:42 23 integrity test that you used to pressure-match, and that's the
04:42 24 collection rates. As I understand it, each of the simulated
04:42 25 cases that you ran was able to provide an estimate of the flow

04:42 1 rate on July 15th?

04:42 2 A. Yes. All of the -- basically, when I run a model, it
04:43 3 provides flow rate at all times, which then I use these rates
04:43 4 on July 14th and 15th to calculate the collection rate and
04:43 5 compare with the measured values.

04:43 6 Q. And once you received these simulated flow rates from the
04:43 7 final day or days, you would then take that flow rate, use some
04:43 8 formulas, and try to calculate what the simulated flow rate --
04:43 9 simulated collection rate would be for that case?

04:43 10 A. Yes, correct. Thank you.

04:43 11 Q. So for each case's predicted flow rate on the final day or
04:43 12 two, you would then derive a corresponding collection rate for
04:43 13 that day?

04:43 14 A. It models collection rate, that is correct.

04:43 15 Q. With respect to the collection data that you used, there
04:43 16 was approximately 12 hours -- 9 or 10 hours of data that you
04:44 17 used from July 15th for history matching, at least with respect
04:44 18 to collection rate?

04:44 19 A. Yes. Approximately 9 to 10 hours of data, and I -- at
04:44 20 this time I don't do any further history matching. It is that
04:44 21 I am -- so in other words, I am not going back to change any
04:44 22 more parameters to see whether I can match these or not. I'm
04:44 23 observing to see what are the models that provide a match and
04:44 24 what are the models that do not provide a match. I check
04:44 25 acceptability of these models.

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04:44 1 Q. And one of the things that you would do is -- and I think
04:44 2 we saw this earlier. You would have this simulated chart that
04:44 3 shows the simulated collection rate from each case, and that
04:44 4 would be superimposed upon data points showing measured
04:45 5 collection rates?

04:45 6 A. That is correct.

04:45 7 Q. Then what you would do is you would look at those -- the
04:45 8 simulated collection rates compared to the measured collection
04:45 9 rates and try to make a determination whether or not the match
04:45 10 was good or mediocre or -- or somewhere in between?

04:45 11 A. Or even --

04:45 12 Q. Or bad?

04:45 13 A. -- bad. That's correct.

04:45 14 Q. And you deemed a match to be good if the collection rates
04:45 15 were within plus or minus 600 barrels of the actual collection
04:45 16 rates during this 9- or 10-hour period on July 15th?

04:45 17 A. Correct. And I'm calling it generally within that range
04:45 18 or generally within the next threshold, because there are
04:45 19 outliers in the collection rate data.

04:45 20 Q. And you considered it a mediocre match if it was between
04:46 21 plus or minus 600 and plus or minus 2500 stock tank barrels?

04:46 22 A. That is correct for the ranges that we specified, but if
04:46 23 the data generally was -- showed that much of a mismatch, then
04:46 24 I called it mediocre.

04:46 25 Q. As part of the process, you would look at this, you would

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04:46 1 run a little cursor along the screen, and then make -- sort of
04:46 2 eyeball it and try to determine, is this a good match? Is this
04:46 3 a good-mediocre match? Is this a mediocre match? Or is it a
04:46 4 bad match?

04:46 5 A. I make a visual determination of that using the error bar,
04:46 6 as I showed in my direct. That's correct.

04:46 7 Q. So, for example --

04:46 8 **MR. FIELDS:** If you pull up -- pull up D-24544.1.

04:46 9 **BY MR. FIELDS:**

04:46 10 Q. So these are two examples of -- from the collection rate
04:46 11 matching process. The first one is a case -- each of these
04:47 12 have case numbers, but I know you have names for them as well.
04:47 13 One was the -- what's called the "Upper Bound Hydrostatic Error
04:47 14 Case." Do you see that?

04:47 15 A. Yes.

04:47 16 Q. And the bottom one is called the "Upper Bound Capping
04:47 17 Stack Error Case." Do you see that?

04:47 18 A. Yes. In these cases, I'm examining what if I had an error
04:47 19 in my evaluation of the hydrostatic pressure, the shut-in
04:47 20 pressures. In the other one, I'm examining what if I had an
04:47 21 error in the -- or there was an uncertainty in the readings of
04:47 22 the cap stack pressures. That's correct.

04:47 23 Q. So with respect to -- just to get us on the same page,
04:47 24 these dots that are on the screen, those represent the actual
04:47 25 measured collection rates from the vessels?

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- 04:47 1 A. That is correct. The dots are their reported measured
04:47 2 collection rates.
- 04:47 3 Q. And the line is actually the simulated or the modeled
04:48 4 collection rate from your case?
- 04:48 5 A. That is correct.
- 04:48 6 Q. And with respect to these two, the upper one, the upper
04:48 7 bound hydrostatic error case, the cumulative flow was
04:48 8 4.85 million. Do you see that?
- 04:48 9 A. Yes.
- 04:48 10 Q. And in the lower -- the lower image, it's the upper bound
04:48 11 capping stack error case -- that was a cumulative estimate of
04:48 12 5.03 million. Do you see that?
- 04:48 13 A. That is correct.
- 04:48 14 Q. The top one, you designated that one as a mediocre match,
04:48 15 and the bottom one you designated as a good match to the
04:48 16 collection data. Do you see that?
- 04:48 17 A. That is correct.
- 04:49 18 Q. Now, would you agree that if a case's simulated flow rate
04:49 19 for July 15th was too high, it would give you a predicted
04:49 20 collection rate that was not a good match with the actual
04:49 21 collection data?
- 04:49 22 A. May I ask you to repeat the question?
- 04:49 23 Q. Sure. Would you agree that if a case's simulated flow
04:49 24 rate on July 15th was too high, it would give you a predicted
04:49 25 collection rate that was not a good match with the actual

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04:49 1 collection data?

04:49 2 A. So there are two -- there are two leaps in that statement.

04:49 3 So, first of all, if you said "if the total flow rate was too

04:49 4 high" -- as compared to what? I don't make a judgment as to

04:49 5 what the collection -- the flow rate on July 15th needs to be.

04:50 6 **MR. FIELDS:** Can we pull up D-24543.

04:50 7 **BY MR. FIELDS:**

04:50 8 Q. Again, this is the demonstrative that has a several

04:50 9 columns. It has the case name or if the primary parameter was

04:50 10 changed, whether or not the case matched the pressure. It also

04:50 11 had the final day flow rate that was generated by the case,

04:50 12 whether -- what was the quality of the match that you

04:50 13 determined for the collection rates, and the cumulative oil

04:50 14 release. Do you see that?

04:50 15 A. Correct. This is your reproduction of the results, I

04:50 16 believe. Correct?

04:50 17 Q. Yeah. It's basically taking it from your report.

04:50 18 A. I do not believe I have this table in my report, but --

04:50 19 Q. No, you do not. The data is in your report.

04:50 20 A. So it's your generation. Okay. Carry on.

04:51 21 Q. Okay. Now, with respect to the -- this chart, which is

04:51 22 based on data from your cases, for any final day flow rate that

04:51 23 was less than 51,600 on the final day, you actually had a

04:51 24 less-than-a-good match?

04:51 25 A. That's a correct observation. Although I do not judge

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04:51 1 whether a case is good or bad based on the final day flow rate.

04:51 2 Q. And if a case generated a flow rate -- final day flow rate
04:51 3 exceeding 54,200, it also was outside the category that you
04:51 4 considered to be good for matching purposes -- collection
04:51 5 matching purposes?

04:51 6 A. Well, once again, that is not my criteria for selection of
04:51 7 the good or bad matches, but the observation is correct.

04:52 8 Q. Now, are you aware of any of your cases that produced a
04:52 9 final day flow rate less than 51,000 stock tank barrels per day
04:52 10 that you deemed to be a good match for collection rate
04:52 11 purposes?

04:52 12 A. None of the cases performed that way. To give a flow rate
04:52 13 on final day of less than 51,000 and leading still to a good
04:52 14 match.

04:52 15 Q. And likewise, are you aware of any cases that exceeded,
04:52 16 let's say, 55,000 for a final day flow rate that resulted in a
04:52 17 good match to your collection rates?

04:52 18 A. The same answer.

04:52 19 Q. And what is that answer?

04:52 20 A. The fact that there are no cases here that gave a flow
04:52 21 rate of more than 55,000 and still provided a good match. I
04:53 22 think this is basically because the availability of the
04:53 23 collection rates and the pressure drops, pressures in the cap
04:53 24 stack and BOP, allows a very good determination of the rates on
04:53 25 the final day. And, therefore, that's just a confirmation of

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- 04:53 1 that point. It's a good calibration point.
- 04:53 2 Q. The data that you used to calibrate your model, at least
- 04:53 3 the collection data that you used to calibrate your model, was
- 04:53 4 from one day?
- 04:53 5 A. That is correct.
- 04:53 6 Q. It was for 9 or 10 hours on that day?
- 04:53 7 A. It's production data and pressures during just 9 to
- 04:53 8 10 hours of one day. That's correct.
- 04:53 9 Q. Now, you were aware that the oil was collected from the
- 04:53 10 Macondo well for multiple days over the course of the 86-day
- 04:53 11 spill?
- 04:53 12 A. That is correct.
- 04:53 13 Q. There were collections through a device called the riser
- 04:53 14 insertion tube tool?
- 04:54 15 A. Yes.
- 04:54 16 Q. That took place in May of 2010?
- 04:54 17 A. Yes.
- 04:54 18 Q. There were collections through a device called Top Hat.
- 04:54 19 Do you recall that?
- 04:54 20 A. Yes.
- 04:54 21 Q. That took place in the summer of 2010 -- beginning in
- 04:54 22 June of 2010. Do you recall that?
- 04:54 23 A. Yes.
- 04:54 24 Q. There were collections from -- there were collections
- 04:54 25 through the BOP's choke line prior to July 15th?

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- 04:54 1 A. I do not remember from what line it was collected, but,
04:54 2 yes, there was -- there were prior collection rates. Yes.
- 04:54 3 Q. And there were collection rates from the kill line of the
04:54 4 BOP prior to July 15th of 2010?
- 04:54 5 A. Again, there were collection rates into *Enterprise* and
04:54 6 other ships prior to July 15. That is correct.
- 04:54 7 Q. In your analysis, you did not match the measured
04:54 8 collection rates for the RITT?
- 04:54 9 A. That is correct, because there is not enough
04:55 10 information -- pressure information. There was no cap stack
04:55 11 installed to allow estimation of the total flow rate.
- 04:55 12 Q. You did not match measured collection rates from Top Hat?
- 04:55 13 A. That is correct.
- 04:55 14 Q. You did -- did you do history matching with measured
04:55 15 collection rates from the BOP for any time period prior to
04:55 16 July 15th?
- 04:55 17 A. I did not.
- 04:55 18 Q. Does the fact that a simulated case or cases provides a
04:55 19 good match of the measured collection rates for 9 or 10 hours
04:55 20 on July 15th prove there was no BOP erosion in April or
04:55 21 May 2010?
- 04:55 22 A. No, just the match of the collection on July 15 doesn't
04:56 23 say one way or the other whether erosion in the BOP occurred or
04:56 24 not. One accounts for it separately, as I have done here.
- 04:56 25 Q. Does the fact that a case or cases provide a good match of

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04:56 1 the measured collection rate for 9 or 10 hours on
04:56 2 July 15th prove there was -- or prove there was a lack of
04:56 3 erosion of any kind in the -- in either the wellbore or the BOP
04:56 4 in April or May of 2010?

04:56 5 A. Same answer: The match of the collection on July 15
04:56 6 doesn't provide an indication if erosion occurred much earlier.
04:56 7 One needs to account for it as it happen.

04:56 8 Q. Does it rule out the existence of significant erosion in
04:57 9 the BOP in April or May 2010?

04:57 10 A. That it does what?

04:57 11 Q. I'm sorry. Does the fact that a case simulation matches
04:57 12 measured collection rates on July 15th rule out the existence
04:57 13 of significant erosion in the BOP or in the bottom hole in
04:57 14 April or May 2010?

04:57 15 A. The match of the collection, all it says is the
04:57 16 description of the reservoir and wellbore that has been
04:57 17 provided is consistent with the reservoir response. Then one
04:57 18 needs to go back in and see what other reservoir or wellbore
04:57 19 descriptions might also be consistent with the reservoir
04:57 20 response.

04:57 21 Q. Let me just ask my question again --

04:57 22 A. -- which I have done.

04:57 23 Yes.

04:57 24 Q. Does the fact that a case simulation can match measured
04:57 25 pressure -- measured collection rates on July 15th does not

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04:57 1 rule out the existence of significant erosion in the BOP or in
04:57 2 the bottom hole in April or May 2010, does it?

04:58 3 A. Right. Just the match of the collection doesn't, and I
04:58 4 don't base my opinion on that.

04:58 5 **MR. FIELDS:** No further questions, Your Honor.

04:58 6 **THE COURT:** Redirect?

04:58 7 **MR. CHAKERES:** No redirect, Your Honor.

04:58 8 **THE COURT:** I think you're done, Doctor. Thank you.

04:58 9 **THE WITNESS:** Thank you.

04:58 10 **MS. PENCAK:** Your Honor, Erica Pencak for the United
04:58 11 States.

04:58 12 I was wondering if BP wanted to address now the
04:58 13 issue of the two Dykhuizen exhibits and one call-out that had
04:58 14 been objected to, or wait until the morning.

04:58 15 **MR. LANGAN:** Your Honor, can we take that up at
04:58 16 8:00 tomorrow morning?

04:58 17 **THE COURT:** That's fine with me.

04:58 18 **MS. PENCAK:** Thank you, Your Honor.

04:58 19 **THE COURT:** Okay. Where do we stand, Mr. O'Rourke?

04:59 20 **MR. O'ROURKE:** About to rest, but --

04:59 21 **MR. IRPINO:** It's not critical, Your Honor, but we do
04:59 22 post onto the Web site for the MDL 2179 trial docs, and there
04:59 23 were two expert reports from, I think you said, Dr. Zick that
04:59 24 you had said you wanted to rule on after -- I think it was
04:59 25 Ms. Karis who had an objection to relevance for the rebuttal

04:59 1 report, if I'm not mistaken.

04:59 2 **THE COURT:** No, I think I admitted -- my recollection
04:59 3 is I admitted them and I told her I would consider her
04:59 4 relevance argument when I considered the case, you know. Just
04:59 5 like any other -- I let it in.

04:59 6 **MR. IRPINO:** Okay. We'll post -- we just didn't want
04:59 7 to post --

04:59 8 **THE COURT:** I believe I admitted it. I don't
04:59 9 remember not admitting it.

04:59 10 **MR. BROCK:** Yes.

04:59 11 **THE COURT:** Mr. Brock agrees with me.

04:59 12 **MR. BROCK:** I think you did.

04:59 13 **MR. IRPINO:** We'll post them then.

04:59 14 **MR. BROCK:** Subject to Ms. Karis' objections to the
04:59 15 United States' own redactions. She will be in touch.

05:00 16 **MR. O'ROURKE:** Before we rest, Your Honor, I'm going
05:00 17 to do the usual litany of reservations and just go ahead and
05:00 18 rest.

05:00 19 **THE COURT:** Go ahead. Go ahead.

05:00 20 **MR. O'ROURKE:** Thank you.

05:00 21 **THE COURT:** I just realized my mic's been off.

05:00 22 Go ahead, Mr. O'Rourke.

05:00 23 **MR. O'ROURKE:** Thank you. So we're going to rest
05:00 24 contingent on the following things: admission of any exhibits
05:00 25 that you've admitted but we haven't marshaled -- haven't done

05:00 1 the overnight affair and brought them in.

05:00 2 **THE COURT:** I think that goes without saying for all
05:00 3 the parties, as Mr. Brock, I think, stated at the beginning of
05:00 4 the trial.

05:00 5 **MR. O'ROURKE:** Great. Also -- so that includes
05:00 6 Griffiths, Zick, Kelkar, and Pooladi-Darvish and -- I'm
05:00 7 sorry -- Dykhuizen, Zick, Kelkar, and Pooladi-Darvish.

05:00 8 We're also going to rest contingent on
05:00 9 deposition --

05:00 10 **THE COURT:** Wait. I didn't understand what you just
05:00 11 said.

05:00 12 **MR. O'ROURKE:** Okay. I'm sorry.

05:00 13 **THE COURT:** You mumbled some names, but I didn't
05:00 14 understand what you said.

05:00 15 **MR. O'ROURKE:** Do you have the microphone?

05:01 16 So the exhibits that have been admitted --

05:01 17 **THE COURT:** Are you talking about exhibits relating
05:01 18 to the experts --

05:01 19 **MR. O'ROURKE:** Right.

05:01 20 **THE COURT:** -- who testified today?

05:01 21 **MR. O'ROURKE:** So that's Dr. Griffiths,
05:01 22 Dr. Pooladi -- I'll start over.

05:01 23 Dr. Dykhuizen, Zick, Kelkar, Pooladi-Darvish.

05:01 24 We're also resting contingent on the deposition
05:01 25 bundles that have not yet been admitted.

05:01 1 THE COURT: I thought we admitted those today.

05:01 2 MS. HIMMELHOCH: Those have now been admitted.

05:01 3 MR. O'ROURKE: Okay. The ones from the other side.

05:01 4 THE COURT: Wait, wait, wait.

05:01 5 MR. O'ROURKE: Right, we have the right to --

05:01 6 THE COURT: Ms. Himmelhoch offered some today, I
05:01 7 think. Right? Or somebody did on your side.

05:01 8 MR. O'ROURKE: Yes, you admitted our bundles.

05:01 9 We're resting, but we're reserving the right to
05:01 10 rely on the bundles admitted by BP in their part of the
05:01 11 quantification case as well as the bundles admitted in the
05:01 12 source control part.

05:01 13 We're also reserving the right to move in the
05:01 14 bundle of Mr. Merrill -- Dr. Merrill, a BP fact witness. If
05:02 15 they don't bring him, we'll have the right to move in his
05:02 16 bundle.

05:02 17 We're also filing an offer of proof, as you
05:02 18 authorized to do during the pretrial conference --

05:02 19 THE COURT: Let me ask you, do you know if you're
05:02 20 calling Mr. Merrill?

05:02 21 MR. BROCK: Right now our plans are to call him. But
05:02 22 if that changes, we will let you know.

05:02 23 THE COURT: Okay.

05:02 24 MR. O'ROURKE: Yes, this was just the procedure in
05:02 25 Phase One also, if the fact witness didn't come.

05:02 1 **THE COURT:** Okay.

05:02 2 **MR. O'ROURKE:** Also, there's a deposition bundle of
05:02 3 Bushnell that I think BP is going to make us move in as part of
05:02 4 the reliance.

05:02 5 There's an offer of proof that we're filing that
05:02 6 we don't think requires any action by the Court. It's just an
05:02 7 offer of proof.

05:02 8 The Category 2 and Category 4 documents and our
05:02 9 rebuttal case.

05:02 10 And contingent on those, we rest our case.

05:02 11 **THE COURT:** Okay.

05:02 12 **MR. O'ROURKE:** Thank you.

05:02 13 **MR. BROCK:** We would want to be heard on the motion
05:02 14 to move in Dr. Bushnell, but I don't have any problem with them
05:03 15 resting subject to the resolution of that issue.

05:03 16 **THE COURT:** Okay. Good.

05:03 17 **MS. HIMMELHOCH:** We're in the process of meet and
05:03 18 confer on that issue, Your Honor.

05:03 19 **THE COURT:** All right. Very well.

05:03 20 Were you standing up to say something,
05:03 21 Mr. Langan?

05:03 22 **MR. LANGAN:** I have nothing to add, Your Honor.

05:03 23 **THE COURT:** Okay. Well, we'll get out of here early
05:03 24 today.

05:03 25 Mr. Irpino, do you have reservations again? You

05:03 1 better not do that. You have to be back here in the morning, I
05:03 2 guess.

05:03 3 **MR. IRPINO:** Based on how things have gone, I know
05:03 4 not to make reservations before 6:00.

05:03 5 **THE COURT:** Okay. So tomorrow morning we'll start up
05:03 6 again at 8:00 with --

05:03 7 **MR. BROCK:** With Dr. Blunt.

05:03 8 **THE COURT:** -- Dr. Blunt.

05:03 9 Okay. Unless there's something else, we'll see
05:03 10 everyone in the morning.

05:03 11 **THE DEPUTY CLERK:** All rise.

05:03 12 (WHEREUPON, the proceedings were concluded.)

13 *****

14 **CERTIFICATE**

15 I, Jodi Simcox, RMR, FCRR, Official Court Reporter
16 for the United States District Court, Eastern District of
17 Louisiana, do hereby certify that the foregoing is a true and
18 correct transcript, to the best of my ability and
19 understanding, from the record of the proceedings in the
20 above-entitled and numbered matter.

21
22
23 *s/Jodi Simcox, RMR, FCRR*
24 Jodi Simcox, RMR, FCRR
25 Official Court Reporter

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		4 percent [1] 2013/19 4.4 [1] 2002/21 4.4 million [1] 2049/19 4.53 million [1] 2039/14 4.7 [1] 2003/3 4.7 million [1] 2049/20 4.85 million [1] 2060/8 4.9 [1] 2003/11 4.9 million [1] 2045/16 400 [1] 1984/25 406 [1] 1953/18 4536 [1] 1949/9
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6	2048/19 2048/21 2049/24 2051/4 2051/11 2051/21 2051/24 2053/18 2053/22 2054/18 2056/18 2056/22 2066/20 2068/17 about using [1] 1984/18 above [3] 2043/10 2046/15 2071/20 above-entitled [1] 2071/20 Absolutely [1] 1982/15 Academies [1] 1962/16 accent [1] 1976/3 accept [3] 1960/13 1970/22 2056/13 acceptability [1] 2057/25 acceptable [4] 1990/25 1991/15 1996/21 2056/14 access [1] 1976/7 accomplished [1] 1973/13 according [2] 2037/21 2053/4 account [12] 1963/13 1964/7 2013/13 2026/25 2027/6 2028/23 2030/21 2036/16 2037/13 2047/12 2047/25 2065/7 accounted [9] 1987/11 2000/23 2027/4 2027/8 2027/9 2027/17 2027/20 2028/11 2047/8 accounting [2] 1963/14 2007/24 accounts [4] 1985/4 2027/13 2043/16 2064/24 accuracy [3] 1969/19 1980/14 1987/8 accurate [3] 1966/16 1982/12 2038/23 accurately [4] 1983/20 2004/24 2044/18 2044/20 acquired [1] 1981/22 across [4] 1975/16 1987/11 2011/11 2043/5 acting [1] 1975/6 action [1] 2070/6 actual [12] 1972/1 1974/6 1976/18 2044/3 2046/12 2046/18 2053/9 2055/7 2058/15 2059/24 2060/20 2060/25 actually [16] 1964/21 1969/23 1989/12 2008/4 2008/25 2043/13 2043/22 2044/4 2044/7 2046/12 2047/18 2048/22 2054/17 2055/25 2060/3 2061/23 add [1] 2070/22 adding [1] 2039/7 addition [7] 1968/12 1979/18 1980/11 1987/13 2029/3 2029/9 2052/21 additional [5] 2012/20 2029/9 2029/15 2038/10 2038/15 address [1] 2066/12 adjust [1] 1999/21 adjusted [1] 2039/6 adjustment [1] 2039/1 admission [1] 2067/24 admit [1] 1960/14 admitted [14] 1955/19 1956/22 1958/13 2067/2 2067/3 2067/8 2067/25 2068/16 2068/25 2069/1 2069/2 2069/8 2069/10 2069/11 admitting [1] 2067/9 adopt [1] 1960/2 advantage [1] 2030/14 advantages [1] 2030/17 affair [1] 2068/1 affect [6] 1963/17 1973/23 1977/15 1979/6 2023/24 2050/10 affected [1] 2033/24 after [27] 1957/4 1968/13 1971/13 1981/23 1983/8 1983/14 1990/13 1991/10 1991/13 1992/24 1993/11 1995/1 2001/19 2005/20 2007/3 2012/10 2016/24 2016/24 2040/24	2047/6 2047/18 2050/5 2050/17 2053/1 2053/23 2054/11 2066/24 afternoon [3] 1949/14 1955/1 1955/7 again [48] 1965/2 1970/14 1977/25 1979/4 1980/6 1984/20 1985/7 1985/19 1988/17 1992/13 1995/7 2000/16 2001/5 2003/22 2006/1 2006/22 2010/4 2010/20 2011/20 2012/2 2013/6 2015/5 2016/4 2020/25 2023/1 2023/10 2026/3 2026/12 2028/23 2033/16 2037/12 2039/24 2041/11 2043/9 2046/4 2047/19 2048/15 2050/7 2051/6 2051/7 2051/10 2055/15 2061/8 2062/6 2064/5 2065/21 2070/25 2071/6 against [24] 1972/9 1975/9 1976/13 1980/12 1992/16 1997/12 1999/21 2000/19 2000/20 2001/6 2003/4 2003/7 2010/10 2010/22 2027/18 2027/21 2027/24 2028/1 2028/2 2028/4 2035/21 2041/5 2046/17 2053/12 ago [1] 1964/24 agree [10] 1998/18 2007/17 2021/16 2023/13 2030/21 2032/22 2035/11 2042/13 2060/18 2060/23 agrees [2] 1991/17 2067/11 ahead [9] 1964/17 1977/1 1986/24 1995/18 1997/3 2067/17 2067/19 2067/19 2067/22 aided [1] 1953/24 air [3] 1984/5 1984/10 1984/12 al [2] 1949/8 1949/11 Alabama [1] 1950/20 ALAN [1] 1953/8 Alberta [2] 1960/24 1964/25 aligned [1] 1956/1 all [70] 1955/4 1955/5 1955/6 1955/18 1956/7 1957/15 1958/12 1960/9 1960/13 1961/16 1961/22 1963/6 1964/17 1966/21 1972/4 1973/2 1973/22 1974/3 1974/8 1977/14 1977/15 1978/18 1979/17 1980/16 1981/21 1985/2 1985/12 1988/10 1989/5 1994/14 1995/16 1999/13 1999/23 1999/25 2000/10 2001/25 2004/18 2005/3 2009/7 2009/16 2009/19 2011/18 2012/23 2014/19 2016/15 2017/7 2017/25 2018/2 2018/4 2018/5 2018/6 2020/20 2021/2 2024/8 2030/5 2037/5 2037/9 2042/8 2047/6 2048/15 2048/15 2051/10 2055/20 2057/2 2057/3 2061/3 2065/15 2068/2 2070/19 2071/11 ALLAN [1] 1951/3 ALLEN [1] 1952/21 allow [10] 1972/6 1983/4 1997/11 1997/21 2001/20 2003/24 2004/15 2037/23 2049/13 2064/11 allowed [9] 1966/3 1968/15 1969/13 1972/24 1972/25 1997/7 2002/3 2004/20 2030/16 allows [3] 2014/17 2030/15 2062/24 along [6] 1970/11 1975/16 2014/21 2016/1 2039/24 2059/1 already [7] 1969/3 1982/21 1989/23 2013/5 2034/17 2036/15 2043/1 also [52] 1955/20 1956/24 1962/10 1963/25 1964/1 1965/2 1969/12 1971/5 1971/10 1974/16 1978/14 1980/8 1982/6 1984/4 1984/8 1984/14 1988/3 1991/10 1991/11 1994/1 1994/24 1995/23 2003/1 2003/4 2008/1 2009/16 2010/12 2011/14 2012/3 2023/7 2024/14 2025/13 2025/25 2029/3
7	7 cases [1] 2036/13 7 million [1] 2056/15 7 million barrels [1] 2056/8 7.8 [1] 1999/16 700 [1] 1950/10 701 [2] 1951/4 1951/18 70112 [1] 1953/13 70113 [1] 1949/20 70130 [3] 1950/8 1951/4 1953/19 70139 [1] 1951/19 70163 [1] 1952/14 70502 [1] 1949/24 70601 [1] 1950/14 70804 [1] 1950/24 75270 [1] 1953/6 7611 [1] 1951/15 77002 [1] 1952/17 77010 [1] 1953/9 777 [1] 1950/16 7780 [1] 1953/19	
8	8,000 [1] 2010/9 820 [1] 1949/19 850 [1] 1985/10 850 millidarcy [1] 2004/22 86 [2] 1972/13 2043/16 86-day [1] 2063/10 8:00 tomorrow [1] 2066/16 8:00 with [1] 2071/6 8th [15] 2001/24 2016/18 2027/25 2028/7 2040/8 2046/13 2047/1 2047/6 2047/9 2047/11 2047/14 2047/19 2048/11 2050/5 2050/17	
9	90071 [2] 1952/4 1952/22 94005 [1] 1950/23 966 [4] 2038/19 2039/22 2041/6 2041/9 966 psi [1] 2039/7 966-psi [1] 2039/2	
A	ability [3] 2017/21 2021/13 2071/18 able [11] 1967/14 1988/21 1991/17 1995/2 2021/7 2030/19 2038/8 2043/22 2044/7 2055/21 2056/25 about [63] 1956/16 1956/17 1961/6 1964/24 1965/14 1966/2 1970/1 1971/3 1973/20 1975/23 1981/5 1982/2 1982/3 1982/17 1982/20 1984/18 1990/5 1992/21 1993/22 1997/22 2001/4 2004/10 2006/24 2009/22 2010/3 2013/19 2014/1 2015/10 2016/6 2016/15 2017/25 2018/17 2019/16 2023/10 2028/6 2028/9 2028/13 2029/25 2030/10 2032/18 2035/21 2037/14 2037/18 2037/23 2038/18 2041/13 2043/12 2045/16 2047/18	

