

In the Matter Of:

PROFAC HOLDING vs
HALLIBURTON ENERGY SERVICES

MICHAEL NIKOLAOU

July 10, 2024



1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3 IPR2023-01319 Patent No. 7,841,394

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5 PROFAC HOLDING CORPORATION and

6 U.S. WELL SERVICES, LLC,

7 Petitioners,

8 vs.

9 HALLIBURTON ENERGY SERVICES,

10 INC.,

11 Patent Owner.

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15 REMOTE DEPOSITION OF DR. MICHAEL NIKOLAOU

16

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19 Wednesday, July 10, 2024

20 7:56 a.m. (EDT)

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23 Reported By:

24 Joan Ferrara, RMR, FCRR

25 Job No. 2024-947515

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July 10, 2024

7:56 a.m. (EDT)

Deposition of DR. MICHAEL NIKOLAOU,
held remotely via Zoom, before Joan
Ferrara, a Registered Merit Reporter,
Federal Certified Realtime Reporter and
Notary Public.

1 REMOTE APPEARANCES:

2

3 ON BEHALF OF PATENT OWNER:

4 BAKER BOTTS LLP

5 2001 Ross Avenue

6 Suite 900

7 Dallas, Texas 75201

8 BY: JENNIFER CARTER, ESQ.

9 CHAD C. WALTERS, ESQ.

10

11

12 ON BEHALF OF PETITIONER:

13 WINSTON & STRAWN LLP

14 1901 L Street NW

15 Washington, DC 20036

16 BY: SCOTT BORDER, ESQ.

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18

19 ALSO PRESENT:

20 JOSE CARRANZA, Remote Monitor

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1 DR. MICHAEL NIKOLAOU,
2 called as a witness, having been
3 duly sworn by a Notary Public, was
4 examined and testified as follows:

5 EXAMINATION BY

6 MR. CARTER:

7 Q All right. Good morning,
8 Dr. Nikolaou.

9 A Good morning.

10 Q You are here to testify today
11 for IPR 2023-01318 for the '082 Patent, is
12 that correct?

13 A That is correct.

14 Q All right. Have you ever been
15 deposed before?

16 A I have.

17 Q How many times?

18 A A single-digit number, close to
19 10 perhaps.

20 Q And have any of those
21 depositions been for PTAB proceedings?

22 A PTAB? Help me with the term,
23 please.

24 Q Sure. "PTAB" means Patent Trial
25 and Appeal Board proceedings. So an IPR,

1 like this one, is a PTAB proceeding. So if
2 you've testified for any other IPRs or
3 PGRs.

4 A Yes, yes.

5 Q And how many of those have
6 been -- of your testimonies have been for
7 IPR proceedings?

8 A A small number, again,
9 single-digit number.

10 Q All right. And now, I'd like to
11 go over just some of the ground rules for
12 the deposition.

13 The common goal is a clean
14 record and just to avoid speaking over one
15 another.

16 Can we get on the same page with
17 that?

18 A Perfect.

19 Q Excellent.

20 And yes and no answers are
21 preferred, no uh-huhs or nodding.
22 Definitely want -- we need some verbal
23 responses.

24 A Agreed.

25 Q All right. And where are you

1 located today?

2 A I am located in Athens, Greece.

3 Q Nice.

4 Is there anyone there in the
5 room with you today?

6 A I'm sorry, could you repeat,
7 please?

8 Q Is there anyone else in the room
9 with you today?

10 A In the room? No.

11 Q All right. And then how did you
12 prepare for this deposition?

13 A I looked at a number of
14 documents related to my previous
15 declaration with regard to this patent, and
16 I had some conversations with the attorneys
17 with whom I'm collaborating.

18 Q And which attorneys did you have
19 conversations with in preparation for this
20 deposition?

21 A Mr. Border, Scott Border, who is
22 in this session today, and Matt Hopkins,
23 and to a lesser extent, Steven Laxton.