<p>A</p> <p>also... [18] 2033/10 2034/17 2041/4 2045/1 2047/9 2048/11 2049/15 2056/3 2061/10 2062/3 2065/19 2068/5 2068/8 2068/24 2069/13 2069/17 2069/25 2070/2</p> <p>alternative [2] 2003/20 2039/3</p> <p>Alternatively [1] 1998/1</p> <p>although [3] 1978/19 1997/14 2061/25</p> <p>Alto [1] 1960/25</p> <p>always [4] 1963/9 1979/8 1988/18 2035/19</p> <p>am [8] 1978/3 1991/17 1995/23 2001/25 2010/8 2017/3 2057/21 2057/21</p> <p>ambient [1] 1970/13</p> <p>AMERICA [8] 1949/10 1951/6 1951/10 1951/18 1951/21 1952/3 1952/6 1952/10</p> <p>among [2] 2004/16 2004/20</p> <p>amount [6] 1964/25 2013/9 2020/23 2021/9 2027/15 2034/4</p> <p>amounts [3] 2012/5 2033/7 2033/16</p> <p>Anadarko [5] 1953/11 1953/11 1953/14 1953/15 2018/11</p> <p>analogous [4] 1975/19 1976/12 1979/2 1979/3</p> <p>analogy [1] 2048/5</p> <p>analyses [1] 2025/8</p> <p>analysis [15] 1959/9 1973/8 1983/4 1983/12 1983/21 1985/8 2014/4 2014/7 2014/9 2015/9 2017/6 2018/14 2039/16 2052/9 2064/7</p> <p>analytical [57] 1965/16 1968/18 1968/22 1968/24 1970/7 1970/10 1970/17 1971/2 1971/14 1971/17 1972/10 1972/12 1980/5 1986/8 1987/6 1987/6 1987/14 1988/3 2018/15 2018/17 2018/18 2019/9 2019/17 2019/18 2019/23 2020/1 2020/13 2020/15 2020/22 2021/8 2022/3 2022/6 2022/9 2022/13 2022/17 2023/1 2023/3 2024/6 2025/7 2025/20 2025/22 2026/3 2026/10 2026/10 2026/17 2026/24 2026/25 2027/4 2027/5 2027/10 2028/6 2028/10 2030/14 2030/20 2034/17 2036/15 2052/9</p> <p>analyze [5] 1983/1 1983/9 2034/6 2034/12 2050/23</p> <p>ANDREW [1] 1951/21</p> <p>Andy [1] 1957/7</p> <p>Angeles [2] 1952/4 1952/22</p> <p>ANNA [1] 1951/13</p> <p>another [1] 2056/11</p> <p>answer [16] 1964/5 1964/11 1966/7 1967/15 1972/16 1973/16 1973/18 1986/7 2013/23 2016/14 2021/6 2021/11 2035/4 2062/18 2062/19 2065/5</p> <p>answered [3] 1973/15 2051/15 2051/18</p> <p>answers [12] 1963/19 1963/21 1964/2 1965/3 1966/4 1967/21 1968/16 1985/18 1997/16 2013/8 2015/18 2056/16</p> <p>ANTHONY [1] 1950/7</p> <p>any [49] 1955/6 1955/18 1958/12 1961/5 1962/13 1962/20 1972/7 1993/11 1999/6 2000/22 2001/20 2008/3 2008/17 2011/12 2015/24 2024/22 2025/8 2027/6 2027/13 2027/17 2027/24 2028/11 2037/7 2037/10 2040/7 2040/9 2041/1 2044/13 2044/14 2046/25 2048/1 2048/6</p>	<p>2049/23 2050/18 2050/21 2051/4 2051/11 2054/24 2057/20 2057/21 2061/22 2062/8 2062/15 2064/15 2065/3 2067/5 2067/24 2070/6 2070/14</p> <p>anymore [1] 1988/12</p> <p>anything [5] 1993/15 1993/16 2000/8 2000/21 2020/10</p> <p>anywhere [1] 2032/20</p> <p>APLC [1] 1951/17</p> <p>apologies [2] 1976/3 2054/22</p> <p>appear [1] 1979/19</p> <p>Appearances [5] 1949/17 1950/1 1951/1 1952/1 1953/1</p> <p>appeared [1] 2039/25</p> <p>Appendix [1] 2015/23</p> <p>Appendix III [1] 2015/23</p> <p>applicable [2] 1974/9 2003/23</p> <p>applies [2] 1949/6 2047/9</p> <p>apply [1] 1985/13</p> <p>appreciate [2] 1957/10 1961/2</p> <p>appropriate [3] 1998/16 1998/20 2016/13</p> <p>approximately [14] 1962/11 1962/23 1969/25 1992/11 2018/19 2019/1 2032/10 2032/11 2032/15 2035/22 2039/2 2054/17 2057/16 2057/19</p> <p>APRIL [17] 1949/5 2002/7 2016/18 2019/4 2021/17 2031/23 2033/15 2040/18 2042/3 2042/8 2042/14 2046/23 2064/20 2065/4 2065/9 2065/14 2066/2</p> <p>April 20th [5] 2016/18 2019/4 2021/17 2040/18 2046/23</p> <p>April 20th and [1] 2002/7</p> <p>April 20th to [3] 2042/3 2042/8 2042/14</p> <p>April 22nd [2] 2031/23 2033/15</p> <p>aquifer [2] 1980/8 2006/7</p> <p>are [126]</p> <p>area [2] 1961/13 1962/20</p> <p>argument [1] 2067/4</p> <p>arithmetic [1] 1984/20</p> <p>around [3] 1961/22 2006/5 2053/19</p> <p>arrive [2] 1967/25 2018/22</p> <p>arrow [3] 1992/21 1993/5 1993/5</p> <p>arrows [1] 1992/20</p> <p>as [139]</p> <p>Asbill [1] 1952/16</p> <p>ascribe [1] 2017/1</p> <p>aside [2] 2008/20 2030/8</p> <p>ask [11] 1957/14 2003/16 2009/22 2025/15 2038/10 2047/19 2050/16 2051/10 2060/22 2065/21 2069/19</p> <p>asked [13] 1961/23 1962/5 1964/12 1964/25 1965/2 1966/7 1966/10 2021/5 2035/6 2051/1 2051/8 2051/15 2051/17</p> <p>asking [1] 2036/20</p> <p>aspects [1] 1963/20</p> <p>assess [5] 1964/25 1974/12 1976/22 2000/8 2002/12</p> <p>assessed [5] 1969/24 1978/12 1985/23 1992/23 2005/3</p> <p>assessing [1] 2003/17</p> <p>assessment [17] 1964/6 1965/17 1973/14 1973/17 1977/13 1982/10 1982/12 1986/13 1988/5 1992/1 1993/11 1993/17 2002/25 2005/15 2015/23 2030/19 2050/20</p> <p>assessments [1] 1973/9</p> <p>ASSET [1] 1949/8</p> <p>associated [7] 1965/4 2013/22 2031/1 2031/3 2031/10 2042/17 2050/12</p> <p>associations [1] 1962/18</p> <p>assume [6] 2003/6 2028/10 2041/16</p>	<p>2042/7 2042/10 2048/2</p> <p>assumed [6] 1981/4 2001/18 2001/18 2001/22 2041/24 2043/5</p> <p>assumes [3] 2015/15 2016/24 2042/3</p> <p>assuming [3] 2002/21 2020/10 2048/10</p> <p>assumption [10] 2003/5 2015/9 2016/18 2016/19 2017/2 2022/7 2028/6 2043/12 2044/11 2044/13</p> <p>assumptions [8] 1987/13 1987/15 2007/11 2008/2 2008/6 2015/14 2015/18 2022/5</p> <p>attempt [7] 2000/13 2004/11 2006/10 2008/20 2009/16 2011/24 2048/16</p> <p>attempted [1] 2009/8</p> <p>Attorney [2] 1950/18 1950/22</p> <p>August [2] 2054/18 2056/20</p> <p>August 10th [1] 2056/20</p> <p>August 3rd [1] 2054/18</p> <p>authorized [1] 2069/18</p> <p>availability [1] 2062/22</p> <p>available [9] 1966/21 1967/3 1968/25 1981/7 1981/10 1981/25 2002/15 2007/2 2008/18</p> <p>Avenue [4] 1949/19 1950/20 1952/10 1952/22</p> <p>average [2] 1984/20 1991/19</p> <p>averages [3] 1984/18 1984/20 2022/11</p> <p>awards [1] 1962/17</p> <p>aware [3] 2062/8 2062/15 2063/9</p> <p>away [2] 1961/6 1985/16</p> <p>axis [8] 1975/1 1975/2 1977/25 1978/1 1991/22 1992/10 2010/4 2010/5</p> <p>B</p> <p>Bachelor's [1] 1960/21</p> <p>back [25] 1957/5 1960/23 1985/6 1994/19 2000/20 2010/10 2010/21 2019/4 2019/6 2019/7 2020/10 2020/17 2020/22 2021/9 2021/14 2027/18 2037/17 2040/16 2046/3 2046/16 2046/22 2048/9 2057/21 2065/18 2071/1</p> <p>background [2] 1960/20 1964/12</p> <p>backward [2] 2021/1 2041/8</p> <p>backwards [2] 2020/7 2020/18</p> <p>bad [12] 1988/23 1993/12 1993/16 1993/21 1994/1 1995/13 1996/6 2058/12 2058/13 2059/4 2062/1 2062/7</p> <p>balance [9] 1965/23 1967/17 1997/11 1997/19 1998/5 1998/14 1999/24 1999/25 2013/10</p> <p>bar [1] 2059/5</p> <p>BARBIER [1] 1949/15</p> <p>Barnett [1] 1958/10</p> <p>BARR [1] 1950/3</p> <p>barrel [1] 1970/1</p> <p>barrels [26] 1967/1 1967/1 1972/14 1992/12 1992/22 1992/25 1993/2 1999/16 1999/20 2006/6 2006/9 2006/17 2012/6 2012/18 2017/11 2018/19 2039/14 2044/5 2045/13 2049/19 2056/3 2056/8 2056/15 2058/15 2058/21 2062/9</p> <p>BARRY [4] 1951/23 1956/13 1960/11 2018/9</p> <p>base [33] 1978/19 1988/10 1989/1 1989/3 1989/10 1989/13 1989/24 1990/5 1996/9 1996/11 2009/10 2014/9 2028/14 2028/21 2029/21 2034/6 2034/11 2034/13 2034/22 2035/1 2035/7 2036/12 2036/20 2047/25 2052/4 2052/7 2052/11 2052/14 2052/17 2052/19 2052/19 2055/23</p>
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2054/21 2056/5 2056/12 2057/9 2058/4 2058/14 2061/5 2062/4 2062/10 2065/19 2067/15 2070/13 2071/1</p> <p>bear [1] 1968/3</p> <p>bears [3] 1963/18 1967/19 1983/23</p> <p>because [22] 1964/9 1965/24 1965/25 1978/3 1980/11 1983/5 1997/11 1998/23 2000/23 2002/3 2007/25 2015/13 2017/13 2028/3 2030/14 2033/17 2040/2 2040/23 2042/16 2058/18 2062/22 2064/9</p> <p>become [2] 1963/14 2032/4</p> <p>been [34] 1958/21 1962/7 1962/17 1964/21 1965/4 1967/4 1967/6 1967/8 1967/18 1969/2 1971/9 1983/3 1983/6 1983/12 1983/13 1984/8 1984/9 1988/21 1989/13 1995/2 2002/25 2046/25 2048/18 2050/1 2051/8 2051/16 2051/16 2056/16 2065/16 2066/14 2067/21 2068/16 2068/25 2069/2</p> <p>before [19] 1949/14 1965/18 1973/16 1983/11 1988/25 1991/9 2001/2 2002/24 2010/3 2020/2 2039/23 2040/7 2040/24 2047/9 2053/14 2053/15 2053/18 2067/16 2071/4</p> <p>began [3] 2018/25 2020/1 2054/12</p> <p>begin [1] 1969/15</p> <p>beginning [6] 1997/10 2022/16 2046/22 2048/10 2063/21 2068/3</p> <p>behalf [3] 1958/15 1960/11 2018/11</p> <p>behavior [5] 1987/7 2010/20 2039/20 2041/4 2050/20</p> <p>behind [1] 1986/20</p> <p>being [8] 1968/11 1969/20 1969/21 1969/23 1970/2 1989/22 2011/21 2043/21</p> <p>believe [36] 1956/17 1958/1 1962/23 1984/14 1998/16 1998/18 2002/6</p>	<p>2006/5 2007/25 2008/13 2013/19 2013/25 2014/1 2018/19 2020/11 2026/13 2028/9 2029/8 2029/12 2029/14 2030/13 2030/25 2031/10 2033/3 2033/5 2033/19 2034/2 2035/5 2036/25 2038/22 2039/22 2047/1 2053/15 2061/16 2061/18 2067/8</p> <p>believed [1] 2039/17</p> <p>below [6] 1979/13 1990/21 1990/23 2022/25 2023/4 2043/10</p> <p>belts [1] 1990/11</p> <p>bend [1] 1961/5</p> <p>BENSON [1] 1951/11</p> <p>best [11] 1956/11 1963/25 1964/5 1966/25 1982/18 1989/1 1989/2 1989/13 2014/12 2014/14 2071/18</p> <p>BETHANY [1] 1951/13</p> <p>better [3] 1993/15 1993/15 2071/1</p> <p>between [31] 1967/1 1978/9 1984/21 1987/5 1991/13 1992/11 1992/18 1993/4 1993/20 1993/23 1996/5 1999/20 2002/7 2004/21 2005/18 2006/8 2012/17 2013/20 2017/10 2020/13 2021/22 2026/19 2045/18 2047/14 2047/21 2048/3 2049/4 2056/15 2056/20 2058/10 2058/20</p> <p>big [9] 1972/19 1972/21 1973/17 1978/10 1978/12 1978/21 1979/11 2034/18 2044/21</p> <p>bigger [1] 1977/8</p> <p>biggest [4] 1974/19 1979/6 2002/11 2002/12</p> <p>billion [1] 2012/6</p> <p>billion barrels [1] 2012/6</p> <p>Bingham [1] 1953/14</p> <p>bit [11] 1961/1 1970/25 1981/5 1982/20 1987/8 1994/11 2000/6 2009/22 2038/7 2047/4 2051/24</p> <p>black [2] 1975/3 1990/11</p> <p>blew [1] 1964/24</p> <p>blocked [1] 2011/9</p> <p>blown [2] 1984/5 1984/11</p> <p>blowout [8] 1963/1 1964/13 1964/20 1982/4 2031/19 2032/8 2035/9 2044/19</p> <p>Blunt [13] 1984/14 2007/1 2007/7 2007/12 2007/13 2008/1 2008/4 2008/11 2012/21 2013/13 2013/17 2071/7 2071/8</p> <p>Blunt's [7] 1998/19 2006/24 2007/17 2008/21 2013/4 2013/15 2014/20</p> <p>board [1] 2028/21</p> <p>BOLES [1] 1952/3</p> <p>books [1] 2005/23</p> <p>BOP [165]</p> <p>BOP's [2] 2041/19 2063/25</p> <p>both [16] 1960/23 1963/20 1976/15 1977/11 1995/20 2006/4 2006/18 2013/11 2041/1 2046/2 2049/7 2049/7 2049/8 2049/10 2049/11 2049/15</p> <p>bottom [28] 1975/1 1975/10 1975/16 1977/25 1990/15 1991/11 2007/6 2007/10 2007/14 2007/20 2007/24 2008/9 2010/4 2022/22 2022/24 2023/8 2024/9 2024/20 2024/23 2027/1 2027/3 2037/11 2050/1 2050/24 2059/16 2060/15 2065/13 2066/2</p> <p>bound [5] 2002/13 2059/13 2059/16 2060/7 2060/10</p> <p>boundary [1] 2002/15</p> <p>BOWMAN [1] 1953/4</p> <p>Box [5] 1949/23 1950/4 1950/23 1951/7 1951/15</p> <p>boxes [2] 1987/9 1987/10</p>	<p>BP [35] 1949/10 1951/17 1951/18 1951/19 1951/20 1951/21 1951/22 1952/2 1952/3 1952/4 1952/5 1952/6 1952/7 1952/9 1952/10 1952/11 1956/2 1956/6 1956/14 1957/3 1957/4 1957/6 1957/7 1960/12 1974/7 1981/18 1981/22 1981/25 1998/13 2018/11 2045/22 2066/12 2069/10 2069/14 2070/3</p> <p>BP's [3] 1974/5 1982/2 1982/9</p> <p>BP-retained [1] 2045/22</p> <p>bracket [1] 2048/16</p> <p>BRAD [1] 1952/20</p> <p>Branch [1] 1951/6</p> <p>bread [1] 1983/18</p> <p>Brennan [1] 1952/16</p> <p>BRIAN [2] 1950/3 1952/20</p> <p>BRIDGET [1] 1952/7</p> <p>brief [1] 1964/19</p> <p>briefly [9] 1960/19 1968/22 1985/6 1986/4 1986/19 2001/14 2012/23 2014/3 2015/2</p> <p>bring [7] 1959/12 1959/16 1974/21 1980/15 1981/12 1991/5 2069/15</p> <p>Broad [1] 1950/13</p> <p>Broadway [1] 1950/10</p> <p>BROCK [3] 1952/10 2067/11 2068/3</p> <p>brought [1] 2068/1</p> <p>BRUCE [1] 1953/4</p> <p>build [3] 1971/21 2011/17 2054/12</p> <p>building [2] 1969/8 1971/22</p> <p>builds [1] 2022/4</p> <p>buildup [17] 1968/14 1973/1 1983/1 1983/2 1983/4 2049/11 2054/1 2054/6 2054/24 2055/3 2055/12 2055/21 2055/25 2056/3 2056/9 2056/12 2056/18</p> <p>built [3] 1972/10 1983/16 2022/10</p> <p>bullet [2] 1971/21 2015/19</p> <p>bundle [4] 1956/16 2069/14 2069/16 2070/2</p> <p>bundles [10] 1955/21 1955/23 1955/24 1956/1 1956/2 1956/4 2068/25 2069/8 2069/10 2069/11</p> <p>Burling [1] 1952/9</p> <p>Bushnell [3] 1956/16 2070/3 2070/14</p> <p>butter [1] 1983/18</p> <p>button [1] 1998/8</p>
		<p>C</p> <p>calculate [3] 1971/18 2057/4 2057/8</p> <p>calculated [2] 1971/6 2025/17</p> <p>calculates [1] 2022/10</p> <p>calculation [4] 2008/3 2027/11 2027/12 2043/15</p> <p>calculations [2] 1971/4 2034/5</p> <p>CALDWELL [1] 1950/22</p> <p>Calgary [1] 1962/12</p> <p>calibrate [5] 1968/6 1997/7 1999/21 2063/2 2063/3</p> <p>calibrated [7] 1968/14 1969/8 1970/17 1971/13 2013/8 2019/13 2020/19</p> <p>calibrating [1] 1980/12</p> <p>calibration [14] 1966/1 1969/15 1970/5 1996/23 1997/12 1997/13 1997/14 1997/18 1999/1 1999/9 2004/19 2014/2 2017/22 2063/1</p> <p>California [3] 1952/4 1952/22 1960/25</p> <p>call [17] 1955/10 1955/13 1956/25 1957/21 1958/17 1965/16 1976/14 1987/16 1989/3 1989/13 2015/7 2025/14 2029/4 2050/14 2052/4 2066/13 2069/21</p>

<p>C</p> <p>call-out [1] 2066/13</p> <p>call-outs [3] 1955/10 1955/13 1956/25</p> <p>called [44] 1961/15 1963/8 1971/19 1971/22 1975/3 1978/19 1979/11 1981/17 1988/13 1988/17 1989/10 1991/1 1991/12 1993/2 1993/24 2001/17 2002/23 2004/16 2006/22 2007/3 2008/12 2009/18 2011/5 2011/13 2012/1 2015/21 2024/9 2024/14 2024/17 2025/18 2037/18 2038/18 2041/10 2041/13 2045/1 2045/7 2048/22 2051/22 2053/2 2058/24 2059/13 2059/16 2063/13 2063/18</p> <p>calling [2] 2058/17 2069/20</p> <p>came [6] 1964/10 1990/20 2018/18 2018/20 2021/2 2030/22</p> <p>Camp [1] 1951/4</p> <p>can [54] 1957/8 1957/11 1961/4 1961/5 1966/15 1968/22 1970/6 1971/18 1972/8 1976/16 1977/11 1983/18 1986/14 1986/17 1986/19 1987/24 1996/17 1997/19 1999/19 1999/19 2001/15 2004/25 2004/25 2007/15 2009/12 2010/6 2011/21 2011/22 2012/2 2015/6 2016/5 2017/7 2017/13 2022/16 2023/13 2023/16 2023/18 2023/20 2023/24 2025/4 2025/6 2029/20 2031/15 2034/10 2036/25 2037/19 2043/9 2044/2 2050/6 2050/17 2057/22 2061/6 2065/24 2066/15</p> <p>Canada [2] 1960/24 1962/12</p> <p>Canadian [1] 1962/16</p> <p>cannot [6] 1966/17 1996/13 1997/11 2017/19 2035/22 2050/6</p> <p>cap [4] 1970/12 2059/22 2062/23 2064/10</p> <p>capacity [1] 1975/21</p> <p>Capital [1] 1950/16</p> <p>capping [9] 1971/3 2007/4 2020/3 2020/5 2053/17 2054/8 2054/11 2059/16 2060/11</p> <p>captured [1] 2047/1</p> <p>care [1] 2034/24</p> <p>careful [1] 1989/13</p> <p>carefully [2] 1969/22 2000/15</p> <p>CARL [1] 1949/15</p> <p>CARRIE [1] 1951/21</p> <p>carries [3] 2013/9 2013/17 2013/23</p> <p>carry [2] 1963/9 2061/20</p> <p>carrying [1] 1964/4</p> <p>case [127]</p> <p>case's [3] 2057/11 2060/18 2060/23</p> <p>cases [94] 1962/5 1989/17 1992/8 1993/11 1994/14 1994/24 1999/13 1999/23 1999/25 2000/10 2001/15 2002/4 2002/5 2002/10 2002/16 2002/17 2003/4 2003/6 2003/8 2004/6 2004/20 2006/3 2006/4 2009/18 2010/20 2010/25 2012/8 2012/10 2028/15 2028/16 2028/17 2028/18 2028/19 2028/20 2028/21 2028/23 2028/24 2028/25 2029/4 2029/6 2029/13 2029/22 2029/22 2029/24 2030/8 2030/9 2030/10 2030/11 2034/6 2034/11 2034/13 2035/1 2035/8 2036/12 2036/13 2036/21 2037/5 2037/7 2037/9 2037/14 2037/15 2037/22 2038/12 2038/14 2038/16 2041/1 2041/3 2045/2 2045/6 2048/22 2048/22 2048/23 2049/3 2049/8</p>	<p>2049/15 2049/18 2049/19 2049/21 2049/23 2053/12 2055/11 2055/16 2055/20 2055/21 2055/23 2056/25 2059/18 2061/22 2062/8 2062/12 2062/15 2062/20 2064/18 2064/25</p> <p>casing [1] 2050/4</p> <p>categories [2] 1979/25 1993/14</p> <p>category [3] 2062/3 2070/8 2070/8</p> <p>cause [1] 1978/20</p> <p>caused [5] 1979/7 2021/19 2024/22 2035/11 2035/20</p> <p>causes [3] 1977/4 1977/9 1979/10</p> <p>cement [11] 2024/20 2024/22 2024/25 2037/11 2049/24 2049/25 2050/17 2050/23 2051/1 2051/5 2051/12</p> <p>center [1] 1978/8</p> <p>CERNICH [1] 1951/12</p> <p>certain [6] 1957/13 1989/9 1996/13 2027/22 2052/6 2055/6</p> <p>certainly [7] 1971/16 1972/18 1988/1 1989/23 1992/10 2037/24 2042/15</p> <p>certainty [1] 1980/14</p> <p>CERTIFICATE [1] 2071/14</p> <p>certify [1] 2071/17</p> <p>CHAKERES [2] 1951/12 1958/15</p> <p>challenge [1] 1967/18</p> <p>challenges [2] 1967/2 1967/4</p> <p>change [34] 1976/24 1976/24 1977/5 1978/9 1978/9 1978/11 1979/5 1979/10 1987/10 1987/11 1988/6 1988/11 1991/1 1996/16 1996/23 1998/11 1998/17 1998/17 1998/24 1999/2 1999/5 2009/11 2011/22 2012/10 2014/8 2022/7 2022/10 2025/1 2025/22 2026/18 2026/20 2026/22 2042/8 2057/21</p> <p>changed [11] 1978/19 1988/8 1990/19 1994/4 1998/14 1998/15 2010/8 2034/3 2034/16 2034/21 2061/10</p> <p>changes [10] 1998/25 2000/15 2014/14 2017/4 2026/20 2026/21 2026/22 2048/14 2050/21 2069/22</p> <p>changing [4] 1977/3 1978/3 1979/7 1994/17</p> <p>characterize [1] 1962/7</p> <p>characterizing [1] 2048/13</p> <p>charge [5] 1961/14 1964/22 1964/22 1965/6 1965/7</p> <p>Charles [1] 1950/14</p> <p>chart [5] 2036/24 2040/16 2055/16 2058/2 2061/21</p> <p>check [5] 1973/4 1999/2 2003/24 2030/2 2057/24</p> <p>checked [1] 1972/9</p> <p>chemical [2] 1960/21 1960/22</p> <p>Chicago [1] 1951/24</p> <p>chief [2] 1958/8 1958/17</p> <p>choice [1] 2016/12</p> <p>choke [1] 2063/25</p> <p>choked [1] 1994/19</p> <p>choose [5] 1966/3 1989/2 2000/20 2012/5 2056/14</p> <p>chooses [1] 2014/11</p> <p>chose [13] 1965/19 1979/17 1979/18 1980/1 1980/2 1980/2 2000/16 2000/19 2006/15 2016/1 2052/6 2052/8 2053/12</p> <p>chosen [2] 1989/9 1993/6</p> <p>circles [3] 1990/14 1991/18 1992/13</p> <p>circulated [1] 1955/11</p> <p>circumstances [1] 1982/19</p> <p>Civil [1] 1951/6</p> <p>clear [2] 2051/10 2051/16</p> <p>clearly [2] 1978/7 1982/11</p>	<p>client [1] 1964/23</p> <p>clients [4] 1961/17 1961/19 1961/24 1963/22</p> <p>clips [2] 1958/7 1958/9</p> <p>close [3] 1978/18 1978/19 2006/8</p> <p>closed [5] 2007/3 2020/3 2020/5 2054/9 2054/11</p> <p>closely [1] 2055/3</p> <p>coefficient [2] 2024/17 2025/18</p> <p>coefficients [4] 1971/19 2024/5 2024/8 2024/15</p> <p>cohesive [2] 1981/20 2014/9</p> <p>collapsed [1] 2031/24</p> <p>collect [1] 1982/6</p> <p>collected [7] 1969/20 1969/21 1970/2 2005/2 2005/20 2063/9 2064/1</p> <p>collection [94] 1966/2 1967/9 1968/11 1968/25 1969/9 1969/19 1970/5 1970/11 1970/13 1970/13 1970/20 1970/22 1970/23 1972/25 1986/16 1988/24 1992/5 1992/9 1992/11 1992/12 1992/14 1992/24 1994/7 1995/7 1995/9 1995/10 1995/12 1995/13 1995/21 1997/2 1997/12 2002/20 2004/15 2006/19 2006/21 2009/1 2009/4 2012/1 2012/3 2012/7 2017/19 2039/17 2039/18 2039/19 2043/22 2044/8 2044/9 2049/15 2053/15 2054/3 2056/24 2057/4 2057/9 2057/12 2057/14 2057/15 2057/18 2058/3 2058/5 2058/8 2058/8 2058/14 2058/15 2058/19 2059/10 2059/25 2060/2 2060/4 2060/16 2060/20 2060/21 2060/25 2061/1 2061/5 2061/13 2062/4 2062/10 2062/17 2062/23 2063/3 2064/2 2064/3 2064/5 2064/8 2064/12 2064/15 2064/19 2064/22 2065/1 2065/5 2065/12 2065/15 2065/25 2066/3</p> <p>collections [4] 2063/13 2063/18 2063/24 2063/24</p> <p>COLLIER [1] 1951/22</p> <p>colored [1] 2010/15</p> <p>colors [1] 1995/8</p> <p>column [13] 1980/17 1994/15 1994/16 1994/24 1994/25 1995/1 1995/3 1995/5 1995/6 1995/14 1995/15 1999/13 2055/17</p> <p>columns [1] 2061/9</p> <p>combination [1] 2049/12</p> <p>combined [2] 1976/18 2009/18</p> <p>come [10] 1966/19 1972/22 1975/5 1975/16 1990/22 2001/20 2011/11 2038/21 2052/8 2069/25</p> <p>coming [1] 2001/20</p> <p>common [1] 1984/1</p> <p>commonly [4] 1963/6 1965/22 2053/4 2053/6</p> <p>companies [4] 1961/20 1961/21 1961/21 1963/3</p> <p>company [9] 1951/19 1951/22 1952/4 1952/7 1952/11 1953/12 1953/15 1961/10 1983/17</p> <p>compare [1] 2057/5</p> <p>compared [4] 1991/13 1995/7 2058/8 2061/4</p> <p>comparing [5] 1992/8 1992/16 2034/13 2053/8 2053/21</p> <p>comparison [1] 2047/24</p> <p>compilation [1] 1981/21</p> <p>COMPLAINT [1] 1949/7</p> <p>component [1] 1997/22</p> <p>components [1] 2036/10</p>
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<p>C</p> <p>compressibility [19] 1974/2 1978/22 1980/9 1989/7 1996/8 1996/12 1996/15 1997/9 1997/15 1997/21 1997/22 1997/23 1998/25 1999/5 2006/7 2013/11 2013/24 2052/15 2052/17 compressible [1] 1996/17 computer [2] 1953/24 1987/19 computer-aided [1] 1953/24 concept [2] 1986/20 2001/4 concepts [2] 1974/11 1986/20 concerned [1] 2017/3 concluded [1] 2071/12 conclusion [3] 1958/7 1966/24 2018/22 conclusions [2] 2051/4 2051/11 conditions [4] 1982/24 1984/10 1990/15 1990/16 conducting [1] 2018/10 confer [1] 2070/18 conference [2] 1962/24 2069/18 confidence [1] 2017/12 confirm [3] 1979/20 1986/6 1988/2 confirmation [1] 2062/25 confirmed [3] 1986/10 1986/11 2056/4 confusing [1] 2047/18 connected [5] 2031/18 2032/1 2032/8 2032/12 2033/4 connection [1] 1957/1 consider [10] 1962/24 1967/23 1985/16 2022/14 2022/20 2047/5 2048/17 2050/8 2050/14 2067/3 consideration [6] 2035/2 2036/13 2036/21 2037/6 2037/10 2040/7 considered [18] 1967/11 1973/22 1974/3 1981/3 2000/10 2002/17 2011/8 2016/23 2022/17 2024/21 2028/4 2043/7 2044/21 2046/15 2048/22 2058/20 2062/4 2067/4 considering [1] 1975/9 consistency [1] 2014/19 consistent [21] 1966/21 1970/23 1973/1 1973/6 1982/14 1988/3 1988/15 1988/18 1988/21 1990/9 1992/3 1992/4 1995/20 2001/12 2002/19 2004/3 2014/18 2019/12 2044/16 2065/17 2065/19 consistently [1] 2014/19 constant [4] 1972/7 2041/17 2041/24 2042/14 constrain [1] 2056/11 contain [1] 1956/5 contained [3] 1955/25 1959/10 1981/19 contains [2] 1955/22 2028/14 context [1] 2004/17 contingent [4] 2067/24 2068/8 2068/24 2070/10 continue [2] 1968/17 2035/7 continued [2] 2033/3 2033/8 control [1] 2069/12 controlled [2] 1982/24 1984/10 conventional [1] 1983/11 conventionally [1] 1971/25 cooling [2] 2007/9 2007/25 cools [1] 2007/9 core [5] 1981/1 1981/9 1984/7 1984/8 1984/11 cores [2] 1984/5 1984/7 COREY [1] 1950/19 Corporation [2] 1953/11 1953/15 correct [131] corrected [7] 1990/15 2002/18 2007/14 2042/4 2042/5 2045/19 2049/5</p>	<p>correcting [1] 2007/7 correction [8] 2007/17 2008/2 2008/6 2008/9 2008/19 2039/23 2040/1 2041/6 corrections [3] 1984/12 2022/5 2045/23 correctly [2] 2006/8 2021/12 corresponding [1] 2057/12 could [62] 1959/12 1959/16 1960/16 1960/19 1961/1 1961/16 1961/17 1964/19 1965/10 1965/13 1966/19 1968/19 1969/16 1971/14 1973/6 1973/13 1974/21 1974/24 1977/20 1978/24 1980/20 1981/12 1982/21 1983/12 1985/23 1986/1 1989/16 1989/19 1989/21 1991/5 1992/8 1993/8 1998/22 1999/8 1999/15 2000/3 2000/25 2002/12 2002/12 2003/14 2004/8 2004/18 2006/25 2012/25 2014/3 2014/21 2014/23 2015/2 2016/1 2035/17 2038/8 2041/3 2042/20 2044/21 2044/23 2049/12 2052/22 2055/11 2055/24 2056/3 2056/5 2056/8 couldn't [1] 1982/12 Council [1] 1962/16 counsel [1] 1967/20 couple [12] 1964/21 1965/4 1967/13 1971/8 1978/13 1981/8 2008/25 2010/20 2011/20 2015/14 2025/19 2038/10 coupled [3] 1975/6 1976/18 2014/17 course [6] 1956/17 1966/14 1987/3 2001/20 2008/10 2063/10 court [31] 1949/1 1953/18 1959/3 1959/10 1959/21 1960/3 1960/19 1961/1 1964/19 1965/8 1965/13 1966/2 1968/23 1971/3 1982/20 1982/21 1985/19 1986/19 1987/24 1989/18 2000/7 2001/3 2004/17 2015/2 2018/3 2028/9 2046/1 2070/6 2071/15 2071/16 2071/23 Court's [1] 1956/18 cover [2] 1959/15 1959/18 Covington [1] 1952/9 crisp [1] 2020/12 criteria [2] 1993/19 2062/6 criterion [1] 1991/16 critical [1] 2066/21 criticisms [1] 2013/3 cross [5] 1951/13 1976/17 2010/13 2018/10 2018/12 cross-examination [2] 2018/10 2018/12 crossing [2] 2010/23 2011/1 cumulative [49] 1966/8 1966/13 1966/20 1966/25 1967/12 1969/13 1972/11 1986/18 1995/15 1995/21 1997/24 1998/4 1998/10 1999/5 1999/8 2001/13 2002/13 2003/2 2003/9 2004/5 2005/5 2009/5 2012/9 2012/16 2015/7 2015/17 2017/9 2017/16 2021/1 2027/11 2039/9 2039/14 2040/13 2043/15 2044/4 2044/24 2045/13 2045/16 2048/4 2048/8 2048/19 2049/18 2052/22 2055/24 2056/2 2056/7 2060/7 2060/11 2061/13 current [2] 1961/3 1961/9 cursor [1] 2059/1 curve [22] 1975/15 1975/15 1975/18 1975/19 1975/19 1976/11 1976/11 1976/12 1976/12 1976/17 1976/17 1977/4 1977/7 1977/11 1977/12 1977/18 1977/19 1978/10 1978/13 1979/6 1979/11 2010/19 curves [17] 1976/7 1976/10 1976/13 1976/21 1978/2 1978/4 1978/8 1978/17</p>	<p>1978/20 1979/4 1979/5 2010/3 2010/7 2010/12 2010/18 2010/23 2010/25 cut [2] 2032/9 2032/12 CV [2] 1949/7 1949/9</p> <p>D</p> <p>D-21810 [1] 1960/16 D-21811 [1] 1965/11 D-21812 [1] 1966/5 D-21815 [1] 1968/20 D-21818 [1] 1969/17 D-21826 [1] 1973/11 D-21829 [1] 1974/22 D-21830 [1] 1977/21 D-21831 [1] 1978/25 D-21832 [2] 1979/22 1985/6 D-21833 [1] 1984/2 D-21834 [1] 1981/13 D-21836 [1] 1986/2 D-21837 [1] 1986/22 D-21838 [1] 1987/22 D-21839A [1] 1989/19 D-21840A [1] 1991/6 D-21841 [1] 1992/6 D-21842 [1] 1993/9 D-21843 [4] 1994/9 2037/1 2037/6 2037/10 D-21847 [1] 2000/4 D-21848A [1] 2000/25 D-21849 [1] 2003/14 D-21850 [1] 2004/8 D-21851 [1] 2009/14 D-21852A [1] 2009/23 D-21854 [1] 2011/15 D-21856 [1] 2013/1 D-21857 [1] 2014/24 D-2420 [1] 2031/15 D-24543 [2] 2055/14 2061/6 D-24544.1 [1] 2059/8 D-24545.3 [1] 2029/18 D-24546-2 [1] 2041/11 D-24546.1 [1] 2037/19 D-24549 [1] 2042/20 D-24550 [1] 2046/3 D-24551.1 [2] 2024/2 2026/2 D-A-R-V-I-S-H [1] 1959/1 D.C [5] 1951/8 1951/16 1952/8 1952/11 1953/16 Dallas [1] 1953/6 Darvish [14] 1958/18 1958/20 1958/24 1959/6 1960/6 1960/19 1964/8 2003/12 2017/7 2017/23 2018/10 2068/6 2068/7 2068/23 dashed [2] 2040/21 2040/23 data [82] 1963/4 1963/4 1963/6 1963/11 1963/16 1963/18 1966/2 1966/21 1967/3 1967/7 1967/7 1967/9 1967/19 1968/3 1968/9 1969/22 1972/17 1980/12 1980/13 1981/15 1981/22 1981/23 1981/25 1982/1 1983/10 1984/4 1984/13 1984/15 1985/11 1985/12 1985/23 1988/23 1990/10 1991/15 1991/24 1992/4 1995/7 1997/12 1999/9 2001/12 2002/1 2002/19 2004/18 2005/11 2005/11 2005/13 2006/5 2009/13 2014/2 2014/19 2017/5 2043/8 2047/16 2049/4 2049/16 2053/9 2053/19 2054/1 2054/3 2054/6 2054/17 2054/24 2055/3 2055/8 2056/12 2056/17 2056/18 2056/19 2057/15 2057/16 2057/19 2058/4 2058/19 2058/23 2060/16 2060/21 2061/1 2061/19 2061/22 2063/2 2063/3</p>
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[1] 2063/7</p> <p>dataset [1] 2056/22</p> <p>date [2] 2020/8 2033/12</p> <p>Daubert [2] 1960/5 1960/9</p> <p>David [1] 1958/10</p> <p>DAVIS [1] 1952/21</p> <p>DAVIS-DENNY [1] 1952/21</p> <p>day [35] 1949/14 1963/3 1963/3 1969/11 1970/1 1971/7 1971/13 1971/18 1972/25 1992/12 1992/22 1992/25 1993/2 2018/23 2019/6 2019/12 2020/2 2021/13 2057/7 2057/11 2057/13 2061/11 2061/22 2061/23 2062/1 2062/2 2062/9 2062/9 2062/13 2062/16 2062/25 2063/4 2063/6 2063/8 2063/10</p> <p>day-to-day [1] 1963/3</p> <p>days [5] 2043/16 2056/17 2056/18 2057/7 2063/10</p> <p>days' [1] 1972/13</p> <p>deal [6] 1957/11 1963/4 1963/11 2001/3 2030/15 2030/16</p> <p>DEBORAH [1] 1953/12</p> <p>decades [2] 1983/3 1983/7</p> <p>decide [1] 2055/6</p> <p>declined [1] 2033/19</p> <p>declines [1] 2033/22</p> <p>deconvolution [2] 2015/21 2015/24</p> <p>decoupled [1] 1975/22</p> <p>decrease [1] 2021/19</p> <p>decreased [1] 2021/16</p> <p>dedicated [1] 2000/11</p> <p>deemed [2] 2058/14 2062/10</p> <p>DEEPWATER [18] 1949/4 1952/14 1952/14 1952/17 1952/17 1952/20 1952/20 2023/21 2027/6 2031/14 2031/18 2031/23 2032/2 2032/8 2032/12 2033/14 2035/8 2044/19</p> <p>defendants' [5] 2003/19 2005/6 2006/13 2009/17 2009/20</p> <p>defense [2] 2003/16 2011/18</p> <p>define [1] 2009/18</p> <p>defined [1] 1966/19</p> <p>degree [33] 1965/3 1967/4 1967/20 1967/21 1969/24 1970/3 1978/11 1980/13 1983/14 1985/2 1985/17 1985/23 1988/15 1991/12 1991/21 1991/22 1992/22 1992/23 1992/25 1993/3 1993/19 1997/8 1997/15 1997/20 1998/11 1999/6 2005/10 2005/17 2005/22 2013/23 2034/25 2035/14 2036/3</p> <p>degrees [1] 2013/18</p> <p>deliverability [3] 1975/20 1976/1 1976/2</p> <p>demand [1] 1976/13</p> <p>demonstrated [3] 1966/19 1998/21 1998/23</p> <p>demonstrates [1] 2010/19</p> <p>demonstration [2] 1974/18 2010/5</p> <p>demonstrative [37] 1960/16 1965/10 1966/5 1968/19 1969/16 1971/11 1973/10 1974/22 1977/21 1978/24 1979/22 1981/12 1984/2 1985/6 1986/1 1986/21 1986/22 1987/22 1989/19 1991/5 1992/6 1993/8 1994/9 2000/3 2000/25 2003/14 2004/8 2009/14 2009/23 2011/15 2012/25 2014/23 2031/16 2037/2 2042/22 2042/23 2061/8</p> <p>demonstratives [5] 1955/10 1955/14 1956/25 1981/8 1981/11</p>	<p>DENNY [1] 1952/21</p> <p>densities [1] 2008/10</p> <p>density [4] 2007/9 2008/13 2008/16 2008/18</p> <p>Department [2] 1951/6 1951/9</p> <p>dependent [1] 2000/17</p> <p>depending [2] 2015/15 2023/10</p> <p>depends [3] 1997/20 2015/18 2021/14</p> <p>depleted [1] 1990/23</p> <p>deposition [11] 1955/21 1956/1 1956/16 1957/21 1958/3 2021/4 2021/5 2033/6 2068/9 2068/24 2070/2</p> <p>derive [1] 2057/12</p> <p>describe [17] 1961/17 1965/13 1968/22 1973/13 1974/24 1975/5 1982/21 1986/19 1986/21 1987/7 1988/4 1989/21 1992/8 2001/16 2006/25 2014/3 2016/3</p> <p>described [3] 1971/9 1994/3 2001/6</p> <p>describes [3] 1974/18 1975/19 1975/25</p> <p>describing [2] 2009/9 2009/25</p> <p>description [12] 1964/19 1966/16 1971/16 1972/22 1972/24 1973/3 1976/21 1980/3 1981/24 1987/1 2000/17 2065/16</p> <p>descriptions [2] 1973/5 2065/19</p> <p>designated [3] 1955/21 2060/14 2060/15</p> <p>designations [4] 1955/25 1956/4 1956/5 1956/8</p> <p>despite [2] 2043/19 2043/19</p> <p>detail [2] 1971/1 2015/24</p> <p>determination [3] 2058/9 2059/5 2062/24</p> <p>determine [3] 2019/8 2051/22 2059/2</p> <p>determined [4] 1993/12 2029/21 2055/2 2061/13</p> <p>determining [1] 1973/20</p> <p>develop [6] 1985/3 1991/2 1991/17 1995/2 2017/13 2047/17</p> <p>developed [15] 1962/3 1964/7 1977/15 1983/3 1983/6 1988/25 1989/23 1991/16 1991/20 1993/18 2003/24 2019/10 2033/10 2052/1 2052/4</p> <p>development [2] 1962/4 1964/3</p> <p>device [2] 2063/13 2063/18</p> <p>Dexter [1] 1950/20</p> <p>diagram [1] 2024/5</p> <p>diameter [6] 1972/2 1990/4 1990/4 1994/18 2026/18 2032/19</p> <p>did [114] 1960/22 1960/23 1964/13 1965/19 1966/24 1967/25 1969/1 1969/4 1969/19 1970/5 1970/20 1971/5 1971/8 1972/10 1973/20 1974/8 1974/11 1978/5 1978/5 1978/16 1980/17 1981/6 1984/4 1985/19 1986/4 1987/18 1989/5 1989/18 1993/11 1994/2 1994/5 1995/10 1997/3 1999/7 2000/8 2000/10 2000/13 2000/14 2002/10 2003/4 2003/5 2003/6 2003/17 2004/11 2004/15 2006/10 2006/12 2006/18 2006/20 2007/1 2007/17 2008/3 2008/20 2008/22 2008/23 2009/16 2010/18 2011/2 2011/25 2012/10 2012/12 2013/13 2013/15 2016/2 2019/6 2019/7 2019/8 2019/8 2021/6 2022/13 2022/20 2025/7 2025/9 2025/10 2025/22 2026/1 2026/10 2026/17 2026/25 2027/5 2029/6 2034/15 2034/17 2034/20 2035/1 2036/8 2036/13 2036/23 2037/6 2037/7 2037/8 2037/10 2038/21 2039/6 2039/22 2041/5 2042/8 2042/13</p>	<p>2042/13 2043/4 2046/21 2047/14 2050/23 2050/25 2051/4 2051/11 2052/9 2064/7 2064/12 2064/14 2064/14 2064/17 2067/12 2069/7 didn't [17] 1972/18 1978/20 1979/19 1981/3 1993/14 1994/5 2001/19 2009/1 2011/12 2020/15 2031/16 2046/18 2056/11 2067/6 2068/10 2068/13 2069/25</p> <p>difference [8] 1984/21 1991/12 1993/4 1993/19 2045/18 2048/3 2049/3 2049/4</p> <p>different [23] 1965/15 1967/13 1969/23 1970/8 1970/8 1971/8 1980/4 1984/19 1986/9 2003/10 2003/25 2006/14 2010/15 2010/15 2011/2 2011/20 2013/18 2015/14 2015/16 2015/17 2025/15 2049/24 2055/11</p> <p>differentiate [1] 2020/12</p> <p>differently [1] 1964/11</p> <p>difficulties [1] 2007/25</p> <p>dimension [2] 1972/1 1992/4</p> <p>dimensions [1] 1987/3</p> <p>DIRE [1] 1959/2</p> <p>direct [8] 1960/17 2036/24 2037/3 2048/21 2051/24 2055/5 2055/17 2059/6</p> <p>directive [1] 1956/18</p> <p>directly [4] 1970/19 2000/16 2016/2 2016/10</p> <p>director [1] 1961/10</p> <p>disagree [1] 2020/25</p> <p>discharge [5] 1971/19 1972/8 1995/22 1998/10 2009/5</p> <p>discharged [1] 2012/11</p> <p>discharges [1] 1999/8</p> <p>discipline [3] 1964/6 1983/3 1988/17</p> <p>disconnected [1] 2032/4</p> <p>discounted [1] 2039/20</p> <p>discuss [4] 1965/21 1970/25 2035/8 2054/5</p> <p>discussed [4] 1967/18 1969/3 1971/17 2007/8</p> <p>discussing [1] 2019/23</p> <p>discussion [2] 1982/2 2050/7</p> <p>display [2] 1960/16 2024/2</p> <p>distinction [1] 1987/5</p> <p>distinguish [1] 1995/8</p> <p>Distinguished [1] 1962/14</p> <p>distinguishing [1] 2026/19</p> <p>DISTRICT [5] 1949/1 1949/2 1949/15 2071/16 2071/16</p> <p>divide [1] 1987/8</p> <p>divided [2] 1965/15 1979/25</p> <p>Division [1] 1951/6</p> <p>do [98] 1956/2 1959/6 1959/8 1960/2 1960/4 1961/14 1962/20 1963/3 1963/11 1963/22 1964/4 1970/21 1971/16 1972/7 1975/4 1976/7 1976/7 1976/21 1977/1 1977/11 1979/15 1982/19 1982/23 1986/4 1986/6 1986/12 1988/1 1988/6 1988/13 1991/1 1991/8 1993/11 1995/25 1997/14 1998/12 1998/16 1998/18 2000/8 2000/13 2002/6 2003/17 2012/20 2012/22 2017/12 2020/21 2021/8 2024/9 2024/18 2026/13 2030/2 2033/12 2034/6 2034/11 2037/3 2037/12 2038/1 2038/3 2038/15 2039/11 2040/14 2041/13 2041/21 2042/5 2045/2 2045/8 2046/6 2047/22 2048/2 2048/23 2049/1 2051/18 2055/18 2057/20 2057/24 2058/1 2058/7 2059/14 2059/17 2060/8</p>
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[19] 2060/12 2060/16 2061/14 2061/18 2061/19 2061/25 2063/19 2063/22 2064/1 2064/14 2066/19 2066/21 2067/17 2068/15 2069/18 2069/19 2070/25 2071/1 2071/17</p> <p>Docket [3] 1949/4 1949/7 1949/9</p> <p>docs [1] 2066/22</p> <p>Doctor [4] 2018/14 2024/4 2040/12 2066/8</p> <p>document [4] 1981/15 1981/20 1981/24 1982/2</p> <p>documents [3] 2005/24 2039/3 2070/8</p> <p>does [19] 1977/6 1979/24 1988/8 1991/15 1994/12 1994/14 2014/8 2017/1 2029/25 2040/6 2044/11 2064/18 2064/25 2065/8 2065/10 2065/11 2065/24 2065/25 2066/2</p> <p>doesn't [21] 1963/19 1985/4 1988/11 1997/9 1997/11 1997/16 1999/5 2000/17 2014/12 2015/13 2015/21 2020/9 2020/10 2026/18 2044/13 2047/16 2047/16 2050/7 2064/22 2065/6 2066/3</p> <p>doing [4] 1964/2 1964/23 1965/17 1989/25</p> <p>Domengeaux [1] 1949/21</p> <p>DON [1] 1951/18</p> <p>don't [16] 2006/15 2029/18 2030/3 2033/13 2041/22 2046/12 2047/16 2047/17 2047/17 2057/20 2061/4 2066/4 2067/8 2069/15 2070/6 2070/14</p> <p>DONALD [1] 1953/3</p> <p>done [15] 1962/7 1963/2 1968/11 1983/12 1983/13 1984/12 1988/20 2005/14 2005/21 2005/21 2034/5 2064/24 2065/22 2066/8 2067/25</p> <p>dots [4] 1990/14 1993/4 2059/24 2060/1</p> <p>dotted [2] 1991/11 2040/21</p> <p>DOUGLAS [1] 1951/3</p> <p>down [10] 1961/1 1966/3 1966/4 1968/15 1996/7 2000/6 2007/9 2031/15 2041/2 2050/1</p> <p>downhole [1] 2050/6</p> <p>downstream [3] 2000/22 2023/20 2027/14</p> <p>downward [3] 1975/15 1975/23 1976/12</p> <p>downward-trending [2] 1975/15 1976/12</p> <p>DOYEN [1] 1952/19</p> <p>dozens [1] 1962/24</p> <p>Dr. [71] 1955/11 1955/11 1955/15 1955/16 1956/16 1957/2 1958/17 1959/6 1960/6 1960/19 1964/8 1968/8 1969/3 1970/15 1970/15 1974/16 1984/8 1984/14 1998/19 2001/3 2002/18 2002/24 2003/12 2004/12 2004/13 2006/24 2007/1 2007/7 2007/12 2007/13 2007/17 2008/1 2008/4 2008/11 2008/14 2008/21 2009/21 2009/25 2011/2 2011/6 2011/10 2011/14 2013/4 2013/13 2013/15 2013/17 2014/12 2014/13 2014/13 2014/20 2014/22 2015/3 2015/6 2016/8 2016/21 2017/1 2017/7 2017/23 2018/10 2045/20 2045/21 2045/22 2049/5 2066/23 2068/21 2068/22 2068/23 2069/14 2070/14 2071/7 2071/8</p> <p>Dr. Blunt [12] 1984/14 2007/1 2007/7 2007/12 2007/13 2008/1 2008/4 2008/11 2013/13 2013/17 2071/7 2071/8</p>	<p>Dr. Blunt's [7] 1998/19 2006/24 2007/17 2008/21 2013/4 2013/15 2014/20</p> <p>Dr. Bushnell [2] 1956/16 2070/14</p> <p>Dr. Dykhuizen [1] 2068/23</p> <p>Dr. Griffiths [4] 1955/11 1955/16 1970/15 2068/21</p> <p>Dr. Griffiths' [1] 2001/3</p> <p>Dr. Gringarten [10] 2004/13 2011/10 2011/14 2014/12 2014/13 2014/13 2015/6 2016/8 2016/21 2017/1</p> <p>Dr. Gringarten's [3] 2004/12 2014/22 2015/3</p> <p>Dr. Hsieh [2] 1955/11 1955/15</p> <p>Dr. Johnson [2] 2011/2 2011/6</p> <p>Dr. Johnson's [2] 2009/21 2009/25</p> <p>Dr. Kelkar [3] 1968/8 1974/16 1984/8</p> <p>Dr. Martin [1] 2045/20</p> <p>Dr. Mehran [1] 1958/17</p> <p>Dr. Merrill [1] 2069/14</p> <p>Dr. Pooladi [1] 2068/22</p> <p>Dr. Pooladi-Darvish [8] 1959/6 1960/6 1960/19 1964/8 2003/12 2017/7 2017/23 2018/10</p> <p>Dr. Ron [2] 1969/3 1970/15</p> <p>Dr. Ronald [1] 1957/2</p> <p>Dr. Trusler [3] 2002/18 2045/21 2045/22</p> <p>Dr. Trusler's [2] 2002/24 2049/5</p> <p>Dr. Whitson [1] 2008/14</p> <p>Dr. Zick [1] 2066/23</p> <p>draw [1] 2046/6</p> <p>drawn [1] 2047/5</p> <p>drew [1] 2043/4</p> <p>drill [7] 1981/17 2011/5 2011/5 2011/7 2011/8 2011/10 2011/13</p> <p>drilled [2] 1967/6 2005/21</p> <p>drilling [5] 1952/14 1952/17 1952/20 1981/23 1981/24</p> <p>drive [1] 1955/22</p> <p>driving [1] 1975/11</p> <p>drop [3] 2035/20 2035/21 2050/12</p> <p>dropped [1] 2011/8</p> <p>drops [2] 2001/23 2062/23</p> <p>Drs. [1] 2012/21</p> <p>Drs. Blunt [1] 2012/21</p> <p>duly [1] 1958/21</p> <p>duration [3] 1965/1 1965/1 1972/13</p> <p>during [18] 1968/25 1970/13 1990/21 2001/3 2027/22 2033/4 2033/5 2036/9 2042/3 2043/9 2047/15 2050/3 2051/12 2053/13 2053/14 2058/16 2063/7 2069/18</p> <p>Dykhuizen [6] 1957/2 1969/3 1970/15 2066/13 2068/7 2068/23</p> <p>dynamic [16] 1968/9 1980/12 1980/13 1990/10 1996/1 1997/12 2001/12 2002/19 2004/4 2005/2 2005/4 2006/5 2009/13 2014/19 2017/17 2053/10</p>	<p>2048/16 2048/19</p> <p>effects [2] 1974/1 2007/25</p> <p>EISERT [1] 1952/6</p> <p>either [14] 1957/11 1962/17 1981/22 1995/11 1995/12 1995/24 2003/20 2006/7 2013/7 2017/15 2027/10 2043/10 2053/19 2065/3</p> <p>Ellis [3] 1951/20 1952/2 1952/5</p> <p>Elm [1] 1953/5</p> <p>else [2] 2032/21 2071/9</p> <p>emphasize [1] 2004/23</p> <p>end [4] 1966/22 2032/1 2032/4 2044/22</p> <p>ended [1] 2056/14</p> <p>Energy [2] 1953/2 1953/7</p> <p>Enforcement [1] 1951/10</p> <p>ENGEL [1] 1951/13</p> <p>engineer [2] 1964/22 1967/14</p> <p>engineering [12] 1960/8 1960/22 1960/23 1961/14 1962/1 1962/21 1965/23 1974/11 1983/4 1988/14 1988/17 2007/5</p> <p>engineers [2] 1969/7 1971/25</p> <p>enjoyed [1] 1981/21</p> <p>enlarged [1] 1990/4</p> <p>enlarging [1] 1990/8</p> <p>enough [2] 2031/16 2064/9</p> <p>Enterprise [1] 2064/5</p> <p>entire [5] 2032/16 2033/4 2041/17 2042/11 2043/6</p> <p>entitled [1] 2071/20</p> <p>Environment [1] 1951/10</p> <p>Environmental [1] 1951/10</p> <p>equal [2] 1976/25 1990/2</p> <p>equally [1] 1997/24</p> <p>equals [2] 1996/8 2005/7</p> <p>equation [5] 1987/6 1998/5 1998/5 1998/14 1998/24</p> <p>equations [1] 1987/9</p> <p>Erica [2] 1955/7 2066/10</p> <p>eroded [1] 2050/24</p> <p>eroding [1] 2024/25</p> <p>erosion [74] 2000/8 2000/11 2000/12 2000/15 2000/22 2001/8 2001/10 2001/24 2002/12 2026/25 2027/3 2027/6 2027/9 2027/13 2027/15 2027/17 2028/5 2028/12 2028/23 2030/9 2032/22 2032/25 2033/3 2033/7 2033/14 2033/16 2033/19 2033/21 2033/23 2035/2 2035/8 2036/9 2036/11 2036/13 2036/21 2037/6 2037/11 2040/7 2041/3 2044/12 2044/14 2044/15 2044/18 2044/20 2044/23 2047/7 2047/12 2047/15 2047/23 2048/1 2048/3 2048/6 2048/10 2048/12 2048/13 2048/16 2048/18 2049/24 2049/24 2050/6 2050/7 2050/9 2050/14 2051/1 2051/5 2051/7 2051/12 2064/20 2064/23 2065/3 2065/6 2065/8 2065/13 2066/1</p> <p>erosional [1] 2046/25</p> <p>error [10] 1991/12 1991/21 1991/23 2059/5 2059/13 2059/17 2059/18 2059/21 2060/7 2060/11</p> <p>especially [2] 2043/18 2053/10</p> <p>ESQ [50] 1949/19 1949/22 1950/3 1950/7 1950/10 1950/13 1950/16 1950/19 1950/19 1950/22 1951/3 1951/3 1951/7 1951/11 1951/11 1951/12 1951/12 1951/13 1951/13 1951/14 1951/14 1951/15 1951/18 1951/21 1951/21 1951/22 1951/22 1951/23 1952/3 1952/6 1952/6 1952/7 1952/10 1952/13 1952/16 1952/19</p>
	<p>E</p> <p>each [10] 1976/14 1994/4 2010/13 2010/15 2022/3 2053/1 2056/24 2057/11 2058/3 2059/11</p> <p>earlier [8] 1989/15 1992/23 1994/3 2009/6 2019/13 2035/6 2058/2 2065/6</p> <p>early [2] 1967/9 2070/23</p> <p>easily [1] 1999/20</p> <p>East [1] 1950/16</p> <p>EASTERN [2] 1949/2 2071/16</p> <p>economics [1] 1976/13</p> <p>education [1] 1960/21</p> <p>educational [1] 1960/20</p> <p>Edwards [1] 1949/22</p> <p>effect [5] 1980/8 2007/9 2033/17</p>	