24 Q And when did you have these
25 conversations?

1 A Yesterday.

2 Q Any other times?

3 A That I spent preparing on this?

4 Q Yes, sir.

5 A Yes. I went over related
6 documents on my own before having a session
7 with these attorneys so I can be better
8 prepared and take better advantage of their
9 time.

10 Q But other than the session
11 preparing with your attorneys yesterday,
12 did you have any other preparation sessions
13 for this particular IPR?

14 A Not with anybody else.

15 Q And do you have any copies of
16 the papers and the exhibits with you?

17 A Not on my screen right now. I
18 have copies of a number of things in my
19 computer, but everything is closed.

20 Q Okay. And do you plan to use
21 those at any time during this deposition?

22 A No, which is why I requested to
23 have a clean copy of the exhibits so it can
24 be the same denominator.

25 Q Got it I can do that for you.

1 Actually, the first
2 deposition -- or the first exhibit that
3 we'd like to talk about is Exhibit 1004,
4 your CV.

5 (Exhibit 1004, Curriculum Vitae
6 for Michael Nikolaou; 23 pages, was
7 referenced.)

8 BY MS. CARTER:

9 Q I've got it in the chat box now.
10 Please let me know when you're able to open
11 it up.

12 A I don't see it in the chat box
13 yet.

14 Q Okay. It's still kind of
15 loading.

16 A Is it a large file -- oh, yeah.
17 Okay. I got it.

18 PTAB-IP -- et cetera, right?

19 Okay. So let me download it.

20 Just one second to download it
21 and...

22 It's downloading now and I
23 believe it's there, so let me open the PDF.

24 Okay. I have that file open
25 now.

1 Q All right. And this
2 Exhibit 1004, this is your curriculum
3 vitae, is that correct?

4 A Correct.

5 Q And let's talk a little bit
6 about your professional experience.

7 A Yes.

8 Q Under your professional
9 experience, you identify some industry
10 experience as a process and computer
11 specialist for Union Pacific Resources, is
12 that correct?

13 A That is correct.

14 Q What were your roles and
15 responsibilities while you were at Union
16 Pacific Resources?

17 A I was working with people in
18 that natural gas plant in Bryan, Texas,
19 which was run by Union Pacific Resources.

20 And specifically. I was
21 providing expertise on design and operation
22 issues related to automating some of these
23 tasks, for example, how to design a new
24 piece of equipment that would be needed to
25 pass fluids from one unit to another in the

1 plant or how to prepare a unit for
2 installation of an advanced control system.

3 So that was my role, and it
4 was -- on a daily basis that was my job for
5 that summer, because the academic position
6 typically involves a full-time employment
7 by the university, which was Texas A&M at
8 the time.

9 And that engagement during the
10 summer of '91 was with the company so I can
11 improve my experience, learn more things
12 about how things get done in practice, and
13 also, contribute my expertise to that
14 plant.

15 Q And the natural gas plant, what
16 type of equipment did the natural gas
17 plant include?

18 A It's typical equipment that you
19 see in processing plants, plants that
20 process chemicals, natural gas in this case
21 in particular.

22 So do I have some time to
23 explain very briefly how this whole thing
24 works?

25 Q Just --

1 A Very briefly.

2 Q -- just the basic equipment with
3 the --

4 A Of course, yes. So -- let me
5 explain very briefly.

6 So natural gas comes from wells
7 that people drill into rock formations.
8 And when that natural gas comes out of the
9 ground, it's not clean for transportation
10 and use.

11 So the first thing that you do
12 to natural gas once you have it ready in
13 the surface of the earth out of the ground
14 is to clean it up and make it ready for
15 transportation and use. That's what a
16 natural gas plant does.

17 That cleanup involves removing
18 acids, such as hydrogen sulfide or carbon
19 dioxide. It involves removing moisture
20 because that would -- both of these things,
21 acids and moisture, would create problems
22 downstream.

23 Acids would create corrosion
24 problems to various pieces of equipment,
25 including transportation lines.

1 Moisture would create problems
2 in downstream operations. For example, the
3 next step for natural gas would be what is
4 known as cryogenic distillation, which is a
5 separation process by which the components
6 of natural gas are separated.