<p>E</p> <p>ESQ... [14] 1952/20 1952/20 1952/21 1952/21 1953/3 1953/3 1953/4 1953/4 1953/5 1953/8 1953/8 1953/12 1953/15 1953/15</p> <p>estimate [39] 1964/1 1965/2 1966/10 1966/12 1966/25 1969/1 1981/2 1982/7 1983/19 1989/1 1989/5 1989/6 1989/13 1989/14 1998/1 1998/3 2006/1 2012/16 2013/22 2014/10 2014/11 2014/12 2014/14 2015/7 2016/16 2018/18 2020/22 2021/9 2028/1 2028/1 2030/22 2039/10 2039/14 2044/23 2045/13 2045/16 2056/7 2056/25 2060/11</p> <p>estimated [6] 1969/9 2009/6 2018/22 2026/13 2041/19 2044/4</p> <p>estimates [12] 1974/4 1974/5 1974/15 1980/24 1980/25 1982/3 1989/2 2015/16 2020/2 2035/18 2036/4 2049/18</p> <p>estimating [1] 2018/25</p> <p>estimation [2] 1972/5 2064/11</p> <p>et [2] 1949/8 1949/11</p> <p>evaluate [3] 2036/8 2050/23 2051/1</p> <p>evaluated [2] 2025/25 2036/6</p> <p>evaluating [1] 1992/24</p> <p>evaluation [1] 2059/19</p> <p>even [14] 1967/9 1973/25 1974/2 1982/18 1983/13 1983/14 1984/18 1999/18 1999/19 2005/20 2017/14 2044/9 2056/4 2058/11</p> <p>event [2] 2041/1 2054/24</p> <p>every [1] 1994/2</p> <p>Everybody [1] 1955/5</p> <p>everyone [3] 2001/4 2018/5 2071/10</p> <p>everything [1] 2014/17</p> <p>evidence [6] 1955/14 1955/24 1956/2 2032/22 2047/15 2047/22</p> <p>exact [5] 1993/17 2003/10 2030/2 2030/4 2033/12</p> <p>exactly [4] 2009/6 2012/8 2036/7 2041/21</p> <p>examination [12] 1957/2 1959/2 1960/17 2001/3 2018/10 2018/12 2036/24 2037/3 2048/21 2051/24 2055/5 2055/17</p> <p>examinations [1] 1955/10</p> <p>examine [8] 1985/7 1986/7 1986/12 1986/13 1988/7 1988/22 2000/12 2009/12</p> <p>examined [7] 1970/21 1980/13 1994/7 1999/17 2001/11 2007/14 2010/18</p> <p>examines [1] 1995/6</p> <p>examining [4] 1990/8 1992/18 2059/18 2059/20</p> <p>example [12] 1978/7 1980/20 1985/9 1988/7 1989/16 1989/18 1993/3 1994/17 1999/12 2000/23 2014/10 2059/7</p> <p>examples [3] 1987/4 1999/4 2059/10</p> <p>exceeded [1] 2062/15</p> <p>exceeding [1] 2062/3</p> <p>except [1] 2055/21</p> <p>exception [2] 1999/14 2034/14</p> <p>executive [1] 2020/11</p> <p>exercise [2] 2053/20 2054/25</p> <p>Exhibit [2] 1959/12 1959/16</p> <p>Exhibit 11653 [1] 1959/12</p> <p>Exhibit 11654R [1] 1959/16</p> <p>exhibits [8] 1955/9 1955/13 1956/25 1957/4 2066/13 2067/24 2068/16 2068/17</p>	<p>exist [8] 1963/18 1974/5 1980/24 1981/1 2001/24 2028/9 2047/16 2047/17</p> <p>existed [8] 1965/25 1967/5 1979/8 1981/2 1985/11 2037/12 2044/15 2048/11</p> <p>existence [4] 2050/6 2065/8 2065/12 2066/1</p> <p>exists [7] 1996/14 1999/10 1999/11 2017/5 2028/3 2044/14 2050/14</p> <p>exiting [1] 2032/17</p> <p>expect [2] 1963/22 2010/12</p> <p>expected [1] 1979/7</p> <p>experience [9] 1964/13 1982/14 1982/15 1982/17 1983/13 1983/20 1998/2 2005/10 2005/17</p> <p>expert [11] 1959/6 1959/10 1959/14 1959/18 1960/7 1962/16 2003/17 2019/21 2036/2 2045/22 2066/23</p> <p>expertise [3] 1961/13 2000/14 2005/13</p> <p>experts [6] 2003/19 2006/13 2009/17 2009/20 2011/19 2068/18</p> <p>explain [3] 1975/8 2021/25 2022/1</p> <p>explained [4] 1993/6 1998/19 2004/2 2033/6</p> <p>explanation [6] 1998/22 2020/14 2035/4 2040/9 2046/20 2047/4</p> <p>explicitly [1] 2044/13</p> <p>exploration [7] 1949/10 1951/17 1951/20 1952/2 1952/5 1952/9 1967/6</p> <p>exploratory [1] 1962/3</p> <p>explore [2] 2004/24 2006/15</p> <p>explosion [5] 2001/19 2016/24 2016/25 2020/8 2041/9</p> <p>expresses [1] 2016/9</p> <p>extent [2] 1981/25 1987/7</p> <p>extrapolate [6] 2019/6 2019/7 2020/10 2020/22 2021/8 2021/13</p> <p>extrapolated [19] 2019/3 2029/16 2038/19 2039/13 2041/6 2041/8 2044/25 2045/2 2045/6 2045/7 2045/8 2045/12 2045/15 2046/1 2046/2 2046/3 2046/5 2046/21 2049/8</p> <p>extrapolating [1] 2048/9</p> <p>extrapolation [1] 2020/25</p> <p>extreme [15] 2001/18 2001/21 2002/2 2002/5 2002/17 2002/22 2003/1 2003/5 2003/7 2016/20 2016/22 2029/17 2044/22 2044/25 2049/21</p> <p>extremely [1] 1963/14</p> <p>eyeball [1] 2059/2</p>	<p>feet [4] 2031/21 2032/7 2032/10 2032/11</p> <p>Fekete [3] 1961/11 1983/16 1983/16</p> <p>fell [1] 2012/8</p> <p>fellowship [1] 1960/25</p> <p>felt [1] 2034/24</p> <p>few [11] 1961/20 1961/20 1962/18 1962/23 1979/18 2005/18 2010/25 2014/5 2015/5 2028/8 2036/17</p> <p>field [4] 1960/14 2043/14 2043/21 2053/9</p> <p>fields [5] 1951/23 1956/13 1960/11 1962/3 2018/9</p> <p>Fifteenth [1] 1952/7</p> <p>file [1] 1955/12</p> <p>filing [2] 2069/17 2070/5</p> <p>final [25] 1956/24 1958/17 1969/11 1971/13 1971/18 2006/23 2013/8 2013/19 2018/23 2019/6 2019/12 2020/2 2020/19 2021/13 2057/7 2057/11 2061/11 2061/22 2061/23 2062/1 2062/2 2062/9 2062/13 2062/16 2062/25</p> <p>finally [1] 2015/11</p> <p>find [36] 1963/19 1966/14 1966/15 1966/16 1968/5 1969/13 1970/16 1971/17 1972/10 1974/8 1974/14 1974/19 1978/5 1979/10 1982/7 1986/13 1986/17 1988/15 1988/21 1997/13 1999/19 2004/24 2008/23 2010/18 2011/22 2011/24 2012/3 2013/15 2015/11 2016/6 2020/19 2021/1 2036/25 2044/20 2049/12 2056/11</p> <p>finding [5] 1966/1 1967/12 1973/17 1983/5 1984/19</p> <p>finds [2] 2014/10 2015/16</p> <p>fine [1] 2066/17</p> <p>finished [2] 2036/18 2036/19</p> <p>Firm [1] 1950/6</p> <p>first [47] 1966/3 1967/16 1970/6 1971/2 1974/25 1976/9 1980/25 1981/15 1982/15 1986/4 1986/6 1988/1 1989/21 1994/15 1994/16 1994/17 1994/24 1995/3 1996/11 2001/2 2001/7 2001/14 2003/16 2006/25 2007/20 2009/21 2011/24 2013/6 2015/19 2016/4 2018/17 2018/22 2020/1 2022/21 2024/8 2025/19 2025/20 2028/21 2030/5 2037/18 2038/18 2046/6 2052/4 2053/25 2054/5 2059/11 2061/3</p> <p>FITCH [1] 1953/15</p> <p>flat [19] 2029/16 2038/5 2038/5 2041/10 2041/13 2041/23 2042/2 2042/7 2042/22 2042/25 2043/4 2043/7 2043/12 2043/20 2044/2 2044/11 2044/16 2044/17 2044/24</p> <p>FLEMING [1] 1953/5</p> <p>Floor [1] 1952/22</p> <p>Florida [1] 1950/5</p> <p>flow [103] 1965/1 1965/1 1969/1 1969/12 1970/14 1970/16 1971/3 1971/6 1971/13 1971/17 1972/14 1975/2 1975/5 1975/13 1975/14 1975/21 1976/18 1976/25 1977/5 1977/8 1977/10 1982/23 1982/24 1982/25 1983/9 1983/10 1983/25 1984/10 1987/10 1990/20 1990/22 2000/19 2010/22 2011/9 2015/10 2015/11 2015/12 2015/13 2016/7 2016/24 2018/23 2018/25 2019/7 2019/8 2019/12 2019/14 2020/2 2020/19 2020/25 2021/13 2022/14</p>
	<p>F</p> <p>faced [3] 1967/2 2007/22 2008/1</p> <p>fact [19] 1967/16 1972/19 1980/9 1984/22 1985/11 1997/2 2013/6 2015/22 2017/20 2027/18 2043/19 2056/6 2062/20 2064/18 2064/25 2065/11 2065/24 2069/14 2069/25</p> <p>factor [8] 1972/8 1997/23 1997/25 1998/3 1998/3 1998/6 2050/11 2050/12</p> <p>fairly [4] 1966/16 1966/19 1966/20 1983/20</p> <p>fall [2] 1978/18 1990/23</p> <p>falls [1] 1990/21</p> <p>familiar [1] 2024/4</p> <p>Fannin [1] 1952/17</p> <p>far [4] 1961/6 2000/10 2017/3 2040/17</p> <p>farther [3] 1995/23 1996/2 2017/20</p> <p>farthest [1] 1978/8</p> <p>fast [3] 2027/19 2031/16 2033/22</p> <p>FCRR [4] 1953/18 2071/15 2071/22 2071/23</p> <p>feel [1] 2035/19</p>	

<p>F</p> <p>flow... [52] 2022/17 2022/20 2022/21 2022/24 2023/25 2025/14 2026/5 2026/22 2026/23 2027/12 2028/4 2031/4 2033/9 2033/17 2033/24 2034/2 2034/24 2035/11 2035/18 2035/21 2036/5 2040/5 2040/17 2041/5 2043/16 2046/17 2050/10 2050/15 2050/22 2051/6 2056/7 2056/25 2057/3 2057/6 2057/7 2057/8 2057/11 2060/7 2060/18 2060/23 2061/3 2061/5 2061/11 2061/22 2062/1 2062/2 2062/2 2062/9 2062/12 2062/16 2062/20 2064/11</p> <p>flowed [5] 2003/7 2020/23 2021/10 2023/11 2032/15</p> <p>flowing [13] 1972/13 1975/9 2000/23 2001/5 2003/4 2021/20 2027/18 2027/21 2027/24 2028/1 2028/2 2050/19 2050/24</p> <p>flows [5] 2000/21 2023/1 2023/3 2023/7 2055/24</p> <p>fluid [10] 1963/9 1969/20 1974/2 1974/10 1975/12 1978/23 2003/20 2007/9 2008/10 2023/7</p> <p>fluids [4] 1982/6 2008/11 2022/21 2022/24</p> <p>FLYNN [1] 1951/7</p> <p>focus [1] 2028/18</p> <p>focusing [1] 2035/7</p> <p>followed [1] 1960/24</p> <p>following [2] 2010/14 2067/24</p> <p>follows [1] 1958/21</p> <p>foot [3] 1985/13 2026/8 2026/9</p> <p>force [1] 1975/11</p> <p>forced [2] 2001/25 2001/25</p> <p>foregoing [1] 2071/17</p> <p>formal [1] 1964/6</p> <p>formation [3] 1982/6 1982/11 1982/13</p> <p>formula [1] 2049/5</p> <p>formulas [1] 2057/8</p> <p>forth [3] 2037/5 2037/9 2055/20</p> <p>forward [3] 2019/11 2019/14 2022/12</p> <p>found [18] 1968/2 1978/16 1980/4 1986/8 1988/2 1988/20 1990/5 1994/20 1998/4 2003/10 2004/18 2009/12 2012/7 2019/13 2034/18 2052/24 2055/10 2056/6</p> <p>four [3] 1988/4 2025/20 2029/8</p> <p>fourth [2] 1995/14 1995/15</p> <p>FRANK [1] 1950/16</p> <p>Frirot [1] 1952/13</p> <p>front [1] 1999/4</p> <p>full [4] 1958/22 1987/7 2004/20 2020/14</p> <p>fully [2] 1993/17 2023/11</p> <p>function [5] 1962/9 1969/12 1990/12 1990/13 1992/14</p> <p>further [13] 1967/22 1979/16 1993/11 1994/19 1999/18 2001/22 2009/2 2011/9 2011/12 2012/2 2017/24 2057/20 2066/5</p> <p>future [2] 1962/8 1983/23</p>	<p>2050/11 2058/17 2058/18 2058/23 generated [3] 2053/8 2061/11 2062/2</p> <p>generating [2] 1978/3 1978/20</p> <p>generation [1] 2061/20</p> <p>geometric [1] 1984/20</p> <p>geophysical [1] 2005/13</p> <p>geoscientists [1] 2005/15</p> <p>get [8] 1961/16 1980/17 2028/19 2037/17 2041/2 2043/22 2059/23 2070/23</p> <p>gets [4] 1990/23 1996/4 1996/4 2017/21</p> <p>getting [1] 1965/18</p> <p>give [10] 1987/8 1995/24 2001/13 2009/1 2021/6 2037/17 2046/1 2060/19 2060/24 2062/12</p> <p>given [4] 1957/13 1998/18 2048/13 2055/2</p> <p>gives [5] 1976/17 1979/25 1996/19 2008/13 2046/17</p> <p>giving [1] 2008/17</p> <p>GLADSTEIN [1] 1951/14</p> <p>GmbH [1] 1949/8</p> <p>go [66] 1964/17 1965/10 1966/5 1968/3 1971/2 1971/11 1971/18 1971/21 1972/6 1973/20 1974/21 1975/13 1975/14 1975/16 1976/9 1977/1 1977/20 1978/24 1979/22 1980/16 1980/20 1984/2 1985/6 1985/15 1985/19 1986/1 1986/22 1986/24 1987/22 1988/6 1989/19 1990/25 1992/6 1993/8 1994/9 1994/11 1995/18 1995/24 1996/22 1997/3 1998/24 1999/3 1999/20 2000/3 2000/25 2001/14 2003/14 2004/7 2004/8 2006/15 2009/14 2009/23 2011/15 2012/25 2014/23 2015/24 2017/20 2030/5 2040/16 2046/3 2052/12 2065/18 2067/17 2067/19 2067/19 2067/22</p> <p>Godwin [3] 1953/2 1953/3 1953/7</p> <p>goes [6] 1996/4 1996/5 2007/10 2007/10 2014/7 2068/2</p> <p>going [12] 1957/25 1965/9 1980/16 2006/23 2015/24 2030/5 2043/7 2057/21 2067/16 2067/23 2068/8 2070/3</p> <p>gone [1] 2071/3</p> <p>good [55] 1955/7 1964/4 1965/24 1966/1 1967/7 1988/23 1989/6 1991/20 1993/2 1993/7 1993/12 1993/13 1993/15 1994/1 1994/7 1995/9 1995/10 1996/5 1996/5 1997/2 2002/20 2003/2 2004/15 2004/20 2006/3 2006/4 2006/18 2006/20 2006/21 2007/15 2009/1 2009/4 2043/22 2051/22 2055/7 2058/10 2058/14 2059/2 2059/3 2060/15 2060/20 2060/25 2061/24 2062/1 2062/4 2062/7 2062/10 2062/13 2062/17 2062/21 2062/24 2063/1 2064/19 2064/25 2070/16</p> <p>good-mediocre [1] 2059/3</p> <p>got [1] 1998/8</p> <p>governments [1] 1961/22</p> <p>gradually [1] 1996/4</p> <p>grand [2] 1952/22 2029/24</p> <p>GRANT [1] 1952/21</p> <p>graph [5] 1974/24 1974/25 1979/2 1990/1 1990/11</p> <p>graphical [2] 1974/15 1987/1</p> <p>great [2] 2001/3 2068/5</p> <p>greater [1] 2056/8</p> <p>green [2] 1995/9 1995/20</p> <p>GREENWALD [1] 1950/10</p>	<p>Griffiths [6] 1955/11 1955/16 1969/3 1970/15 2068/6 2068/21</p> <p>Griffiths' [1] 2001/3</p> <p>Gringarten [11] 2004/13 2011/10 2011/14 2012/21 2014/12 2014/13 2014/13 2015/6 2016/8 2016/21 2017/1</p> <p>Gringarten's [3] 2004/12 2014/22 2015/3</p> <p>group [2] 1987/19 2004/16</p> <p>guess [2] 2035/19 2071/2</p> <p>GULF [2] 1949/5 2032/17</p> <p>GWENDOLYN [1] 1953/8</p>
<p>G</p> <p>GASAWAY [1] 1952/6</p> <p>gave [8] 1972/14 1977/18 1997/4 1999/16 2002/20 2003/2 2045/15 2062/20</p> <p>general [2] 1966/15 1982/17</p> <p>General's [2] 1950/18 1950/22</p> <p>generally [15] 1962/5 1980/23 1989/2 1991/22 1993/4 2003/9 2003/19 2006/13 2007/23 2025/6 2033/21</p>	<p>H</p> <p>had [89] 1956/17 1964/14 1967/6 1967/8 1967/18 1968/14 1969/9 1969/10 1969/11 1972/17 1972/19 1972/21 1972/22 1973/3 1973/15 1973/21 1974/13 1977/2 1978/12 1978/19 1979/14 1979/17 1980/4 1981/4 1981/21 1981/23 1983/13 1984/8 1984/9 1986/8 1988/2 1988/10 1992/23 1994/20 1997/7 1997/10 1998/8 1998/13 1998/19 1999/18 2000/10 2000/11 2002/3 2002/17 2002/24 2002/24 2003/10 2003/23 2004/20 2004/21 2006/6 2006/7 2007/13 2009/6 2011/3 2011/6 2011/8 2011/8 2011/9 2011/11 2014/13 2019/13 2024/20 2029/3 2032/4 2033/8 2034/18 2036/15 2038/12 2038/13 2039/17 2039/19 2039/19 2046/25 2049/25 2050/21 2052/8 2052/24 2052/25 2054/17 2056/17 2056/18 2059/18 2059/20 2061/11 2061/23 2066/13 2066/24 2066/25</p> <p>half [4] 1964/24 1984/23 1984/24 2032/16</p> <p>Halliburton [2] 1953/2 1953/7</p> <p>hand [1] 1991/21</p> <p>hanging [1] 2011/7</p> <p>happen [6] 1980/2 1986/13 2001/11 2002/4 2014/14 2065/7</p> <p>happened [4] 1994/18 2002/7 2033/14 2051/8</p> <p>happening [3] 1974/24 2033/1 2050/21</p> <p>happens [10] 1976/9 1990/9 1996/2 1996/10 1996/19 2000/16 2000/22 2000/22 2001/24 2010/22</p> <p>HARIKLIA [1] 1951/21</p> <p>HARVEY [1] 1951/14</p> <p>has [26] 1957/3 1964/6 1966/2 1967/17 1969/2 1971/3 1978/7 1978/14 1983/3 1983/6 1984/14 1987/2 1990/22 1996/17 2004/13 2007/11 2007/12 2008/12 2010/15 2013/25 2022/3 2028/9 2051/16 2061/8 2061/9 2065/16</p> <p>Hat [2] 2063/18 2064/12</p> <p>have [194]</p> <p>haven't [3] 1957/13 2067/25 2067/25</p> <p>having [1] 1958/20</p> <p>HAYCRAFT [1] 1951/18</p> <p>HB [1] 1953/18</p> <p>HB-406 [1] 1953/18</p> <p>he [25] 2007/8 2008/11 2008/12 2011/3 2011/8 2013/7 2013/7 2013/9 2013/25 2014/7 2014/10 2014/11 2014/12 2015/9 2015/10 2015/13 2015/14 2015/15 2015/16 2015/20 2016/8 2017/4 2017/5 2045/23 2051/18</p> <p>heard [8] 1957/5 1964/10 1966/2 1971/3 1982/20 2001/3 2028/9 2070/13</p> <p>Helix [1] 1969/22</p> <p>Helix Producer [1] 1969/22</p>	

<p>H</p> <p>her [2] 2067/3 2067/3</p> <p>here [44] 1971/4 1979/11 1984/19 1987/3 1988/4 1989/4 1989/22 1989/24 1990/6 1991/8 1991/9 1993/2 1994/14 1995/7 1996/7 1997/6 1998/22 2001/15 2006/10 2006/24 2009/9 2009/12 2010/7 2014/7 2015/5 2015/12 2015/25 2016/8 2020/9 2020/15 2037/17 2038/1 2038/3 2038/5 2038/6 2038/7 2040/19 2047/7 2053/12 2055/20 2062/20 2064/24 2070/23 2071/1</p> <p>hereby [1] 2071/17</p> <p>Herman [3] 1949/18 1949/18 1949/19</p> <p>heterogeneity [1] 1996/14</p> <p>hey [1] 1998/24</p> <p>high [9] 1982/10 1985/10 1995/16 2011/5 2011/13 2041/1 2060/19 2060/24 2061/4</p> <p>high-permeability [1] 1982/10</p> <p>higher [5] 1975/17 1995/11 1995/25 1996/20 2017/15</p> <p>highlights [2] 2012/23 2015/3</p> <p>Hill [4] 1957/22 1957/23 1958/3 1958/11</p> <p>him [5] 1960/7 1960/13 2001/6 2069/15 2069/21</p> <p>HIMMELHOCH [3] 1951/15 1957/19 2069/6</p> <p>himself [2] 2007/12 2016/9</p> <p>hired [1] 1974/6</p> <p>his [18] 1960/14 2007/12 2013/8 2013/17 2013/18 2013/23 2014/4 2014/7 2015/9 2015/10 2015/18 2015/18 2016/9 2016/15 2016/18 2016/21 2017/6 2069/15</p> <p>history [29] 1988/13 1988/18 1991/1 1991/10 1991/11 1994/5 1994/13 1995/1 1996/22 1999/3 2004/2 2005/22 2008/24 2011/21 2040/18 2040/24 2040/24 2052/12 2053/2 2053/4 2053/8 2053/20 2053/21 2053/25 2054/6 2054/25 2057/17 2057/20 2064/14</p> <p>history-matching [7] 1994/13 1996/22 1999/3 2004/2 2011/21 2053/20 2054/25</p> <p>hit [1] 1976/14</p> <p>hold [1] 2012/15</p> <p>Holdings [3] 1952/13 1952/16 1952/19</p> <p>hole [16] 1975/1 1975/10 1975/16 1977/25 1990/15 2007/6 2007/10 2007/14 2007/21 2007/24 2008/9 2010/4 2033/10 2033/12 2065/13 2066/2</p> <p>holes [1] 2032/23</p> <p>Honor [25] 1955/7 1956/7 1956/23 1957/7 1957/18 1957/19 1958/1 1958/6 1958/14 1958/15 1959/24 1960/5 1960/11 2018/7 2018/9 2051/15 2066/5 2066/7 2066/10 2066/15 2066/18 2066/21 2067/16 2070/18 2070/22</p> <p>HONORABLE [1] 1949/15</p> <p>honors [1] 1962/13</p> <p>Hope [1] 1952/3</p> <p>HORIZON [5] 1949/4 2031/14 2031/18 2031/23 2044/19</p> <p>Horizon's [7] 2023/21 2027/7 2032/2 2032/8 2032/12 2033/14 2035/8</p> <p>horizontal [3] 1975/2 1978/1 2010/5</p> <p>hour [1] 2058/16</p> <p>hours [8] 1992/14 2057/16 2057/16 2057/19 2063/6 2063/8 2064/19 2065/1</p> <p>Houston [2] 1952/17 1953/9</p>	<p>how [28] 1957/25 1963/11 1963/20 1964/4 1967/25 1968/17 1970/5 1973/20 1974/18 1976/7 1976/7 1976/21 1976/24 1985/15 1998/13 1998/16 2000/13 2010/5 2012/11 2019/8 2019/8 2029/6 2034/15 2034/18 2034/20 2044/21 2044/22 2071/3</p> <p>however [7] 1966/22 1983/20 2004/23 2015/15 2019/11 2028/3 2047/13</p> <p>Hsieh [2] 1955/11 1955/15</p> <p>huge [1] 2036/17</p> <p>hundreds [1] 1982/11</p> <p>hydrocarbons [5] 1962/9 2021/19 2022/14 2022/18 2032/15</p> <p>hydrostatic [4] 2007/8 2059/13 2059/19 2060/7</p> <p>hyphen [1] 1959/1</p> <p>hyphenated [1] 1958/25</p> <p>hypothetical [3] 2025/3 2027/3 2037/12</p> <p>I</p> <p>I'd [13] 1964/8 1965/8 1994/11 1996/7 2000/2 2001/4 2003/12 2003/16 2004/10 2005/6 2006/23 2009/21 2014/21</p> <p>I'll [3] 1960/13 2051/19 2068/22</p> <p>I'm [58] 1956/10 1956/13 1957/13 1961/10 1961/14 1966/18 1971/24 1975/9 1979/4 1979/6 1980/3 1980/11 1989/25 1990/6 1990/8 1990/8 1992/16 1992/18 1994/16 1994/17 1994/18 1995/7 1995/8 2010/8 2010/9 2012/14 2013/19 2015/24 2020/10 2022/16 2027/18 2028/1 2028/2 2029/20 2029/22 2031/15 2033/23 2034/8 2036/18 2036/19 2038/2 2038/4 2038/6 2042/15 2050/13 2051/2 2053/22 2054/14 2054/21 2057/22 2058/17 2059/18 2059/20 2065/11 2067/1 2067/16 2068/6 2068/12</p> <p>I've [2] 1990/1 2015/19</p> <p>I-M-E-X [1] 1987/19</p> <p>ID [2] 1990/2 1990/4</p> <p>idea [1] 2046/1</p> <p>identified [5] 1977/2 1979/17 2014/6 2037/22 2041/7</p> <p>identify [2] 1956/12 2008/3</p> <p>ifs [5] 2029/14 2029/15 2034/14 2038/15 2048/16</p> <p>ignored [3] 2000/11 2035/22 2035/23</p> <p>IHS [2] 1961/10 1961/13</p> <p>Ill [1] 2015/23</p> <p>Illinois [1] 1951/24</p> <p>image [1] 2060/10</p> <p>images [2] 2032/25 2036/10</p> <p>IMEX [1] 1987/19</p> <p>immediately [2] 1969/4 1971/21</p> <p>impact [38] 1963/19 1963/21 1973/18 1973/21 1974/19 1977/2 1977/8 1977/9 1977/14 1978/10 1978/12 1978/15 1978/17 1978/21 1979/14 1979/18 1979/19 1985/17 1999/5 2000/9 2002/11 2002/12 2033/8 2034/18 2035/17 2036/4 2036/16 2044/21 2044/23 2048/7 2048/7 2048/14 2050/8 2050/15 2050/21 2051/6 2052/22 2052/24</p> <p>impacted [1] 2034/24</p> <p>implication [1] 2010/24</p> <p>importance [2] 1974/12 1976/22</p> <p>important [6] 1963/15 1964/5 1973/21 1974/14 1978/6 2017/22</p> <p>importantly [1] 1963/16</p>	<p>impose [1] 2046/16</p> <p>imposed [3] 2003/1 2010/16 2035/21</p> <p>imposing [2] 2010/9 2010/21</p> <p>INC [14] 1949/11 1951/18 1951/21 1952/3 1952/6 1952/10 1952/14 1952/14 1952/17 1952/17 1952/20 1952/20 1953/3 1953/8</p> <p>inch [1] 1994/21</p> <p>inches [3] 1990/2 1990/5 1990/8</p> <p>incident [1] 2046/22</p> <p>include [5] 1972/2 1973/23 2002/10 2009/19 2031/7</p> <p>included [2] 1978/22 2001/8</p> <p>includes [2] 2031/12 2068/5</p> <p>including [1] 2024/9</p> <p>incomplete [1] 1967/8</p> <p>inconsistencies [1] 2014/4</p> <p>inconsistent [6] 1956/18 2017/17 2034/23 2043/13 2043/21 2044/3</p> <p>incorporate [7] 1972/1 2000/15 2004/11 2006/10 2008/20 2028/5 2030/19</p> <p>incorporated [10] 1983/21 1984/13 1995/3 2004/1 2004/14 2007/8 2024/23 2026/23 2027/15 2034/5</p> <p>incorporating [1] 2011/18</p> <p>incorrectly [1] 2047/20</p> <p>increase [2] 2010/21 2025/6</p> <p>increased [1] 1990/3</p> <p>increases [1] 2054/15</p> <p>incremental [2] 2010/12 2010/13</p> <p>independent [4] 1971/6 1975/22 1980/24 1985/22</p> <p>independently [3] 1972/5 1972/9 1975/6</p> <p>independents [1] 1961/21</p> <p>Index [1] 2024/12</p> <p>indicate [1] 2047/14</p> <p>indicated [2] 2018/14 2045/12</p> <p>indication [1] 2065/6</p> <p>individual [3] 1972/8 1987/10 2009/7</p> <p>industry [1] 1987/20</p> <p>industry-standard [1] 1987/20</p> <p>inflow [2] 1974/15 1975/4</p> <p>information [9] 1968/10 1968/25 1981/6 1982/7 2005/20 2028/10 2038/7 2064/10 2064/10</p> <p>informed [1] 1967/21</p> <p>initial [5] 1975/12 1994/20 2017/2 2019/14 2021/22</p> <p>initially [4] 1971/19 1973/22 1974/1 1974/8</p> <p>input [30] 1963/4 1967/19 1968/2 1968/3 1972/4 1976/8 1976/22 1976/23 1977/1 1978/20 1989/25 1990/19 1991/2 1997/8 1997/20 1998/8 1998/17 1998/24 2000/1 2003/18 2003/25 2009/3 2009/7 2011/18 2011/22 2012/4 2014/18 2017/14 2052/10 2052/21</p> <p>inputs [3] 1972/6 1981/20 2053/1</p> <p>insertion [1] 2063/14</p> <p>installed [2] 2053/17 2064/11</p> <p>instances [1] 2049/7</p> <p>integrated [3] 1961/15 1983/22 2005/14</p> <p>integrity [8] 2021/24 2038/23 2053/13 2053/14 2053/15 2053/25 2054/8 2056/23</p> <p>intend [4] 1959/6 1959/9 1959/21 1965/13</p> <p>intends [1] 1975/4</p> <p>interest [1] 2040/20</p> <p>interested [1] 1963/25</p> <p>Interests [1] 1950/19</p> <p>intermediary [1] 2022/6</p> <p>internal [2] 1990/3 1990/4</p>
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<p>international [1] 1961/21 interpretation [1] 2003/25 interpretations [2] 1981/25 2003/20 intersect [1] 1977/7 introduce [1] 1955/13 investigated [1] 1989/22 investigation [1] 1985/20 investments [1] 1964/3 invited [1] 1962/15 involved [1] 2008/2 involves [1] 2053/8 IPR [15] 1974/16 1974/18 1975/15 1976/11 1976/17 1977/4 1977/11 1978/2 1978/4 1978/8 1978/10 1978/13 1978/15 1978/17 1978/20 Iran [1] 1960/23 Irpino [3] 1950/6 1950/7 2070/25 irregularities [1] 2011/11 is [353] issue [7] 1956/10 1956/15 2000/12 2002/21 2066/13 2070/15 2070/18 issues [1] 2008/3 it [227] it's [51] 1956/8 1961/6 1963/6 1967/17 1968/4 1968/4 1974/25 1982/23 1983/16 1983/17 1984/1 1985/10 1987/19 1990/21 1991/23 1993/21 1993/25 1995/16 1996/17 2000/23 2002/1 2002/20 2002/21 2005/19 2007/21 2007/23 2011/21 2013/19 2013/20 2015/21 2019/11 2020/13 2026/4 2026/12 2027/10 2032/10 2034/4 2036/17 2036/17 2040/12 2050/11 2051/16 2053/6 2055/16 2060/10 2061/17 2061/20 2063/1 2063/7 2066/21 2070/6 its [14] 1958/8 1958/17 1958/17 1986/18 2009/5 2010/24 2022/4 2026/18 2034/18 2036/16 2044/21 2048/14 2050/15 2051/6 itself [3] 1997/9 1997/16 2022/10</p>	<p>2046/13 2047/21 2053/17 July 13th is [1] 2042/4 July 13th was [2] 2039/23 2041/20 July 14th [1] 2019/2 July 14th and [2] 1969/1 2057/4 July 15 [4] 2019/1 2064/6 2064/22 2065/5 July 15th [13] 1992/13 2020/5 2021/17 2039/18 2044/8 2053/23 2054/9 2054/11 2056/20 2057/1 2058/16 2063/25 2064/16 July 15th and [1] 2053/20 July 15th does [1] 2065/25 July 15th for [1] 2057/17 July 15th needs [1] 2061/5 July 15th of [1] 2064/4 July 15th prove [2] 2064/20 2065/2 July 15th rule [1] 2065/12 July 15th through [1] 2054/18 July 15th was [3] 1969/21 2060/19 2060/24 July 19th [1] 1992/15 July 2010 [2] 2040/18 2041/2 June [3] 2032/13 2033/15 2063/22 June 3rd [2] 2032/13 2033/15 June of [1] 2063/22 just [67] 1956/8 1961/1 1961/16 1961/16 1964/19 1965/18 1971/19 1972/7 1975/8 1980/20 1981/2 1981/8 1982/10 1982/20 1982/21 1984/22 1985/16 1986/9 1987/1 1989/10 1989/16 1993/14 1996/13 1997/3 1997/20 1998/4 1999/15 1999/23 2001/7 2002/14 2004/17 2010/14 2014/6 2017/4 2022/25 2023/4 2024/4 2024/6 2027/18 2028/4 2036/20 2038/10 2038/16 2043/1 2043/2 2044/14 2045/25 2050/8 2051/10 2053/14 2053/15 2055/23 2056/12 2056/13 2059/23 2062/25 2063/7 2064/22 2065/21 2066/3 2067/4 2067/6 2067/17 2067/21 2068/10 2069/24 2070/6 Justice [2] 1951/6 1951/9</p>	<p>2043/18 2053/9 2059/12 2067/4 2069/19 2069/22 2071/3 knowing [3] 1996/14 2021/14 2028/23 knowledge [1] 2013/10 known [3] 1988/17 2014/2 2035/12 KRAUS [1] 1951/3 Kuchler [2] 1953/11 1953/12 KY [1] 1953/15</p>
<p>J Jackson [1] 1950/17 JAMES [2] 1949/22 1950/22 Jefferson [1] 1949/23 JENNY [1] 1953/3 job [1] 1963/12 Jodi [5] 1953/18 1953/20 2071/15 2071/22 2071/23 Johnson [2] 2011/2 2011/6 Johnson's [2] 2009/21 2009/25 JOSEPH [1] 1952/6 journal [1] 1962/22 JR [1] 1953/4 judge [2] 1949/15 2061/25 judgment [2] 2048/19 2061/4 JUDY [1] 1951/14 July [47] 1969/1 1969/21 1992/13 1992/15 2019/1 2019/2 2020/5 2021/17 2039/1 2039/6 2039/18 2039/23 2040/18 2041/2 2041/20 2042/4 2042/8 2042/14 2044/8 2046/7 2046/13 2047/14 2047/21 2053/17 2053/20 2053/23 2054/9 2054/11 2054/18 2056/20 2057/1 2057/4 2057/17 2058/16 2060/19 2060/24 2061/5 2063/25 2064/4 2064/6 2064/16 2064/20 2064/22 2065/2 2065/5 2065/12 2065/25 July 13th [6] 2042/8 2042/14 2046/7</p>	<p>K K-BOP [6] 2024/18 2026/2 2026/4 2026/11 2026/12 2026/14 K-RES [6] 2024/9 2024/12 2024/21 2024/24 2025/1 2025/8 K-well [4] 2024/14 2025/14 2025/18 2025/22 Kanner [2] 1951/2 1951/3 KARIS [2] 1951/21 2066/25 Karis' [1] 2067/14 Katz [2] 1949/18 1952/21 keep [1] 1996/17 Kelkar [6] 1968/8 1974/16 1984/8 2068/6 2068/7 2068/23 KERRY [1] 1952/13 key [7] 1966/8 1967/4 1979/8 1987/5 1997/6 2014/16 2030/24 kill [1] 2064/3 kind [3] 1976/12 2001/12 2065/3 King [1] 1958/6 kink [3] 2002/3 2032/23 2033/10 KIRBY [1] 1953/15 Kirkland [3] 1951/20 1952/2 1952/5 knew [4] 1973/4 1993/16 1996/13 2036/9 know [19] 1956/11 1956/15 1964/1 1964/4 1964/5 1972/18 1985/15 1989/8 2015/13 2033/10 2041/7 2042/16</p>	<p>L laboratories [1] 1974/6 laboratory [1] 1984/9 lack [2] 2028/10 2065/2 laed.uscourts.gov [1] 1953/20 Lafayette [1] 1949/24 Lake [1] 1950/14 Lamar [1] 1953/9 LANGAN [3] 1951/21 1957/7 2070/21 large [31] 1963/18 1967/10 1967/19 1968/4 1977/6 1977/7 1977/9 1978/14 1978/17 1979/18 1979/19 1985/2 1997/15 1999/6 2005/19 2005/23 2007/11 2008/1 2008/6 2013/9 2013/12 2027/19 2035/15 2035/17 2035/19 2036/4 2036/4 2036/6 2044/22 2048/18 2052/24 larger [12] 1961/21 1975/11 1977/9 1977/18 1985/16 1999/11 2006/7 2008/17 2010/9 2010/9 2034/25 2042/17 largest [3] 1994/23 2031/3 2031/10 Lasalle [1] 1951/23 last [6] 1957/25 1958/25 1971/7 1972/25 1972/25 2033/12 late [1] 2033/11 later [7] 1957/11 1960/22 2011/14 2014/11 2026/4 2053/20 2056/4 latter [1] 2011/10 Law [1] 1950/6 lawyer [1] 1957/8 layered [1] 1980/9 leading [3] 2013/12 2040/4 2062/13 leads [1] 1977/4 leaps [1] 2061/2 learn [1] 2038/21 learned [1] 2049/25 LEASING [1] 1949/8 least [10] 1971/9 1983/23 2024/6 2026/2 2027/8 2033/15 2037/21 2056/15 2057/17 2063/2 leave [1] 1980/20 leaves [1] 2014/19 leaving [4] 2022/15 2025/1 2032/16 2050/18 Lecturer [1] 1962/14 led [1] 1978/7 left [1] 1967/8 legend [1] 1990/1 length [4] 2004/10 2032/18 2032/19 2032/21 less [12] 1967/23 1970/3 1984/24 1985/12 2005/1 2032/18 2046/17 2052/25 2061/23 2061/24 2062/9 2062/13 less-than-a-good [1] 2061/24 lesser [1] 1984/23 let [10] 2025/14 2036/25 2038/10 2047/19 2050/16 2051/10 2065/21 2067/5 2069/19 2069/22 let's [42] 1966/5 1968/17 1968/17 1969/15 1971/2 1971/11 1973/10 1974/21 1976/9 1977/20 1979/22 1981/5 1981/11 1984/2 1985/6 1985/25</p>