7 The main component is methane.
8 That's what you get when you have a line in
9 your house, let's say, that provides
10 natural gas. It's mostly methane.

11 And the other components are
12 other hydrogen carbons, such as ethane,
13 propane, butane, other liquid hydrocarbons.

14 So from there, there may be
15 other separation steps that may be done in
16 the same plant or, most of the time, in
17 other plants, depends on the situation.

18 So that, in summary, is what a
19 natural gas plant does. It treats the gas
20 so that it can be clean for transportation
21 and use.

22 Q And the natural gas plant, it
23 gets natural gas from producing wells, is
24 that correct?

25 A It gets natural gas from

1 producing wells, yes. It's not clean gas.

2 It's gas as it gets out of the ground, yes.

3 Q Where was the natural gas
4 located with respect to the producing
5 wells?

6 A You mean the source for this
7 plant?

8 Q Yes.

9 A I don't remember. To be honest
10 with you, I don't remember what were the
11 exact sources of natural gas were at the
12 time.

13 And it wasn't just a single
14 source. There were a number of sources
15 that would feed natural gas to the plant.

16 Typically, that is done over
17 short distances, and the lines are sturdy
18 enough to withstand the natural gas being
19 transported through these lines so it can
20 be cleaned up at that plant and then
21 transported further or long distances in
22 use, for example, to be transported to the
23 northeast or thousands of miles.

24 Q And have you had any other oil
25 and gas industry experience other than your

1 role at Union Pacific?

2 A Oh, yeah, yes. It was through a
3 number of engagements, which I list in my
4 resumé.

5 So one such engagement was
6 through Noble -- it was called "Noble
7 Drilling" at the time. So I participated
8 in a project which developed an automation
9 system for horizontal drilling.

10 My role was to design the
11 algorithms that would provide this kind of
12 capability for the system, that is, to
13 automatically adjust the drilling operation
14 so that horizontal drilling can be done
15 smoothly.

16 It was quite a successful
17 project, actually, because after that,
18 there was a small company put together by
19 the principals of that project, which was
20 eventually bought by Schlumberger. So if
21 you go to SLB.com these days, I believe
22 they still have that project called
23 "Slider," and that describes roughly what
24 the technology is and what it does.

25 At the same -- during the same

1 period actually, I had additional
2 interactions with the people at -- excuse
3 me for a minute. Is there an echo or can
4 you hear me okay?

5 Q I can hear you okay. I'm not
6 hearing any echo.

7 MR. WALTERS: I'm hearing
8 something as well.

9 THE WITNESS: Okay. If that is
10 not bothering anyone, I'll continue
11 then.

12 I hear that I should continue.

13 A So I was saying that I had
14 additional interactions with people at
15 Noble Drilling at actual websites providing
16 expertise usually for automation-related
17 issues on how to drill a well -- well,
18 excuse the pun -- like how to adjust the
19 weight on the bit at the bottom of the
20 drill string that drills to the well or how
21 to design the optimal path or how to follow
22 the optimal path and other things like
23 that.

24 This collaboration with Noble
25 Drilling was in early 2000, I believe

1 2002-3, around that time, and years later,
2 I also had additional involvement with
3 this -- well, the principals of the Slider
4 company for designing improvements on the
5 system, generation 2 type of improvements,
6 and so forth.

7 There have been other
8 interactions through consulting projects
9 that I did with other companies over the
10 years, and I list those in my resumé. If
11 you'd like me to expand on any one of
12 those, I'd be happy to do that.

13 Q And with all the experience
14 that -- the industry experience you
15 referenced, has any of that industry
16 experience brought you to spending time at
17 a well site?

18 A At a well site? Yes, yeah.

19 On a number of occasions, for
20 example, with Noble Drilling, we had a
21 number of days spent, from my end, in a
22 well in Carthage, Texas, I believe, or
23 Longview, in that area, in north Texas.

24 I spent time at a well in Bryan,
25 Texas, where we did the testing for Slider

1 to drill that well.