<p>L</p> <p>let's... [26] 1986/22 1987/22 1991/4 1992/6 1994/9 2001/14 2004/7 2006/9 2009/14 2009/23 2011/15 2012/23 2017/25 2021/4 2028/13 2028/18 2035/7 2037/14 2037/25 2038/16 2038/18 2041/10 2054/5 2055/14 2056/22 2062/16</p> <p>level [4] 2033/7 2048/6 2048/7 2050/9</p> <p>Levin [1] 1950/2</p> <p>Lewis [3] 1951/17 1953/2 1953/7</p> <p>LI [1] 1952/20</p> <p>like [26] 1958/9 1958/16 1960/7 1964/8 1965/8 1972/1 1978/22 1985/3 1989/7 1989/16 1990/25 1994/11 1996/7 1997/10 2000/2 2001/4 2003/12 2003/16 2004/10 2005/6 2006/23 2009/22 2010/20 2014/21 2016/4 2067/5</p> <p>likely [14] 1968/3 2002/6 2002/14 2012/16 2016/22 2029/16 2029/17 2030/22 2033/3 2033/8 2033/14 2034/3 2034/4 2048/5</p> <p>likewise [1] 2062/15</p> <p>line [36] 1975/3 1990/17 1990/18 1991/11 1991/17 1992/17 2001/7 2009/21 2010/15 2017/4 2028/4 2028/11 2039/25 2040/21 2040/22 2040/23 2041/8 2043/4 2043/7 2043/20 2043/20 2044/3 2044/16 2046/6 2046/9 2046/9 2046/11 2046/22 2047/5 2047/10 2047/11 2048/9 2060/3 2063/25 2064/1 2064/3</p> <p>linear [3] 2021/22 2022/7 2022/11</p> <p>linearly [1] 2001/22</p> <p>lines [4] 2001/9 2021/4 2040/19 2042/16</p> <p>Liskow [1] 1951/17</p> <p>list [5] 1955/9 1955/20 1956/25 1974/13 1980/1</p> <p>listed [2] 1962/19 2015/6</p> <p>lists [1] 1955/11</p> <p>litany [1] 2067/17</p> <p>little [12] 1961/1 1970/25 1981/5 1982/20 1994/11 2000/6 2009/22 2038/7 2048/3 2050/21 2051/24 2059/1</p> <p>LLC [8] 1949/18 1949/22 1951/2 1952/13 1952/13 1952/16 1952/19 1953/11</p> <p>LLP [8] 1950/12 1951/20 1952/2 1952/5 1952/9 1952/16 1952/19 1953/14</p> <p>logging [1] 2005/11</p> <p>long [7] 1957/25 1985/14 2031/21 2033/8 2033/18 2040/23 2040/24</p> <p>look [31] 1968/19 1969/16 1969/19 1974/4 1976/23 1977/3 1977/20 1981/1 1981/6 1981/11 1981/15 1984/4 1984/22 1987/2 1991/4 1994/22 1996/7 1999/12 2001/2 2002/5 2012/23 2021/4 2024/4 2027/10 2041/10 2042/19 2045/25 2055/14 2055/14 2058/7 2058/25</p> <p>looked [15] 1967/2 1974/3 1977/14 1977/18 1979/15 1980/8 1981/7 1981/9 1981/16 1985/22 2004/5 2011/6 2025/13 2045/1 2050/5</p> <p>looking [4] 1982/16 2043/1 2050/16 2053/19</p> <p>looks [1] 1975/21</p> <p>lookup [3] 2008/12 2008/14 2008/16</p> <p>loop [1] 2014/18</p> <p>Los [2] 1952/4 1952/22</p> <p>lot [4] 1966/12 1971/3 1972/4 1981/22</p>	<p>LOUISIANA [15] 1949/2 1949/6 1949/20 1949/24 1950/8 1950/14 1950/22 1950/24 1951/3 1951/4 1951/19 1952/14 1953/13 1953/19 2071/17</p> <p>low [6] 1985/10 1991/23 1995/16 2011/10 2016/16 2055/24</p> <p>lower [11] 1975/11 1975/16 1977/8 1995/11 1995/24 2002/13 2006/16 2017/15 2045/16 2060/10 2060/10</p> <p>lowest [1] 2006/5</p> <p>LP [2] 1953/12 1953/15</p> <p>LUIS [1] 1952/20</p> <p>Lundy [3] 1950/12 1950/12 1950/13</p> <p>Luxenberg [1] 1950/9</p>	<p>matching [31] 1972/24 1972/25 1988/13 1988/18 1991/1 1994/5 1994/13 1996/22 1999/3 2004/2 2005/22 2008/24 2011/21 2017/22 2040/24 2040/25 2052/12 2053/2 2053/4 2053/8 2053/20 2053/22 2053/25 2054/6 2054/25 2057/17 2057/20 2059/11 2062/4 2062/5 2064/14</p> <p>material [9] 1965/23 1967/17 1997/10 1997/19 1998/5 1998/14 1999/23 1999/25 2013/10</p> <p>matter [3] 1956/24 2050/7 2071/20</p> <p>matters [3] 1955/6 2033/17 2050/8</p> <p>MATTHEW [2] 1950/13 1951/22</p> <p>mature [1] 1962/3</p> <p>may [57] 1959/3 1962/2 1962/2 1962/3 1963/18 1964/1 1974/18 1975/8 1982/7 1989/8 1993/17 2001/24 2002/7 2016/18 2017/15 2018/7 2020/23 2021/9 2021/25 2022/1 2024/4 2024/22 2027/1 2027/6 2027/25 2028/7 2030/3 2033/11 2037/24 2040/8 2044/18 2046/7 2046/13 2046/22 2047/1 2047/6 2047/9 2047/11 2047/14 2047/19 2047/21 2048/1 2048/9 2048/11 2048/11 2050/5 2050/12 2050/17 2051/5 2051/12 2060/22 2063/16 2064/21 2065/4 2065/9 2065/14 2066/2</p> <p>May 19th [1] 2033/11</p> <p>May 2010 [4] 2064/21 2065/9 2065/14 2066/2</p> <p>May 8th [13] 2001/24 2016/18 2027/25 2028/7 2040/8 2046/13 2047/6 2047/9 2047/11 2047/14 2047/19 2050/5 2050/17</p> <p>May 8th and [1] 2047/21</p> <p>May 8th at [1] 2002/7</p> <p>May 8th to [3] 2046/7 2046/22 2048/9</p> <p>maybe [8] 1967/8 1971/9 2005/2 2006/7 2008/13 2011/8 2047/18 2047/19</p> <p>MAZE [1] 1950/19</p> <p>McCutchen [1] 1953/14</p> <p>MD [1] 1949/4</p> <p>MDL [1] 2066/22</p> <p>MDT [6] 1981/1 1981/15 1982/3 1982/4 1982/16 1982/16</p> <p>me [46] 1956/24 1963/15 1966/3 1968/15 1969/13 1977/18 1982/9 1982/11 1985/2 1989/4 1990/25 1991/23 1995/23 1995/24 1996/19 1996/21 1997/4 1997/21 1999/16 2000/17 2002/21 2003/2 2003/24 2004/15 2009/1 2025/14 2029/20 2030/16 2033/18 2035/6 2036/25 2037/17 2037/23 2038/10 2039/25 2047/19 2048/5 2050/7 2050/8 2050/11 2050/16 2051/10 2065/21 2066/17 2067/11 2069/19</p> <p>mean [6] 1977/8 1990/3 2014/3 2020/9 2020/10 2050/2</p> <p>means [2] 2023/4 2025/10</p> <p>measure [4] 1979/12 1982/5 1982/24 1984/6</p> <p>measured [32] 1969/23 1969/25 1970/11 1972/5 1972/9 1985/22 1990/14 1990/22 1991/13 1996/20 2004/4 2007/4 2043/1 2043/2 2053/9 2053/23 2054/14 2054/15 2055/7 2057/5 2058/4 2058/8 2059/25 2060/1 2064/7 2064/12 2064/14 2064/19 2065/1 2065/12 2065/24 2065/25</p> <p>measurement [3] 1963/9 1989/8 2028/3</p> <p>measurements [18] 1962/6 1963/7</p>
	<p>M</p> <p>M-E-H-R-A-N [1] 1958/25</p> <p>Macondo [11] 2017/10 2018/20 2020/24 2021/10 2021/14 2022/8 2027/1 2030/23 2032/16 2050/1 2063/10</p> <p>made [7] 1955/25 1956/4 1956/5 1994/20 2002/24 2028/6 2052/13</p> <p>Magazine [1] 1950/7</p> <p>maintain [1] 1956/3</p> <p>maintains [1] 1957/6</p> <p>majority [1] 2027/23</p> <p>make [19] 1964/11 1976/4 1982/12 2000/17 2010/14 2015/9 2022/6 2042/15 2044/11 2044/13 2047/16 2048/2 2048/18 2058/9 2059/1 2059/5 2061/4 2070/3 2071/4</p> <p>makes [3] 1978/10 1987/14 2015/14</p> <p>making [1] 2022/5</p> <p>many [11] 1970/3 1979/5 1983/3 1983/7 2005/23 2005/23 2006/14 2020/14 2028/9 2029/6 2055/11</p> <p>marshaled [1] 2067/25</p> <p>MARTIN [2] 1952/3 2045/20</p> <p>MARTINEZ [1] 1953/3</p> <p>Mason [1] 1958/10</p> <p>Master's [1] 1960/22</p> <p>match [103] 1970/18 1970/21 1970/22 1988/9 1988/11 1988/23 1991/10 1991/11 1991/13 1991/15 1991/20 1992/18 1993/2 1993/7 1993/22 1993/24 1993/25 1994/5 1994/6 1994/7 1995/2 1995/4 1995/6 1995/9 1995/10 1995/12 1995/13 1995/25 1996/3 1996/25 1997/1 1997/2 1999/3 1999/8 1999/14 1999/15 1999/18 2004/6 2004/15 2004/18 2004/21 2006/4 2006/18 2006/20 2006/21 2007/15 2009/1 2009/4 2009/8 2009/16 2011/22 2011/25 2012/3 2012/7 2014/18 2017/14 2017/19 2039/17 2039/19 2043/22 2044/7 2049/13 2049/15 2051/22 2053/12 2055/3 2055/7 2055/11 2055/17 2055/21 2055/25 2056/3 2056/8 2056/23 2057/22 2057/23 2057/24 2058/9 2058/14 2058/20 2059/2 2059/3 2059/3 2059/4 2060/14 2060/15 2060/20 2060/25 2061/12 2061/24 2062/10 2062/14 2062/17 2062/21 2064/7 2064/12 2064/19 2064/22 2064/25 2065/5 2065/15 2065/24 2066/3</p> <p>match-up [1] 2039/19</p> <p>matched [11] 1969/11 1970/19 1988/11 1991/24 1991/24 1993/1 2005/4 2005/25 2011/24 2049/11 2061/10</p> <p>matches [10] 1986/15 1989/24 1991/3 1993/15 2005/1 2005/2 2006/3 2009/13 2062/7 2065/11</p>	

<p>M</p> <p>measurements... [16] 1970/4 1973/2 1974/6 1981/7 1988/19 1990/24 1991/18 1992/17 1992/19 1993/1 1993/20 2008/17 2028/8 2053/13 2053/24 2054/5</p> <p>measuring [2] 1983/9 1985/12</p> <p>mechanical [1] 1953/24</p> <p>mediocre [16] 1988/23 1993/24 1993/25 1995/12 1996/5 1996/5 2012/7 2012/8 2039/17 2039/19 2058/10 2058/20 2058/24 2059/3 2059/3 2060/14</p> <p>meet [2] 1976/10 2070/17</p> <p>meeting [1] 1957/9</p> <p>Mehran [3] 1958/17 1958/20 1958/24</p> <p>member [1] 1962/15</p> <p>memorandum [2] 1981/17 1981/19</p> <p>mentioned [14] 1970/15 1970/16 1973/16 1980/23 1988/2 1988/16 1997/10 1999/23 2005/8 2008/5 2008/8 2013/5 2014/6 2034/4</p> <p>mentioning [1] 1967/4</p> <p>mentions [1] 2008/12</p> <p>mere [1] 2027/18</p> <p>Merrill [3] 2069/14 2069/14 2069/20</p> <p>method [31] 1967/16 1967/17 1967/17 1971/2 1971/15 1987/25 1997/10 1997/19 2016/2 2016/9 2018/15 2018/15 2018/17 2018/18 2019/16 2019/24 2020/1 2022/17 2024/6 2025/7 2025/21 2026/10 2026/17 2026/25 2027/5 2028/6 2028/13 2030/13 2030/14 2030/16 2053/4</p> <p>methodology [13] 1966/3 1980/11 1985/4 1997/7 1998/20 1999/1 2000/16 2003/23 2013/7 2015/10 2016/12 2030/18 2034/23</p> <p>methods [6] 1965/20 1965/24 1967/13 1984/19 2016/6 2018/15</p> <p>metric [1] 2055/6</p> <p>MEXICO [2] 1949/5 2032/17</p> <p>mic's [1] 2067/21</p> <p>MICHAEL [1] 1952/19</p> <p>microphone [2] 1961/4 2068/15</p> <p>microsips [7] 1996/8 1996/9 1996/9 1996/12 1996/16 2052/18 2052/20</p> <p>middle [2] 1978/18 1995/24</p> <p>midpoint [1] 1996/2</p> <p>might [29] 1963/16 1963/21 1967/14 1967/23 1973/17 1974/1 1974/9 1974/9 1974/19 1975/5 1976/24 1977/2 1979/5 1980/24 1984/24 1985/17 1989/9 2002/25 2015/16 2028/7 2028/12 2030/18 2030/18 2033/18 2034/18 2038/23 2041/23 2048/17 2065/19</p> <p>MIKE [2] 1952/10 1958/10</p> <p>miles [1] 1985/14</p> <p>MILLER [1] 1952/13</p> <p>millidarcy [4] 1982/11 2004/14 2004/22 2004/22</p> <p>million [22] 1967/1 1972/14 1999/16 1999/20 2006/6 2006/9 2012/18 2017/10 2018/19 2039/14 2044/5 2045/13 2045/16 2049/19 2049/20 2055/24 2056/2 2056/8 2056/8 2056/15 2060/8 2060/12</p> <p>mind [2] 1967/13 1972/19</p> <p>mine [2] 2006/14 2006/16</p> <p>minus [4] 1970/1 2058/15 2058/21 2058/21</p> <p>minute [1] 2017/25</p> <p>minutes [1] 1958/1</p>	<p>mismatch [2] 1993/3 2058/23</p> <p>misrepresented [1] 1989/14</p> <p>missing [1] 2030/3</p> <p>Mississippi [1] 1950/17</p> <p>mistaken [1] 2067/1</p> <p>Mitchell [1] 1950/2</p> <p>mix [1] 1956/15</p> <p>model [81] 1968/14 1968/17 1969/11 1970/6 1970/18 1970/19 1970/20 1970/25 1972/10 1972/12 1983/22 1986/15 1986/15 1986/17 1988/11 1988/15 1988/20 1988/21 1989/10 1990/9 1990/18 1990/25 1991/3 1991/9 1991/10 1991/13 1991/17 1991/20 1991/23 1992/3 1992/16 1992/17 1992/18 1993/1 1993/4 1993/20 1995/2 1996/10 1996/19 1997/1 1999/21 2000/15 2000/18 2000/19 2001/11 2002/20 2003/2 2004/12 2004/14 2006/11 2008/19 2008/21 2009/3 2009/12 2009/21 2010/1 2011/4 2011/11 2011/12 2011/17 2011/24 2012/3 2019/9 2020/22 2021/8 2022/10 2022/13 2026/5 2026/16 2027/16 2034/15 2034/20 2040/17 2044/20 2052/4 2052/7 2052/19 2055/2 2057/2 2063/2 2063/3</p> <p>modeled [3] 2023/12 2026/7 2060/3</p> <p>modeling [3] 1987/19 2053/5 2053/6</p> <p>models [41] 1968/3 1968/6 1969/8 1970/21 1971/22 1971/23 1971/23 1972/6 1980/12 1986/17 1988/18 1993/14 1995/8 1995/10 1995/19 1995/20 1995/20 1995/24 1999/15 2004/3 2005/3 2007/15 2009/2 2011/2 2011/3 2017/13 2017/22 2019/10 2019/13 2020/18 2020/19 2026/5 2048/2 2052/1 2055/11 2056/7 2056/14 2057/14 2057/23 2057/24 2057/25</p> <p>models' [1] 2019/11</p> <p>molecular [2] 2033/7 2048/6</p> <p>moment [2] 1961/17 1971/1</p> <p>Monday [1] 1957/2</p> <p>Montgomery [1] 1950/20</p> <p>more [32] 1962/23 1962/23 1962/25 1971/1 1972/7 1981/5 1983/24 1984/17 1984/21 1984/22 1984/23 1987/8 1990/20 1990/22 1990/23 1993/5 1993/16 1993/20 1993/21 1996/17 1996/17 1996/18 2009/22 2010/21 2010/22 2030/3 2037/25 2038/1 2038/3 2046/16 2057/22 2062/21</p> <p>Morgan [2] 1950/15 1950/15</p> <p>morning [5] 2066/14 2066/16 2071/1 2071/5 2071/10</p> <p>most [8] 1962/14 1978/5 2002/6 2012/16 2016/22 2030/22 2043/9 2046/15</p> <p>motion [1] 2070/13</p> <p>motions [2] 1960/6 1960/9</p> <p>move [19] 1958/9 1973/10 1980/21 1985/25 1986/12 1987/16 1988/25 1998/10 2000/2 2003/12 2005/6 2006/23 2014/21 2016/1 2019/10 2069/13 2069/15 2070/3 2070/14</p> <p>moved [2] 1998/9 2022/15</p> <p>Mr. [8] 2066/19 2067/11 2067/22 2068/3 2069/14 2069/20 2070/21 2070/25</p> <p>Mr. Brock [2] 2067/11 2068/3</p> <p>Mr. Irpino [1] 2070/25</p> <p>Mr. Langan [1] 2070/21</p> <p>Mr. Merrill [2] 2069/14 2069/20</p> <p>Mr. O'Rourke [2] 2066/19 2067/22</p>	<p>Ms. [3] 2066/25 2067/14 2069/6</p> <p>Ms. Himmelhoch [1] 2069/6</p> <p>Ms. Karis [1] 2066/25</p> <p>Ms. Karis' [1] 2067/14</p> <p>much [11] 1961/20 1963/21 1970/3 1976/24 1979/14 2010/6 2012/11 2032/20 2056/5 2058/23 2065/6</p> <p>multiphase [3] 2026/4 2026/22 2026/23</p> <p>multiple [1] 2063/10</p> <p>mumbled [1] 2068/13</p> <p>Munger [1] 1952/19</p> <p>must [3] 1957/9 2030/21 2054/21</p> <p>my [136]</p> <p>N</p> <p>N.W [3] 1952/7 1952/10 1953/16</p> <p>name [5] 1958/22 1958/24 1958/25 1983/17 2061/9</p> <p>names [2] 2059/12 2068/13</p> <p>narrow [7] 1966/3 1966/4 1966/20 1968/15 2005/4 2013/21 2013/21</p> <p>Nat [1] 1958/15</p> <p>NATHANIEL [1] 1951/12</p> <p>Natural [1] 1951/10</p> <p>necessarily [1] 2007/19</p> <p>necessary [1] 2021/25</p> <p>need [10] 1956/12 1963/11 1966/14 1973/4 1973/16 1984/12 2030/2 2030/2 2030/4 2038/25</p> <p>needed [12] 1968/5 1974/14 1986/6 1988/1 1992/3 2012/4 2012/5 2012/6 2034/24 2035/19 2040/9 2052/12</p> <p>needs [8] 2007/5 2008/10 2015/9 2036/7 2036/16 2061/5 2065/7 2065/18</p> <p>negligible [1] 2027/19</p> <p>net [1] 1978/14</p> <p>never [1] 2044/20</p> <p>nevertheless [1] 1979/20</p> <p>New [10] 1949/6 1949/20 1950/8 1950/11 1950/11 1951/4 1951/19 1952/14 1953/13 1953/19</p> <p>next [5] 1973/8 1992/1 1994/22 2014/8 2058/18</p> <p>no [31] 1955/12 1960/5 1960/9 1966/12 1970/13 1972/18 1981/2 2002/9 2007/19 2008/7 2012/12 2016/24 2017/5 2017/24 2019/5 2021/25 2026/18 2028/3 2028/8 2033/8 2042/25 2048/2 2048/18 2061/19 2062/20 2064/10 2064/20 2064/22 2066/5 2066/7 2067/2</p> <p>no-collection [1] 1970/13</p> <p>non [3] 2028/18 2028/18 2030/11</p> <p>non-what-if [2] 2028/18 2030/11</p> <p>none [3] 2013/25 2017/3 2062/12</p> <p>NONJURY [1] 1949/14</p> <p>nonunique [1] 2011/21</p> <p>nonuniqueness [1] 2015/22</p> <p>North [1] 1950/23</p> <p>not [148]</p> <p>nothing [2] 2008/5 2070/22</p> <p>notion [1] 2026/12</p> <p>now [58] 1968/18 1969/8 1969/10 1971/18 1971/21 1971/24 1972/5 1972/13 1973/10 1974/13 1976/23 1983/22 1985/25 1988/8 1988/25 1990/9 1990/18 1992/3 1994/19 1996/16 1997/21 1998/7 2000/2 2000/19 2001/7 2003/12 2005/6 2005/10 2005/25 2006/23 2021/13 2024/20 2025/4 2028/25 2030/13 2031/14 2031/16 2034/8 2035/8 2037/23 2046/21 2048/21 2049/23</p>
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<p>N</p> <p>now... [15] 2051/17 2052/21 2053/4 2053/12 2053/24 2054/5 2054/8 2056/22 2060/18 2061/21 2062/8 2063/9 2066/12 2069/2 2069/21</p> <p>number [8] 1962/17 2007/11 2008/1 2008/6 2022/3 2036/25 2037/15 2056/17</p> <p>numbered [1] 2071/20</p> <p>numbers [5] 2003/10 2006/15 2030/2 2030/4 2059/12</p> <p>numeric [1] 2052/19</p> <p>numerical [33] 1965/17 1970/7 1970/19 1970/20 1970/25 1979/20 1985/8 1985/25 1986/4 1986/8 1986/20 1987/5 1987/8 1987/12 1987/17 1987/18 1987/20 1987/25 1988/3 1989/17 1994/13 2014/16 2018/15 2019/16 2020/13 2028/13 2029/21 2030/13 2030/16 2030/18 2034/8 2034/22 2052/11</p>	<p>1997/4 1997/17 1997/24 1998/1 1998/4 1998/10 1999/6 1999/16 1999/20 2001/13 2001/20 2001/20 2002/14 2003/2 2003/9 2004/5 2005/5 2005/7 2005/9 2005/16 2005/22 2005/25 2006/2 2006/11 2006/13 2009/5 2012/5 2012/9 2012/11 2012/17 2013/10 2013/16 2013/18 2013/22 2015/8 2015/10 2015/11 2015/11 2015/13 2015/16 2015/16 2015/17 2016/9 2017/9 2017/16 2020/23 2021/2 2021/9 2022/11 2026/14 2027/12 2030/22 2032/16 2040/13 2043/15 2044/4 2044/24 2048/4 2048/8 2048/20 2052/22 2056/2 2056/16 2061/13 2063/9</p> <p>OIP [2] 1972/23 2005/8</p> <p>okay [34] 1957/11 1958/2 1958/19 1961/1 1961/13 1964/16 1974/13 1976/4 1984/24 1990/6 1994/15 1996/11 2011/4 2012/2 2016/1 2028/5 2032/11 2038/20 2040/16 2051/19 2054/7 2061/20 2061/21 2066/19 2067/6 2068/12 2069/3 2069/23 2070/1 2070/11 2070/16 2070/23 2071/5 2071/9</p> <p>Olson [1] 1952/19</p> <p>once [17] 1969/1 1969/3 1971/17 1972/10 1976/16 1979/4 1979/15 1988/20 1988/21 1997/1 1997/14 2000/20 2008/25 2016/4 2020/25 2057/6 2062/6</p> <p>one [125]</p> <p>one-third [2] 2032/18 2032/19</p> <p>ones [8] 1965/5 1965/6 1965/7 1970/22 1974/14 1978/18 2006/16 2069/3</p> <p>only [23] 1956/10 1963/25 1967/6 1969/11 1970/22 1970/23 1973/3 1973/24 1976/15 1977/13 1991/9 1999/18 2002/21 2009/11 2012/6 2012/7 2013/19 2016/21 2017/6 2025/19 2026/12 2027/21 2044/9</p> <p>onshore [1] 1962/2</p> <p>OOIP [2] 2005/6 2005/7</p> <p>open [1] 2003/22</p> <p>opened [1] 1990/19</p> <p>opening [3] 1959/14 1989/14 1998/7</p> <p>operating [3] 1976/15 1976/24 1976/24</p> <p>operations [1] 2050/3</p> <p>opinion [17] 1959/7 1966/18 1972/16 1989/6 2012/10 2012/13 2012/15 2013/13 2013/19 2016/12 2017/8 2017/12 2033/6 2047/17 2051/7 2051/9 2066/4</p> <p>opinions [7] 1959/9 1959/21 1960/2 2003/18 2012/21 2014/21 2015/3</p> <p>opposed [1] 1975/20</p> <p>ordered [1] 1995/16</p> <p>original [12] 2005/7 2005/9 2006/2 2006/10 2029/3 2029/6 2029/22 2029/25 2036/2 2038/13 2055/15 2055/23</p> <p>Orleans [8] 1949/6 1949/20 1950/8 1951/4 1951/19 1952/14 1953/13 1953/19</p> <p>other [44] 1956/4 1962/17 1964/20 1965/5 1965/6 1965/7 1967/8 1967/22 1967/23 1970/4 1973/5 1976/14 1978/13 1979/14 1979/18 1981/1 1986/10 1987/13 1988/14 1989/7 1991/1 1994/24 2003/6 2003/23 2008/5 2009/2 2009/3 2010/13 2011/7 2017/13 2018/25 2020/20 2028/16 2032/4</p>	<p>2039/20 2044/22 2056/6 2057/21 2059/20 2064/6 2064/23 2065/18 2067/5 2069/3</p> <p>others [4] 1974/7 1980/10 1989/5 2030/18</p> <p>otherwise [3] 1964/3 1968/5 2048/6</p> <p>our [15] 1956/3 1963/25 1964/2 1964/5 1964/7 1983/18 1989/2 1989/2 2007/19 2015/12 2040/20 2069/8 2069/21 2070/8 2070/10</p> <p>ourselves [1] 1983/19</p> <p>out [26] 1963/19 1964/10 1964/24 1974/8 1974/14 1974/19 1979/10 1986/13 1990/20 1990/22 2001/20 2001/20 2004/24 2018/20 2021/2 2023/8 2044/21 2050/6 2050/17 2052/8 2052/24 2065/8 2065/12 2066/1 2066/13 2070/23</p> <p>outcome [2] 1963/17 1964/1</p> <p>outliers [1] 2058/19</p> <p>output [4] 1997/9 1998/25 2013/12 2040/13</p> <p>outs [3] 1955/10 1955/13 1956/25</p> <p>outside [1] 2062/3</p> <p>over [32] 1972/13 1978/11 1983/3 1983/7 1984/17 2000/8 2016/16 2019/8 2025/2 2025/5 2025/8 2025/11 2025/23 2026/11 2026/17 2027/1 2027/16 2030/14 2033/20 2034/3 2034/16 2034/21 2035/2 2036/14 2036/22 2043/16 2050/24 2051/4 2051/11 2054/15 2063/10 2068/22</p> <p>overestimation [1] 2008/19</p> <p>overnight [1] 2068/1</p> <p>overview [3] 1965/9 1965/19 1987/24</p> <p>own [5] 1971/5 1982/15 2002/25 2009/10 2067/15</p>
<p>O</p> <p>O'CONNOR [1] 1952/7</p> <p>O'Keefe [1] 1949/19</p> <p>O'ROURKE [3] 1951/11 2066/19 2067/22</p> <p>objected [1] 2066/14</p> <p>objection [5] 1955/19 1956/17 1958/13 2051/19 2066/25</p> <p>objections [8] 1955/12 1955/18 1956/3 1957/3 1957/5 1957/14 1958/12 2067/14</p> <p>objective [6] 1963/17 1967/11 2004/23 2015/12 2021/1 2039/24</p> <p>observation [2] 2061/25 2062/7</p> <p>observe [5] 1982/25 1983/1 1995/17 1995/19 2048/19</p> <p>observed [1] 2043/21</p> <p>observing [2] 1979/6 2057/23</p> <p>obtain [5] 1988/18 1991/3 1996/25 1997/1 2007/20</p> <p>obtained [6] 1967/7 1981/23 1984/7 1984/9 2009/3 2053/13</p> <p>obvious [2] 1973/24 1980/7</p> <p>occur [1] 2027/13</p> <p>occurred [13] 2027/3 2027/6 2027/17 2028/12 2033/18 2040/7 2044/18 2046/13 2048/11 2051/5 2051/12 2064/23 2065/6</p> <p>occurring [5] 2035/2 2036/13 2036/22 2043/13 2048/1</p> <p>ocean [1] 2023/3</p> <p>October [2] 1949/7 1955/2</p> <p>off [1] 2067/21</p> <p>offer [5] 1955/13 1955/24 2069/17 2070/5 2070/7</p> <p>offered [3] 1956/1 1957/1 2069/6</p> <p>offering [2] 1956/2 1956/19</p> <p>Office [7] 1949/23 1950/4 1950/18 1950/22 1950/23 1951/7 1951/15</p> <p>Official [3] 1953/18 2071/15 2071/23</p> <p>offshore [4] 1952/13 1952/16 1952/19 1962/2</p> <p>often [1] 1963/23</p> <p>oh [2] 1956/13 2049/8</p> <p>oil [90] 1949/4 1949/4 1963/3 1966/9 1966/12 1966/13 1966/20 1966/25 1967/12 1967/19 1968/4 1969/13 1969/25 1970/16 1972/3 1972/11 1972/15 1973/7 1978/1 1978/8 1978/14 1986/18 1995/15 1995/22 1997/3</p>	<p>P</p> <p>P-O-O-L-A-D-I [1] 1959/1</p> <p>p.m [1] 2056/20</p> <p>PA [1] 1950/3</p> <p>page [5] 1954/2 1959/15 1959/18 2021/4 2059/23</p> <p>pages [1] 2025/20</p> <p>Palo [1] 1960/25</p> <p>Palo Alto [1] 1960/25</p> <p>panel [1] 1962/16</p> <p>Papantonio [1] 1950/2</p> <p>papers [1] 1962/24</p> <p>parameter [21] 1977/8 1978/20 1982/18 1988/8 1988/11 1989/6 1989/7 1989/9 1989/11 1989/21 1992/2 1994/4 1994/16 1995/3 1998/9 1998/25 1999/2 2005/11 2006/2 2016/11 2061/9</p> <p>parameters [85] 1966/22 1972/4 1972/8 1972/9 1973/17 1973/19 1973/20 1973/21 1973/22 1974/4 1974/5 1974/9 1974/12 1974/13 1974/19 1976/8 1976/22 1976/23 1977/2 1977/14 1977/15 1977/17 1977/18 1978/3 1978/5 1978/10 1978/13 1978/16 1978/22 1979/5 1979/14 1979/15 1979/17 1979/19 1980/1 1980/6 1980/7 1980/10 1980/25 1981/2 1985/7 1985/21 1985/24 1986/7 1986/14 1988/7 1988/14 1989/4 1989/8 1989/25 1990/19 1991/2 1994/3 1994/6 1996/24 1997/8 1997/14 1997/21 1998/8 1998/11 1998/15 1998/17 2000/1 2003/18 2003/25 2009/3 2009/7 2009/11 2009/16 2011/18 2011/22 2012/4 2014/8 2014/18 2017/14 2029/1</p>	

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<p>Q</p> <p>Q4000 [1] 1969/22 quality [4] 1992/18 1995/6 1996/3 2061/12 quantification [1] 2069/11 quantify [2] 2020/23 2021/9 question [17] 1956/16 1964/9 1966/7 1966/8 1972/19 1972/21 2021/5 2021/7 2025/15 2033/5 2034/10 2035/5 2046/18 2047/19 2051/10 2060/22 2065/21 questioned [1] 1965/2 questions [5] 1973/15 1979/8 2017/24 2038/10 2066/5 quickly [5] 1965/18 1967/12 1967/20 1975/8 2024/7 quite [4] 1957/13 1966/23 1983/11 2015/5</p>	<p>R</p> <p>R-E-S [1] 2024/9 Rachel [1] 1958/6 Rafferty [1] 1950/3 raised [3] 1956/17 1957/3 1957/14 ran [5] 1989/17 2012/10 2052/1 2053/1 2056/25 range [47] 1961/19 1963/15 1963/20 1964/2 1966/4 1966/20 1967/9 1968/15 1973/18 1974/8 1980/17 1980/17 1980/23 1981/3 1991/2 1995/24 1996/24 1997/18 1999/7 1999/11 1999/17 1999/19 2003/10 2004/17 2004/20 2004/21 2004/22 2004/25 2005/4 2005/25 2006/2 2009/6 2012/8 2013/12 2013/13 2013/15 2013/21 2013/21 2017/20 2028/25 2031/12 2052/21 2056/4 2056/11 2056/12 2056/15 2058/17 ranges [1] 2058/22 ranging [1] 2056/7 rate [80] 1964/25 1968/11 1969/1 1969/9 1969/11 1969/12 1970/22 1971/13 1971/17 1975/2 1975/13 1975/14 1976/18 1977/5 1977/8 1977/10 1978/1 1982/25 1983/10 1984/1 2002/20 2010/5 2018/23 2019/4 2019/6 2019/7 2019/8 2019/12 2020/2</p>	<p>2020/7 2020/18 2020/19 2020/19 2023/25 2033/17 2033/19 2033/23 2035/18 2036/5 2040/18 2044/8 2048/10 2048/12 2048/13 2049/15 2050/15 2050/22 2054/3 2057/1 2057/3 2057/4 2057/7 2057/8 2057/9 2057/11 2057/12 2057/14 2057/18 2058/3 2058/19 2059/10 2060/4 2060/18 2060/20 2060/24 2060/25 2061/3 2061/5 2061/11 2061/22 2062/1 2062/2 2062/2 2062/9 2062/10 2062/12 2062/16 2062/21 2064/11 2065/1 rated [1] 2039/16 rates [64] 1969/19 1970/5 1970/11 1970/20 1970/23 1971/6 1975/17 1976/25 1983/9 1986/16 1988/24 1992/5 1992/9 1992/11 1992/12 1992/24 1994/7 1995/9 1995/11 1995/12 1995/13 1995/21 1997/2 1997/12 2004/15 2006/19 2006/21 2009/1 2009/4 2012/1 2012/3 2012/7 2015/10 2015/16 2016/7 2017/19 2020/25 2021/13 2041/1 2044/9 2053/15 2056/24 2057/3 2057/6 2058/5 2058/8 2058/9 2058/14 2058/16 2059/25 2060/2 2061/13 2062/17 2062/23 2062/24 2064/2 2064/3 2064/5 2064/8 2064/12 2064/15 2064/19 2065/12 2065/25 RE [2] 1949/4 1949/7 reach [3] 1966/24 2051/4 2051/11 read [3] 1997/3 2021/12 2031/16 reading [5] 2016/5 2039/1 2039/7 2041/19 2046/7 readings [11] 2038/22 2039/6 2045/19 2045/19 2045/23 2046/5 2046/13 2046/16 2047/13 2047/22 2059/21 real [2] 2002/1 2025/4 realistic [1] 2016/23 realized [2] 1985/11 2067/21 really [6] 1985/6 1989/8 2001/14 2047/24 2050/7 2051/18 realm [1] 1969/7 realtime [1] 1964/10 reason [2] 1972/21 2026/18 reasonable [9] 1984/25 1984/25 1985/1 2015/15 2017/14 2039/23 2042/15 2043/17 2047/10 rebuttal [19] 1959/18 1971/10 1999/7 1999/17 2003/12 2008/8 2012/20 2014/6 2015/22 2029/10 2029/14 2029/15 2029/23 2029/25 2038/4 2038/14 2038/15 2066/25 2070/9 rebutted [1] 1998/19 recall [14] 2026/7 2033/12 2033/13 2037/3 2038/1 2038/3 2038/12 2041/21 2045/2 2045/8 2048/23 2049/1 2063/19 2063/22 receive [2] 1963/5 1963/6 received [6] 1955/12 1962/13 1962/17 2003/16 2044/4 2057/6 recently [1] 1962/14 recess [2] 2018/1 2018/3 recollection [1] 2067/2 record [3] 1958/23 1971/5 2071/19 recorded [2] 1953/24 2046/5 red [5] 1990/17 1990/18 2004/16 2006/22 2012/1 redactions [1] 2067/15 redirect [2] 2066/6 2066/7 reduce [1] 2012/6 reduced [2] 1975/13 1994/21 referred [6] 1968/8 1974/16 1984/8</p>

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[3] 1984/14 2007/12 2008/12</p> <p>referring [4] 2028/24 2032/24 2033/5 2045/3</p> <p>reflect [3] 1997/9 1997/16 2044/18</p> <p>reflected [2] 2005/23 2026/2</p> <p>REGAN [1] 1951/22</p> <p>regarding [2] 2003/18 2012/21</p> <p>regardless [2] 2013/21 2034/20</p> <p>related [1] 1955/15</p> <p>relating [1] 2068/17</p> <p>relation [1] 1998/10</p> <p>relationship [2] 1974/16 1975/4</p> <p>relationships [1] 1970/14</p> <p>relaxed [1] 1987/16</p> <p>release [10] 1973/7 1997/3 2039/10 2040/13 2043/15 2044/5 2048/20 2052/23 2056/2 2061/14</p> <p>released [31] 1966/9 1966/20 1966/25 1969/13 1972/11 1986/18 1995/15 1997/5 1997/17 1997/24 1998/4 1999/6 1999/16 2001/13 2002/14 2003/2 2003/9 2004/6 2005/5 2012/9 2012/17 2015/8 2015/17 2016/10 2017/9 2017/16 2026/14 2044/24 2048/4 2048/8 2056/16</p> <p>relevance [2] 2066/25 2067/4</p> <p>reliance [1] 2070/4</p> <p>rely [3] 1985/4 2016/7 2069/10</p> <p>remain [1] 2014/17</p> <p>remained [4] 2003/22 2032/7 2041/17 2042/10</p> <p>remaining [2] 1971/14 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2013/10 2047/4 2070/6</p> <p>RES [6] 2024/9 2024/12 2024/21 2024/24 2025/1 2025/8</p> <p>reservations [3] 2067/17 2070/25 2071/4</p> <p>reserve [1] 1957/8</p>	<p>resolving [2] 2069/9 2069/13</p> <p>reservoir [109] 1960/7 1961/14 1961/15 1962/1 1962/6 1962/7 1962/9 1962/20 1963/8 1964/3 1965/22 1966/10 1966/14 1966/22 1967/5 1967/14 1968/6 1968/9 1968/10 1969/6 1969/8 1969/10 1970/24 1971/20 1971/22 1971/23 1972/2 1972/12 1972/23 1973/4 1973/5 1973/6 1973/22 1973/23 1974/9 1974/11 1974/14 1974/20 1975/5 1975/6 1975/9 1975/12 1975/20 1975/22 1976/16 1976/19 1977/3 1977/14 1978/6 1980/3 1980/6 1980/9 1983/22 1984/1 1985/13 1986/14 1986/15 1987/2 1987/2 1987/7 1987/9 1987/11 1988/14 1988/17 1990/20 1990/23 1996/1 1996/17 1996/24 2000/18 2000/21 2003/21 2004/4 2005/14 2007/5 2017/10 2017/18 2018/20 2019/10 2020/24 2021/10 2021/14 2021/20 2021/22 2021/23 2022/7 2022/15 2022/18 2022/21 2023/14 2023/24 2025/4 2025/11 2026/21 2029/1 2030/23 2031/1 2031/6 2031/7 2031/11 2032/17 2049/12 2052/2 2053/6 2053/10 2065/16 2065/17 2065/18 2065/19</p> <p>reservoir's [1] 2021/16</p> <p>reservoirs [2] 1962/2 1996/14</p> <p>resistance [19] 1979/12 2024/5 2024/8 2024/15 2024/17 2024/22 2025/10 2025/13 2025/17 2025/25 2032/20 2033/24 2033/24 2034/2 2034/7 2034/12 2034/15 2034/21 2048/14</p> <p>resistances [18] 2023/13 2023/16 2023/18 2023/20 2023/23 2023/23 2025/4 2025/6 2031/3 2031/5 2031/7 2031/7 2031/8 2031/11 2031/12 2048/7 2050/9 2050/9</p> <p>resolution [1] 2070/15</p> <p>resolve [1] 2015/21</p> <p>Resources [1] 1951/10</p> <p>respect [24] 1960/6 1960/10 1984/4 1985/20 2007/1 2013/16 2013/24 2014/22 2015/3 2026/15 2026/15 2028/5 2028/20 2037/5 2037/9 2040/6 2049/23 2055/23 2056/17 2057/15 2057/17 2059/23 2060/6 2061/21</p> <p>responded [1] 1957/4</p> <p>response [20] 1957/5 1963/8 1968/5 1968/7 1968/9 1970/24 1973/6 1973/23 1977/16 1986/15 1992/19 1996/1 2004/4 2005/2 2005/4 2017/17 2019/11 2053/10 2065/17 2065/20</p> <p>responsible [1] 1957/9</p> <p>rest [8] 1985/21 2017/5 2066/20 2067/16 2067/18 2067/23 2068/8 2070/10</p> <p>resting [3] 2068/24 2069/9 2070/15</p> <p>restricted [14] 2001/15 2001/17 2001/19 2002/4 2002/16 2002/23 2026/9 2026/15 2048/23 2048/25 2049/1 2049/7 2049/10 2049/11</p> <p>restriction [8] 1979/7 1979/9 1990/7 1990/20 1994/19 2035/11 2035/14 2036/3</p> <p>result [4] 1990/18 2025/1 2040/2 2041/4</p> <p>resulted [4] 2039/9 2039/13 2044/15 2062/16</p> <p>results [19] 1964/23 1973/21 1982/16 1986/10 1991/9 1991/10 1992/16 1992/17 1994/12 1998/13 1998/17 2000/9 2001/2 2001/14 2002/16 2003/8</p>	<p>2011/17 2053/8 2061/15</p> <p>retained [1] 2045/22</p> <p>review [1] 1980/24</p> <p>reviewed [3] 1962/22 1969/22 1981/21</p> <p>RICHARD [2] 1951/14 1953/8</p> <p>Richeson [1] 1953/11</p> <p>rig [2] 1949/4 2032/5</p> <p>right [37] 1955/5 1955/6 1955/18 1957/15 1958/12 1960/9 1960/13 1961/16 1964/17 1991/21 2001/19 2012/23 2016/15 2016/24 2017/7 2017/25 2018/5 2018/6 2028/18 2030/1 2030/4 2030/5 2031/16 2033/13 2039/22 2052/12 2052/13 2066/3 2068/19 2069/5 2069/5 2069/7 2069/9 2069/13 2069/15 2069/21 2070/19</p> <p>right-hand [1] 1991/21</p> <p>rise [5] 1955/4 1982/25 2018/2 2018/4 2071/11</p> <p>riser [28] 2023/21 2023/24 2031/19 2031/21 2031/24 2032/1 2032/4 2032/7 2032/9 2032/11 2032/15 2032/19 2032/22 2032/23 2033/1 2033/3 2033/4 2033/10 2033/15 2033/23 2033/25 2034/2 2034/7 2034/12 2034/15 2034/21 2035/2 2063/13</p> <p>rising [1] 1975/1</p> <p>risk [1] 1964/4</p> <p>RITT [1] 2064/8</p> <p>RMR [4] 1953/18 2071/15 2071/22 2071/23</p> <p>ROBERT [2] 1952/6 1952/10</p> <p>ROBERTS [1] 1952/16</p> <p>ROBIN [1] 1950/10</p> <p>rock [8] 1963/9 1980/8 1985/15 1996/7 1996/12 1997/22 2052/15 2052/17</p> <p>Ron [2] 1969/3 1970/15</p> <p>Ronald [1] 1957/2</p> <p>Room [1] 1953/18</p> <p>Rouge [1] 1950/24</p> <p>roughly [1] 1978/18</p> <p>roughness [1] 1979/12</p> <p>row [1] 1980/25</p> <p>Roy [2] 1949/21 1949/22</p> <p>rule [6] 2050/6 2050/17 2065/8 2065/12 2066/1 2066/24</p> <p>rules [1] 2007/20</p> <p>run [4] 1982/4 2003/4 2057/2 2059/1</p>
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<p>s/Jodi [1] 2071/22</p> <p>said [21] 1955/15 1969/5 1975/24 1988/25 1991/16 1992/24 1993/19 1996/13 1996/15 1998/9 2003/22 2003/25 2012/2 2033/6 2047/19 2055/5 2061/3 2066/23 2066/24 2068/11 2068/14</p> <p>sake [1] 2000/6</p> <p>same [13] 1984/15 1987/21 1989/1 2004/2 2005/8 2008/24 2010/11 2024/12 2035/5 2048/13 2059/23 2062/18 2065/5</p> <p>samples [4] 1984/7 1984/8 1984/17 1984/22</p> <p>sandface [3] 1975/10 1975/11 1990/15</p> <p>sank [1] 2031/23</p> <p>SARAH [2] 1951/15 1957/19</p> <p>saw [7] 1998/7 2004/2 2010/20 2012/3 2032/25 2055/24 2058/2</p> <p>say [17] 1964/14 1965/19 1983/18 1983/24 1984/24 2006/9 2016/1 2019/23 2020/1 2020/7 2023/4 2028/16 2028/25 2040/19 2062/16 2064/23</p>		