2 I had other involvement with,
3 you know, actual wells -- let me try to
4 remember -- in Norway -- actually, that was
5 an experimental well that the International
6 Research Institute of Stavanger, in
7 Stavanger, they test automation practices
8 usually for drilling and sometimes they do
9 this for production purposes.

10 I also had -- let's see -- there
11 was an experimental well in Oklahoma where
12 we had tests done with a company called
13 "Rotus," again testing some new ideas for
14 development of better drilling practices
15 for horizontal drilling.

16 So, roughly, those are some
17 involvements on my end that I can recall
18 off the top of my head.

19 Q So recently, you provided
20 testimony for IPR 2023-01319 for the '394
21 Patent, is that correct?

22 A Yes.

23 Q And I'd like to share --

24 A To be honest, I don't recall the
25 numbers --

1 Q Excuse me?

2 A -- but I trust you cited -- I
3 don't recall the exact numbers, but I trust
4 that you cited them correctly, so we'll
5 move on.

6 Q I'd like to share the transcript
7 of your testimony from that deposition.
8 You should get it in the chat box.

9 THE COURT REPORTER: What
10 exhibit number is this?

11 MS. CARTER: This would be
12 Exhibit 2002.

13 (Exhibit 2002, Deposition
14 Transcript of Dr. Michael Nikolaou,
15 dated June 6, 2024; 240 pages, was
16 referenced.)

17 A Okay. I opened the file. This
18 is a file that starts with: "In the matter
19 of: Profac Holding Corporation v.
20 Halliburton Energy Services," etc., right?

21 Q Okay. And this is the
22 transcript of your testimony for the '394
23 Patent IPR, is that correct?

24 A Yes.

25 Q Exhibit 2002.

1 So I'd like to confirm some of
2 your testimony from the '394 IPR.

3 Is that okay?

4 A Yes.

5 Q So you testified earlier that
6 you have never been to a well site where
7 fracturing operations were occurring, is
8 that correct?

9 A That is correct, yes.

10 Q And you also testified earlier
11 that you've never been at a well during
12 production operations, is that correct as
13 well?

14 A Not when actual production was
15 taking place, that is correct, yes. Not
16 that I can recall at least.

17 Q All right. Next, I'd like to go
18 over your -- some of the things in your
19 declaration, and I'm going to share
20 Exhibit 1003 with you in the chat box.

21 (Exhibit 1003, Declaration of
22 Michael Nikolaou, filed October 3,
23 2023; 184 pages, was referenced.)

24 A Okay. I opened that file. It's
25 a file that starts: "In The United States

1 Patent and Trademark Office," et cetera, et
2 cetera?

3 Q Yes. And this is the
4 declaration that you provided for the '082
5 Patent IPR, is that correct?

6 A Correct.

7 Q Let's go to paragraph 2 of your
8 declaration.

9 It lists a -- it provides a list
10 of materials that you used to prepare your
11 declaration.

12 A Yes.

13 Q Did you rely on anything else
14 other than these materials when preparing
15 your declaration?

16 A I relied on what I cite there
17 and my general knowledge of the field of
18 drilling and production of hydrocarbons
19 from hydrocarbon wells.

20 Now, everything that was
21 important for my declaration is listed
22 there.

23 Q Now, let's go to paragraph 27.

24 A 27, that would be on what page?

25 Q 16 of Exhibit 1003.

1 A 16, yes.

2 Paragraph 27 starting: "As
3 discussed above and detailed," et cetera,
4 correct?

5 Q And so paragraph 27, the last
6 sentence says: "I believe that I would
7 qualify as understanding the knowledge and
8 skill of a POSITA as of October 16, 2007,
9 and I have a sufficient level of knowledge,
10 experience, and expertise to provide an
11 expert opinion in the field of the '082
12 Patent."

13 A Yes.

14 Q And so you would consider
15 yourself to be a POSITA for the purposes of
16 this proceeding as of October 16, 2007, is
17 that correct?

18 A I'm stating there that I
19 understand -- I believe I understand what
20 would be the level of a POSITA for that
21 date.

22 Q Got it.

23 And what are the specific
24 experiences by this 2007 date that you feel
25 that most qualifies you as a POSITA?

1 A Those have to do with design and
2 operation practices that are followed to
3 construct and operate hydrocarbon-producing
4 wells.

5 Q And would you say that your
6 experiences far exceed those of a POSITA
7 with respect to the '082 Patent?

8 A Perhaps, because I have
9 additional expertise through my research or
10 consulting activities, for example, in
11 issues related to automation or designing a
12 special fluid, or things like that.

13 Q All right. Let's go to the
14 background of the technology section
15 starting in paragraph 28.

16 A 28, yes.

17 Q So in this section in paragraphs
18 30 through 32, you discuss oil and gas
19 extraction from wells including drilling,
20 is that right?

21 A Paragraphs 30 through 32, oil
22 and gas extraction from wells. That's
23 section A, correct?

24 Q Yes.

25 A Yes, very good.

1 Q And what happens during the
2 drilling stage? What particular equipment
3 is involved in drilling?

4 A It's a drilling rig that is
5 placed on the ground.

6 So there is a rotated so-called
7 drill string. It's a long tube made of
8 sections of inter-threaded pieces about, I
9 think, 30-foot long each, which has a drill
10 bit at the bottom.

11 So you rotate that using related
12 equipment, and that chews -- at the bottom,
13 it chews the rock, and the fragments, the
14 so-called cuttings, which is essentially
15 rock that was chewed by the drill bit,
16 those cuttings are lifted to the surface by
17 the drilling mud.

18 The drilling mud flows through
19 the drill string. That long pipe that I
20 mentioned of metal that consists of pieces
21 about 30-foot long each threaded to each
22 other, that pipe of the drill string
23 carries drilling mud, and the mud goes down
24 through the drill string and up through the
25 annular space.

1 The annular is between the drill
2 string and the walls of the well.

3 And mud actually has a number of
4 functions. One is to carry the cuttings to
5 the top. It helps to lubricate the drill
6 string. It helps to cool off the drill
7 string.

8 Those are some basic functions
9 that the drilling mud has.

10 All of these pieces that I
11 mentioned are operations on which -- and
12 the practices that -- on which there is a
13 lot of expertise developed both through
14 theory and practice, and it is used in the
15 field to produce hydrocarbons.

16 Q And is drilling a part of well
17 development?

18 A Drilling is -- well, it creates
19 the well, yeah. It creates a big hole in
20 the ground -- a long hole in the ground so
21 that hydrocarbons can move from the rock --
22 from the pores of the rock to the well and
23 then to the surface.

24 Q And would that process of
25 drilling or creating the well, is that a

1 part of well development?

2 A Well, you create the well, yes,
3 through that process.

4 Q Is drilling a part of well
5 treatment?

6 A Drilling creates the well. And
7 when you have created the well, when you
8 have created that long hole in the ground,
9 then you can do other things to it, which
10 typically are called "well treatment."

11 Q And so well treatment comes
12 after drilling the well?

13 A Well, how you do all these
14 things is a matter of how you coordinate
15 your operations, but you must have a well
16 to start with, or at least part of a well,
17 to do well treatment.

18 Q All right. And so is drilling a
19 part of well treatment then, or is it
20 something that occurs after?

21 A No. The drilling is what
22 creates the well.

23 Q And is drilling a part of well
24 production?

25 A Drilling -- well, you mean well

1 production or hydrocarbon production --

2 production of hydrocarbons?

3 Q Well production.

4 A I'm not sure that I understand
5 what the term "well production" means,
6 unless you mean production of hydrocarbons
7 through a drilled well?

8 Q Sure. Well, then I can ask the
9 question that way.

10 Is drilling a part of
11 hydrocarbon production?

12 A Well, usually, no, unless you do
13 some more special techniques, like
14 under-balanced drilling, which is not with
15 production in mind, but it's mainly on how
16 to make sure that we avoid unsafe
17 situations during drilling of wells.