<p>S</p> <p>say... [1] 2070/20</p> <p>saying [5] 1990/6 1994/18 1995/7 2036/7 2068/2</p> <p>says [5] 1985/2 2001/7 2042/2 2044/14 2065/15</p> <p>scenario [10] 2002/2 2002/5 2002/6 2002/7 2002/17 2002/22 2003/1 2016/21 2016/23 2025/3</p> <p>scenarios [4] 2001/10 2011/6 2044/22 2048/17</p> <p>Schell [1] 1953/11</p> <p>Schlumberger [1] 1974/7</p> <p>SCOTT [1] 1951/12</p> <p>screen [2] 2059/1 2059/24</p> <p>se [1] 2051/1</p> <p>sea [4] 2022/15 2022/19 2023/9 2023/11</p> <p>seafloor [1] 2031/24</p> <p>SEAN [1] 1953/5</p> <p>seated [2] 1955/5 2018/5</p> <p>second [14] 1971/21 1988/23 1992/4 1993/18 1994/25 1995/1 1999/13 2002/23 2005/6 2009/3 2014/1 2037/17 2054/3 2056/22</p> <p>secondly [1] 2015/20</p> <p>section [3] 1949/5 1951/10 2000/12</p> <p>sections [1] 2013/17</p> <p>see [40] 1970/21 1972/7 1973/4 1976/23 1980/2 1981/3 1984/16 1985/17 1988/8 1991/22 1992/3 1993/3 1997/1 1997/4 1999/2 1999/4 1999/12 2004/5 2011/22 2017/20 2024/10 2024/18 2036/25 2040/14 2041/14 2042/5 2043/9 2044/2 2044/22 2055/18 2057/22 2057/23 2059/14 2059/17 2060/8 2060/12 2060/16 2061/14 2065/18 2071/9</p> <p>seeing [1] 1993/25</p> <p>seemed [1] 1982/9</p> <p>seems [1] 2016/21</p> <p>segments [1] 1965/16</p> <p>seismic [2] 2005/11 2005/13</p> <p>select [1] 1979/16</p> <p>selection [1] 2062/6</p> <p>senior [1] 1961/10</p> <p>sense [5] 2016/13 2020/12 2034/18 2036/16 2047/25</p> <p>sensitivity [14] 2028/14 2028/22 2029/9 2029/22 2029/23 2034/6 2034/11 2034/13 2034/22 2035/1 2035/7 2036/12 2036/21 2055/16</p> <p>sent [1] 1984/9</p> <p>sentence [1] 2022/16</p> <p>separately [1] 2064/24</p> <p>sequence [1] 1969/12</p> <p>series [4] 1970/20 2010/2 2010/7 2052/1</p> <p>Services [2] 1953/3 1953/8</p> <p>SESSION [2] 1949/14 1955/1</p> <p>set [8] 1968/17 1984/15 2006/5 2028/21 2030/8 2037/5 2037/9 2055/20</p> <p>sets [2] 1968/10 2053/24</p> <p>setting [2] 2008/20 2050/4</p> <p>seven [3] 2029/12 2029/14 2029/23</p> <p>several [4] 2031/21 2032/7 2051/17 2061/8</p> <p>shall [1] 2003/25</p> <p>sharply [1] 2033/22</p> <p>She [1] 2067/15</p> <p>ship [1] 1969/24</p> <p>ships [3] 1969/21 1992/24 2064/6</p>	<p>short [3] 1981/4 2040/21 2040/23</p> <p>short-sighted [1] 1981/4</p> <p>shots [1] 2008/25</p> <p>should [6] 2010/12 2010/13 2013/7 2013/8 2016/23 2035/22</p> <p>show [6] 1979/24 1991/9 1991/10 1991/15 1999/19 2015/19</p> <p>showed [3] 2036/10 2058/23 2059/6</p> <p>showing [6] 1977/23 1994/16 1995/1 2032/25 2040/13 2058/4</p> <p>shown [10] 1978/2 1984/19 1987/3 1991/21 1992/17 1992/21 1994/14 1994/24 2042/25 2046/11</p> <p>shows [7] 1978/7 1979/4 1984/16 1991/12 2040/17 2055/17 2058/3</p> <p>shut [47] 1968/12 1968/13 1968/13 1973/1 1982/25 1983/8 1983/11 1986/16 1988/9 1988/12 1988/16 1988/22 1989/24 1990/12 1990/13 1990/14 1990/21 1991/3 1991/24 1994/5 1994/6 1994/6 1995/4 1995/20 1996/20 1999/8 1999/14 1999/15 1999/18 1999/21 2004/21 2006/18 2006/20 2006/24 2007/1 2007/2 2007/15 2008/21 2009/4 2011/25 2017/15 2044/9 2049/14 2053/21 2053/22 2056/13 2059/19</p> <p>shut-in [44] 1968/13 1973/1 1983/8 1983/11 1986/16 1988/9 1988/12 1988/16 1988/22 1989/24 1990/12 1990/13 1990/14 1990/21 1991/3 1991/24 1994/5 1994/6 1994/6 1995/4 1995/20 1996/20 1999/8 1999/21 2004/21 2006/18 2006/20 2006/24 2007/1 2007/2 2007/15 2008/21 2009/4 2011/25 2017/15 2044/9 2049/14 2053/21 2053/22 2056/13 2059/19</p> <p>shutting [1] 2056/9</p> <p>side [5] 1978/6 1984/7 1991/22 2069/3 2069/7</p> <p>sighted [1] 1981/4</p> <p>significant [6] 2030/14 2047/15 2047/22 2065/8 2065/13 2066/1</p> <p>significantly [2] 1983/7 2015/17</p> <p>Simcox [5] 1953/18 1953/20 2071/15 2071/22 2071/23</p> <p>similar [8] 1969/2 1970/14 1977/15 1977/24 1985/20 2001/5 2016/20 2055/16</p> <p>similarly [3] 1961/25 1978/11 1978/14</p> <p>simple [2] 1967/17 1970/14</p> <p>simplified [1] 1987/15</p> <p>simply [2] 2036/20 2046/18</p> <p>simulated [15] 2039/5 2039/5 2053/1 2055/7 2056/24 2057/6 2057/8 2057/9 2058/2 2058/3 2058/8 2060/3 2060/18 2060/23 2064/18</p> <p>simulation [11] 1970/20 1979/21 1987/12 1987/17 1987/18 2040/17 2053/6 2053/9 2053/12 2065/11 2065/24</p> <p>simulator [3] 1987/2 2014/17 2026/5</p> <p>simulators [2] 1986/20 1987/20</p> <p>SINCLAIR [1] 1950/19</p> <p>single [3] 1980/10 1987/6 1994/2</p> <p>sir [5] 1959/18 2023/17 2023/19 2034/20 2036/3</p> <p>sit [2] 2038/1 2038/3</p> <p>site [1] 2066/22</p> <p>sitting [1] 1999/4</p> <p>six [6] 2029/24 2030/8 2030/10 2037/22 2037/23 2037/24</p>	<p>Sixteen [1] 1984/8</p> <p>size [4] 1972/3 1993/5 1993/5 2026/17</p> <p>skin [12] 1968/5 1972/3 1972/23 1978/7 1978/9 1980/7 1981/2 1994/22 2012/6 2016/7 2050/11 2050/12</p> <p>skip [1] 2016/16</p> <p>slide [4] 1962/19 1998/13 2016/4 2042/25</p> <p>slightly [4] 1970/8 2025/15 2045/16 2053/18</p> <p>slope [2] 1975/23 2017/2</p> <p>slow [2] 1961/1 2000/6</p> <p>slowly [4] 2001/23 2001/23 2001/23 2001/23</p> <p>small [6] 1961/19 1987/9 2027/19 2034/4 2034/19 2048/18</p> <p>smaller [6] 1974/1 1979/14 1994/20 2006/10 2006/14 2032/20</p> <p>SMITH [1] 1953/4</p> <p>so [154]</p> <p>so-called [11] 1971/19 1971/22 1975/3 1978/19 1981/17 1991/12 2007/3 2008/12 2009/18 2011/5 2011/13</p> <p>software [3] 1953/24 1971/24 1987/18</p> <p>Soileau [1] 1950/12</p> <p>solid [6] 1975/3 1990/14 1991/17 1992/13 1992/17 1993/4</p> <p>solution [1] 1967/25</p> <p>solve [2] 1987/9 2016/6</p> <p>some [47] 1956/11 1957/14 1965/22 1966/15 1966/22 1967/7 1967/7 1978/16 1980/24 1981/1 1981/25 1982/6 1984/12 1989/4 1989/5 1989/7 1991/1 1996/23 1997/14 2004/7 2004/10 2005/20 2010/19 2012/4 2013/3 2013/5 2014/5 2014/7 2015/6 2022/4 2029/3 2029/9 2033/14 2033/16 2038/12 2038/22 2038/25 2039/3 2045/22 2047/10 2049/25 2052/24 2052/25 2056/6 2057/7 2068/13 2069/6</p> <p>somebody [2] 2003/24 2069/7</p> <p>somehow [1] 2024/25</p> <p>something [11] 1957/10 1963/22 1993/23 2013/20 2024/9 2024/14 2041/13 2045/7 2046/15 2070/20 2071/9</p> <p>sometimes [4] 1963/18 1966/15 1966/16 2007/21</p> <p>somewhat [1] 2046/15</p> <p>somewhere [2] 2035/21 2058/10</p> <p>sorry [22] 1956/13 1956/13 1995/19 2012/14 2022/16 2029/22 2031/15 2033/23 2034/8 2034/10 2036/18 2038/2 2045/3 2049/9 2050/13 2051/2 2051/3 2054/14 2054/21 2065/11 2068/7 2068/12</p> <p>sort [3] 2024/4 2038/16 2059/1</p> <p>sound [1] 2029/25</p> <p>source [1] 2069/12</p> <p>sources [1] 1981/6</p> <p>South [3] 1950/4 1950/12 1952/3</p> <p>space [2] 2020/15 2020/16</p> <p>SPE [1] 1962/15</p> <p>speak [1] 2009/25</p> <p>specific [1] 2008/5</p> <p>specifically [2] 1981/8 2004/24</p> <p>specified [1] 2058/22</p> <p>spectrum [1] 1961/25</p> <p>spelled [1] 1958/25</p> <p>spelling [1] 1958/23</p> <p>spill [8] 1949/4 2018/23 2027/22 2027/23 2036/9 2041/17 2051/13 2063/11</p>
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1982/23 1982/23 1983/8 1983/12 2021/24 2038/23 2053/13 2053/14 2053/16 2053/25 2054/8 2056/23 testified [5] 1958/21 2004/10 2014/1 2016/15 2068/20 testify [1] 1965/13 testimony [4] 1957/4 1960/2 2003/13 2037/3 testing [3] 1965/23 2007/20 2015/7 tests [8] 1967/8 1982/4 1982/19 1982/20 1983/15 1983/16 1983/21 2005/21 Texas [3] 1952/17 1953/6 1953/9 than [31] 1962/23 1962/23 1970/3 1980/4 1983/24 1984/17 1984/21 1984/22 1984/23 1984/24 1984/24 1985/12 1993/5 1993/15 1993/16 1993/20 1993/21 1994/20 1996/20 2005/1 2006/14 2006/16 2008/5 2008/17 2032/18 2032/20 2061/23 2061/24 2062/9 2062/13 2062/21 thank [22] 1956/20 1956/23 1957/16 1957/18 1958/14 1961/7 1986/25 2017/23 2022/2 2029/11 2030/24 2036/19 2042/6 2054/4 2056/10 2057/10 2066/8 2066/9 2066/18 2067/20 2067/23 2070/12 that [737] that's [46] 1955/17 1956/18 1958/25 1960/12 1961/11 1965/7 1968/9 1976/4 1976/15 1989/21 1998/16 2001/7 2005/18 2007/19 2015/18 2017/3 2017/5 2017/5 2019/2 2024/16 2030/24 2031/6 2033/13 2033/17 2034/9 2036/7 2036/7 2045/17 2049/24 2050/13 2051/8 2052/13 2052/20 2053/14 2053/23 2056/16 2056/20 2056/23 2058/13 2059/6 2059/22 2061/25 2062/25 2063/8 2066/17 2068/21 their [18] 1962/4 1962/7 1962/8 1969/24 1973/7 1988/14 1990/23 1991/2 1999/25 2003/17 2019/12 2019/12 2030/19 2033/17 2048/3 2048/19 2060/1 2069/10 them [39] 1957/6 1961/19 1962/19 1964/21 1964/22 1965/16 1966/15 1966/16 1967/24 1970/8 1970/11 1971/4 1972/5 1977/3 1980/16 1984/21 1984/23 1987/16 1988/10 1995/9 1999/14 2006/15 2007/12 2013/6 2014/7 2015/5 2015/6 2030/2 2036/6 2036/8 2040/20 2045/18 2049/4 2052/24 2059/12 2067/3 2067/13 2068/1 2070/14 themselves [1] 2019/14 then [75] 1956/24 1960/23 1965/4 1966/1 1966/4 1969/2 1970/7 1970/17 1970/17 1971/18 1973/7 1973/18 1974/4 1977/4 1977/7 1982/25 1986/12 1986/17 1986/18 1988/4 1988/22 1991/20 1993/21 1993/23 1994/6 1996/5 1996/6 1996/12 1997/2 1997/7 1998/9 1999/4 2000/21 2001/8 2001/10 2001/12 2001/22 2002/2 2002/10 2002/25 2004/5 2009/2 2009/12 2012/2 2012/7 2014/11 2014/21 2015/10 2019/3 2019/14 2020/7 2022/24 2023/7</p>
	<p>T</p> <p>table [15] 1973/24 1977/15 1979/24 1979/25 1994/12 1995/11 1995/23 1999/10 1999/12 2008/12 2008/14 2008/16 2008/17 2030/3 2061/18 take [19] 1964/7 1989/16 2017/25 2020/15 2021/4 2022/18 2026/25 2027/5 2030/6 2031/15 2034/24 2035/1 2036/13 2037/6 2037/10 2040/6 2045/25 2057/7 2066/15 taken [3] 2027/1 2030/21 2036/16 taking [2] 2046/25 2061/17 talk [13] 1981/5 1984/18 1997/22 2006/23 2018/17 2028/13 2030/10 2037/18 2038/18 2041/13 2049/23 2051/21 2056/22 talked [4] 1967/20 2010/3 2048/21 2051/24 talking [9] 1975/23 2019/16 2023/10 2034/8 2037/14 2037/23 2047/18 2053/22 2068/17 talks [1] 1981/9 tank [17] 1967/1 1970/1 1972/14 1999/20 2006/17 2012/17 2012/18 2017/11 2018/19 2039/14 2044/5 2045/13 2049/19 2056/2 2056/15 2058/21 2062/9 Technical [1] 1981/17 technique [7] 1969/2 1974/15 1983/6 1999/1 2015/7 2016/3 2016/8 techniques [8] 1965/22 1967/23 1969/23 1986/9 1987/14 1987/15 2015/20 2016/5 tells [2] 1995/23 2048/5 tender [1] 1960/7</p>	

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there [100] 1956/11 1960/5 1960/9 1962/1 1962/16 1964/21 1973/5 1975/10 1975/11 1976/5 1978/13 1978/16 1982/2 1985/2 1987/13 1988/4 1988/6 1999/19 2006/14 2008/1 2008/5 2008/7 2008/18 2010/7 2010/25 2014/5 2014/14 2015/5 2017/13 2023/7 2023/10 2023/13 2023/16 2023/18 2023/20 2026/14 2026/21 2026/22 2029/12 2029/15 2029/21 2029/23 2029/24 2030/3 2030/6 2030/25 2032/7 2032/11 2032/22 2032/23 2036/9 2036/11 2036/24 2037/24 2038/1 2038/3 2038/4 2038/9 2038/12 2038/25 2038/25 2040/19 2041/3 2042/17 2042/25 2044/11 2045/1 2045/6 2047/9 2048/2 2048/3 2048/5 2048/6 2048/18 2048/25 2048/25 2050/21 2052/12 2055/5 2055/10 2057/15 2058/18 2059/21 2061/2 2061/2 2062/20 2063/13 2063/18 2063/24 2063/24 2064/2 2064/2 2064/3 2064/5 2064/9 2064/10 2064/20 2065/2 2065/2 2066/22	third [5] 1950/23 1995/5 1995/6 2032/18 2032/19 this [203] Thomas [2] 1950/2 1951/11 thorough [1] 1979/20 those [48] 1955/11 1955/19 1955/23 1956/21 1957/3 1957/5 1958/13 1961/24 1965/6 1971/6 1972/6 1977/17 1980/14 1981/11 1987/15 1991/18 1998/11 1999/23 1999/25 2001/16 2002/4 2003/8 2004/1 2004/6 2013/11 2017/21 2019/11 2029/12 2029/12 2031/5 2037/22 2037/23 2038/13 2038/14 2045/2 2049/3 2049/7 2049/8 2049/11 2049/15 2049/18 2050/9 2052/11 2058/7 2059/24 2069/1 2069/2 2070/10	top [9] 1975/3 1980/6 1994/17 2002/5 2003/1 2022/25 2060/14 2063/18 2064/12 topic [1] 1962/1 Torts [1] 1951/6 total [9] 1970/16 1972/14 1997/22 2029/24 2032/19 2033/9 2043/16 2061/3 2064/11 touch [1] 2067/15 toward [1] 1975/12 towards [3] 1961/4 1961/5 1996/6 TPC [17] 1975/18 1975/19 1976/11 1976/17 1977/7 1977/11 1977/18 1977/19 1979/4 1979/5 1979/6 1979/11 1979/14 2010/3 2010/7 2010/12 2010/19
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<p>T</p> <p>two... [23] 2002/17 2009/18 2011/2 2011/3 2011/6 2018/14 2026/19 2029/15 2045/1 2045/6 2045/18 2048/22 2048/22 2049/3 2049/18 2053/24 2057/12 2059/10 2060/6 2061/2 2061/2 2066/13 2066/23</p> <p>type [4] 1985/20 2003/20 2049/24 2054/5</p> <p>types [2] 1961/17 1961/23</p> <p>typically [4] 1961/23 1963/7 1969/7 1988/10</p>	<p>2018/18 2019/19 2028/20 2029/18 2036/25 2037/19 2038/9 2039/19 2040/10 2041/11 2041/22 2042/20 2043/24 2045/10 2047/7 2054/20 2056/2 2056/14 2059/8 2059/8 2061/6 2066/15 2070/20 2071/5</p> <p>upon [2] 1983/16 2058/4</p> <p>upper [6] 1991/17 2059/13 2059/16 2060/6 2060/6 2060/10</p> <p>upstream [2] 2023/2 2023/4</p> <p>upward [2] 1975/1 1976/11</p> <p>upward-trending [1] 1976/11</p> <p>upwards [1] 2005/19</p> <p>us [5] 1999/4 2001/25 2008/15 2059/23 2070/3</p> <p>use [37] 1963/12 1965/22 1967/14 1970/5 1970/11 1974/11 1976/7 1976/21 1977/1 1984/18 1986/9 1987/6 1987/18 1997/11 1998/4 2001/9 2001/25 2008/12 2014/11 2014/12 2014/16 2016/6 2020/18 2021/22 2024/5 2027/11 2030/16 2030/18 2038/8 2041/5 2044/7 2046/12 2046/18 2052/7 2056/13 2057/3 2057/7</p> <p>used [53] 1955/10 1957/1 1965/20 1965/24 1968/24 1970/8 1971/25 1974/19 1975/24 1976/5 1980/18 1982/7 1984/14 1987/19 1987/20 1987/21 1996/12 2000/18 2001/7 2002/18 2008/11 2008/16 2011/14 2013/7 2013/7 2013/9 2016/8 2016/21 2018/14 2025/21 2026/16 2037/2 2043/20 2045/19 2045/25 2046/10 2051/21 2052/11 2052/14 2052/17 2052/19 2053/4 2053/6 2053/24 2054/5 2054/24 2055/6 2055/16 2056/23 2057/15 2057/17 2063/2 2063/3</p> <p>useful [2] 1968/12 1975/8</p> <p>uses [7] 2015/6 2015/20 2017/4 2017/5 2041/8 2043/12 2044/2</p> <p>using [15] 1953/24 1967/18 1969/23 1971/24 1984/18 1987/14 1992/13 1995/8 2005/11 2018/17 2027/12 2049/4 2049/5 2056/12 2059/5</p> <p>usual [1] 2067/17</p> <p>usually [1] 1961/6</p>	<p>1992/10 2010/4</p> <p>very [30] 1962/2 1963/6 1963/23 1964/5 1967/17 1968/12 1981/20 1982/18 1984/1 1984/14 1994/17 1998/2 2001/18 2005/19 2007/23 2013/6 2013/21 2013/21 2015/15 2016/4 2016/11 2016/13 2016/22 2016/22 2020/12 2024/7 2048/3 2050/21 2062/24 2070/19</p> <p>vessels [1] 2059/25</p> <p>video [4] 1957/21 1957/23 1958/7 1958/9</p> <p>videotaped [1] 1958/3</p> <p>view [3] 2035/15 2047/13 2047/21</p> <p>views [1] 2004/11</p> <p>virtually [1] 1999/13</p> <p>viscosity [2] 1973/25 1978/14</p> <p>visual [1] 2059/5</p> <p>VOIR [1] 1959/2</p> <p>volume [44] 1966/8 1966/13 1966/20 1966/25 1967/12 1969/13 1969/25 1970/16 1972/11 1972/14 1973/7 1986/18 1995/15 1995/22 1997/3 1997/4 1997/16 1997/24 1998/4 1998/10 1999/5 2001/13 2002/13 2003/2 2003/9 2004/5 2005/5 2005/15 2009/5 2012/9 2012/17 2015/8 2015/17 2016/9 2017/9 2021/2 2026/13 2027/12 2030/22 2044/24 2048/4 2048/8 2048/20 2052/22</p> <p>volumes [1] 2017/16</p>
<p>U</p> <p>U.S [2] 1951/6 1951/9</p> <p>ultimately [7] 1966/24 1967/25 1980/1 1999/4 2004/3 2045/4 2045/5</p> <p>uncertain [10] 1966/23 1982/18 1983/6 1998/2 1998/3 1998/5 2013/11 2016/11 2016/13 2043/18</p> <p>uncertainties [11] 1963/10 1963/16 1965/25 1973/19 2014/5 2030/15 2030/17 2030/21 2030/25 2031/3 2031/10</p> <p>uncertainty [61] 1963/4 1963/11 1963/14 1963/15 1963/19 1963/20 1964/2 1964/6 1965/3 1965/17 1967/5 1967/10 1967/20 1967/21 1967/23 1968/4 1968/15 1969/24 1970/3 1973/9 1973/14 1973/16 1977/13 1978/12 1983/14 1983/23 1983/25 1985/3 1985/4 1985/5 1985/17 1985/23 1986/12 1988/5 1988/15 1991/2 1992/22 1992/23 1992/25 1996/24 1997/8 1997/15 1997/20 2005/10 2005/17 2005/22 2013/10 2013/12 2013/14 2013/15 2013/18 2013/22 2013/23 2017/1 2030/19 2035/14 2035/17 2036/3 2042/17 2042/17 2059/21</p> <p>under [6] 1962/1 1982/18 1982/24 1984/9 2025/3 2040/13</p> <p>underground [3] 1969/4 1969/5 1971/18</p> <p>understand [4] 2006/25 2056/24 2068/10 2068/14</p> <p>understanding [3] 1956/21 2033/21 2071/19</p> <p>understood [1] 1976/5</p> <p>Unfortunately [1] 1983/10</p> <p>unique [3] 1972/16 1972/19 1972/20</p> <p>UNITED [21] 1949/1 1949/10 1949/15 1951/6 1951/9 1955/8 1955/9 1955/21 1955/25 1956/6 1957/1 1957/10 1957/20 1958/6 1958/8 1958/16 1958/16 2037/2 2066/10 2067/15 2071/16</p> <p>University [2] 1960/24 1962/12</p> <p>unknown [1] 1983/11</p> <p>Unless [1] 2071/9</p> <p>unlikely [1] 2039/25</p> <p>unphysical [1] 2010/19</p> <p>unreal [1] 2049/21</p> <p>unrealistic [1] 2016/22</p> <p>unreasonable [4] 2012/5 2040/2 2040/4 2040/4</p> <p>until [6] 2001/24 2032/8 2032/12 2033/15 2041/2 2066/14</p> <p>unusual [1] 2039/20</p> <p>up [39] 1957/13 1959/12 1959/16 1966/19 1968/17 1970/6 1972/22 1974/21 1975/13 1975/14 1981/12 1990/19 1991/5 2007/10 2007/10</p>	<p>us [5] 1999/4 2001/25 2008/15 2059/23 2070/3</p> <p>use [37] 1963/12 1965/22 1967/14 1970/5 1970/11 1974/11 1976/7 1976/21 1977/1 1984/18 1986/9 1987/6 1987/18 1997/11 1998/4 2001/9 2001/25 2008/12 2014/11 2014/12 2014/16 2016/6 2020/18 2021/22 2024/5 2027/11 2030/16 2030/18 2038/8 2041/5 2044/7 2046/12 2046/18 2052/7 2056/13 2057/3 2057/7</p> <p>used [53] 1955/10 1957/1 1965/20 1965/24 1968/24 1970/8 1971/25 1974/19 1975/24 1976/5 1980/18 1982/7 1984/14 1987/19 1987/20 1987/21 1996/12 2000/18 2001/7 2002/18 2008/11 2008/16 2011/14 2013/7 2013/7 2013/9 2016/8 2016/21 2018/14 2025/21 2026/16 2037/2 2043/20 2045/19 2045/25 2046/10 2051/21 2052/11 2052/14 2052/17 2052/19 2053/4 2053/6 2053/24 2054/5 2054/24 2055/6 2055/16 2056/23 2057/15 2057/17 2063/2 2063/3</p> <p>useful [2] 1968/12 1975/8</p> <p>uses [7] 2015/6 2015/20 2017/4 2017/5 2041/8 2043/12 2044/2</p> <p>using [15] 1953/24 1967/18 1969/23 1971/24 1984/18 1987/14 1992/13 1995/8 2005/11 2018/17 2027/12 2049/4 2049/5 2056/12 2059/5</p> <p>usual [1] 2067/17</p> <p>usually [1] 1961/6</p>	<p>1992/10 2010/4</p> <p>very [30] 1962/2 1963/6 1963/23 1964/5 1967/17 1968/12 1981/20 1982/18 1984/1 1984/14 1994/17 1998/2 2001/18 2005/19 2007/23 2013/6 2013/21 2013/21 2015/15 2016/4 2016/11 2016/13 2016/22 2016/22 2020/12 2024/7 2048/3 2050/21 2062/24 2070/19</p> <p>vessels [1] 2059/25</p> <p>video [4] 1957/21 1957/23 1958/7 1958/9</p> <p>videotaped [1] 1958/3</p> <p>view [3] 2035/15 2047/13 2047/21</p> <p>views [1] 2004/11</p> <p>virtually [1] 1999/13</p> <p>viscosity [2] 1973/25 1978/14</p> <p>visual [1] 2059/5</p> <p>VOIR [1] 1959/2</p> <p>volume [44] 1966/8 1966/13 1966/20 1966/25 1967/12 1969/13 1969/25 1970/16 1972/11 1972/14 1973/7 1986/18 1995/15 1995/22 1997/3 1997/4 1997/16 1997/24 1998/4 1998/10 1999/5 2001/13 2002/13 2003/2 2003/9 2004/5 2005/5 2005/15 2009/5 2012/9 2012/17 2015/8 2015/17 2016/9 2017/9 2021/2 2026/13 2027/12 2030/22 2044/24 2048/4 2048/8 2048/20 2052/22</p> <p>volumes [1] 2017/16</p>
<p>under [6] 1962/1 1982/18 1982/24 1984/9 2025/3 2040/13</p> <p>underground [3] 1969/4 1969/5 1971/18</p> <p>understand [4] 2006/25 2056/24 2068/10 2068/14</p> <p>understanding [3] 1956/21 2033/21 2071/19</p> <p>understood [1] 1976/5</p> <p>Unfortunately [1] 1983/10</p> <p>unique [3] 1972/16 1972/19 1972/20</p> <p>UNITED [21] 1949/1 1949/10 1949/15 1951/6 1951/9 1955/8 1955/9 1955/21 1955/25 1956/6 1957/1 1957/10 1957/20 1958/6 1958/8 1958/16 1958/16 2037/2 2066/10 2067/15 2071/16</p> <p>University [2] 1960/24 1962/12</p> <p>unknown [1] 1983/11</p> <p>Unless [1] 2071/9</p> <p>unlikely [1] 2039/25</p> <p>unphysical [1] 2010/19</p> <p>unreal [1] 2049/21</p> <p>unrealistic [1] 2016/22</p> <p>unreasonable [4] 2012/5 2040/2 2040/4 2040/4</p> <p>until [6] 2001/24 2032/8 2032/12 2033/15 2041/2 2066/14</p> <p>unusual [1] 2039/20</p> <p>up [39] 1957/13 1959/12 1959/16 1966/19 1968/17 1970/6 1972/22 1974/21 1975/13 1975/14 1981/12 1990/19 1991/5 2007/10 2007/10</p>	<p>V</p> <p>valid [1] 1986/8</p> <p>validation [1] 1971/6</p> <p>value [12] 1992/21 1994/23 1994/23 1996/9 1996/13 2004/13 2005/1 2006/5 2006/16 2016/22 2041/24 2052/19</p> <p>values [16] 1980/17 1984/17 1991/14 1992/13 1993/22 1995/16 1995/25 1995/25 1996/21 2006/14 2007/13 2008/13 2008/16 2043/1 2043/2 2057/5</p> <p>variable [1] 1983/11</p> <p>variations [1] 2052/2</p> <p>varied [8] 1986/14 1989/25 1997/23 1998/2 2025/8 2027/16 2042/15 2052/21</p> <p>varies [1] 1983/24</p> <p>various [15] 1977/1 1978/2 1978/3 1981/7 1986/17 1998/8 2001/9 2001/10 2013/17 2022/14 2023/23 2031/1 2036/10 2042/16 2048/17</p> <p>vary [9] 1980/2 1985/15 1988/14 1996/8 1997/24 2025/5 2025/10 2026/11 2026/17</p> <p>varying [1] 2053/1</p> <p>versus [1] 1984/20</p> <p>vertical [5] 1975/1 1977/25 1991/22</p>	<p>wait [7] 1964/9 1964/9 2066/14 2068/10 2069/4 2069/4 2069/4</p> <p>waive [1] 1956/3</p> <p>walk [4] 1971/14 1989/17 2024/7 2038/16</p> <p>wall [1] 1984/7</p> <p>want [25] 1964/1 1964/4 1964/11 1965/18 1965/19 1965/21 1965/21 1966/12 1981/3 1981/15 1985/13 1993/14 1999/21 2004/23 2010/14 2018/17 2020/12 2020/16 2024/6 2030/8 2030/10 2037/18 2041/13 2067/6 2070/13</p> <p>wanted [14] 1967/22 1979/20 1985/7 1985/16 2002/11 2002/13 2002/14 2020/14 2041/7 2049/23 2051/21 2056/13 2066/12 2066/24</p> <p>WARREN [1] 1953/15</p> <p>was [224]</p> <p>Washington [5] 1951/8 1951/16 1952/8 1952/11 1953/16</p> <p>way [16] 1961/5 1998/20 1998/23 2000/14 2006/8 2010/11 2013/9 2020/12 2027/9 2028/11 2030/16 2048/12 2050/13 2056/11 2062/12 2064/23</p> <p>ways [1] 1971/8</p> <p>we [117] 1955/11 1955/12 1955/24 1956/2 1956/17 1957/4 1957/8 1957/11 1957/13 1957/21 1959/12 1959/16 1960/16 1961/1 1962/5 1963/6 1963/13 1964/5 1964/7 1965/10 1965/22 1966/12 1966/14 1966/15 1966/16 1966/19 1968/19 1969/16 1970/4 1970/6 1971/4 1972/5 1974/21 1976/14 1977/20 1978/24 1980/20 1981/1 1981/12 1982/19 1982/23 1982/23 1982/24 1983/1 1983/19 1984/16 1984/17 1984/18 1984/22 1985/11 1985/13 1985/19 1986/1 1986/9 1987/6</p>
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