18 When hydrocarbons escape from
19 the rock formation, it may damage your
20 drilling operation. This is what happened
21 in the Macondo well, for example, back in
22 2010.

23 There is also a technique that
24 allows hydrocarbons, mostly gases, to go to
25 the well during the drilling operation, and

1 this is called under-balanced drilling.

2 But the concern there is how to drill the
3 well well rather than how to optimize
4 production.

5 Q All right. And let's move on to
6 paragraph 33.

7 A Paragraph 33.

8 Q In this paragraph, you discuss
9 completion.

10 A Yes.

11 Q And do you have any experience
12 with well completions?

13 A Experience on the spot, no.
14 Experience on how you may complete the
15 well, mainly how you put additional
16 equipment and how you stimulate the well
17 and all that, yes, through my consulting
18 and research projects, leading to a number
19 of publications on the subject.

20 Q What happens during completion?

21 A You have the well, which is a
22 big hole in the ground. And as I am
23 explaining in my declaration, there are a
24 number of things that you can do once you
25 have that big hole in the ground.

1 33 starts after the well is
2 drilled, it needs to be cased. That can be
3 done step by step. You drill part of the
4 well, you case it, you go to the next part
5 and you case it, and you keep going like
6 that, or it can be in a single shot
7 depending on the length of the well, the
8 depth of the well, the configuration of the
9 well and all of these things.

10 And there may be additional
11 equipment that you may add to that well, as
12 I'm discussing further down.

13 Q And does completion use
14 different equipment from drilling
15 equipment?

16 A Completion, yeah, it may use
17 additional equipment. That is correct,
18 yes.

19 Q And what typically happens to
20 the drilling equipment once completion
21 activities are started?

22 A It's a matter of how you
23 coordinate, how you use your equipment
24 optimally. So you may drill part of the
25 well, then case it, and then continue

1 drilling and continue casing until you
2 finish, and then you may do other things.

3 If you count those -- if you
4 count stimulation, for example, as part of
5 the completion and well treatment, then you
6 may no longer need the drilling equipment
7 in place.

8 It's a matter of coordinating
9 different pieces of equipment that do
10 different things for the well or to the
11 well so that you can have the highest
12 benefit with a minimum cost.

13 Q Is completion a part of well
14 development?

15 A Completion, yes, it is part of
16 well development.

17 Q What about well treatment, is
18 completion a part of well treatment?

19 A Could you repeat that?

20 Q Sure.

21 Is completion a part of well
22 treatment?

23 A Completion, yes, it's part of
24 well treatment, correct.

25 Q And is completion a part of

1 hydrocarbon production?

2 A Completion prepares the well for
3 hydrocarbon production.

4 Q But isn't it part of hydrocarbon
5 production?

6 A Usually, you do a completion so
7 you can facilitate hydrocarbon production.

8 Now, the two may alternate,
9 completion production, then re-completing
10 and resuming production, and so forth. But
11 usually, you try not to mix the two.

12 Q Okay. And then in paragraphs 35
13 through 38, you discuss well stimulation,
14 is that correct?

15 A Correct, yes, hydraulic
16 fracturing, yes.

17 Q What happens during well
18 stimulation?

19 A What happens during well
20 stimulation is the following: The
21 hydrocarbons to be produced through a well
22 come from the pores of the rock around the
23 well. And for these hydrocarbons to be
24 produced, namely to reach through the well
25 the surface, these hydrocarbons must first

1 reach the well.

2 To reach the well, those
3 hydrocarbons have to travel through these
4 interconnected pores of the rock.

5 The pores of the rock that bears
6 the hydrocarbons may not be very well
7 connected. As a result, the hydrocarbons
8 may not easily flow to the well and then to
9 be produced by traveling through the well
10 to the surface.

11 This problem is extreme in
12 unconventional formations, most notably,
13 the famous shale formations, where how
14 easily hydrocarbons flow through shale is
15 1,000 times more difficult than
16 hydrocarbons flowing through a brick, for
17 example.

18 So to facilitate that, mainly,
19 to help hydrocarbons travel from their
20 pores to the well, people create hydraulic
21 fractures.

22 These hydraulic fractures are
23 what the term says, the hydraulic means --
24 it refers to how they are created. But
25 fractional fractures, they're thin, narrow

1 openings in the rock through which the
2 hydrocarbons can travel to the well after
3 leaving, abandoning their pores.

4 The idea is though that from
5 pores to the fracture, the hydrocarbons
6 have to travel a very, very small distance.
7 And so they spend the time to travel to the
8 fracture, and from there, they travel
9 quickly to the well, and from there, to the
10 surface.

11 It's like trying to travel by
12 car and you can -- you live in a
13 neighborhood, you go traffic light by
14 traffic light through a few traffic lights
15 to the freeway, and then you take the
16 freeway -- which is the fracturing in our
17 case -- to go perhaps even to an airport,
18 and from there, take a plane and go to your
19 final destination.

20 So that's a nice analogy to
21 describe what happens.

22 That's the hydraulic fracturing
23 process. And as I said, it's of paramount
24 importance in horizontal -- in shale wells,
25 where with horizontal wells, despite

1 massive, extensive hydraulic fracturing,
2 people can produce large amounts of
3 hydrocarbons that had historical
4 implications that are well-known and widely
5 discussed.

6 Q And what equipment is used
7 during the stimulation?

8 A The equipment -- well, there are
9 a number of steps in stimulation.

10 So you have the well. You have
11 to initiate the fractures, so, essentially,
12 lower equipment to the well that may
13 initiate the fracture, essentially to what
14 people call a "gun." And that's what it
15 is, it shoots bullets to the rock and it
16 initiates the fracture.

17 And then you remove that. You
18 fill the well with fluid, usually water,
19 plus additional things that help various --
20 accomplish various tasks.

21 So you put the water in. You
22 pressurize the water. The pumps at the top
23 pressurize the water. The rock will
24 initiate fractures where the bullets were
25 shot first, and those fractures will

1 propagate.

2 So by doing this judiciously, it
3 help to create fractures where you want
4 them and not let them escape to various
5 places where you don't want them.

6 And once you are there, namely,
7 have your fractures where you want them,
8 then you take that water back and you have
9 your well ready now for production. So you
10 have your production equipment there and
11 start producing.

12 Q Who typically owns the
13 stimulation equipment?

14 A I'm sorry, you typically what?

15 Q Who typically owns the
16 stimulation equipment?

17 A The stimulation equipment -- oh,
18 who owns it. That's an issue that I cannot
19 say 100 percent who the owner is.

20 But companies that offer oil
21 field services have access to stimulation
22 equipment so that they can complete the
23 jobs for which they are tasked.

24 So, typically, it's oil field
25 services companies that do the fracturing,

1 and they have access to that equipment.

2 Whether they rent it or own it
3 and all that, it's a financial decision. I
4 haven't looked into that in detail, to be
5 honest with you.

6 Q Does the company that performs
7 the stimulation -- the well stimulation,
8 typically, does that company also perform
9 the flowback operation?

10 A Flowback, you mean to pick up
11 the water used in stimulation and dispose
12 of it in a good way?

13 Q Yes.

14 A Yeah, that's quite typical, yes.

15 Q And so the -- it's typical that
16 stimulation equipment, including the
17 flowback equipment, is owned by the same
18 company?

19 A Well, the company that does the
20 job typically will do the whole job. So
21 they're not going to do half of the job and
22 leave it for somebody else to finish it.

23 And, again, that's what
24 typically happens. I haven't dealt with an
25 economic analysis of who exactly owns what

1 and who may rent or lease equipment or do
2 other things. Those are financial
3 decisions in which I do not have much
4 experience.

5 But I can tell that an
6 integrated operation, where you inject the
7 water and then you pick the water back once
8 your stimulation is completed, yeah, that's
9 typical of what a service company does.

10 Q Okay. And is stimulation a part
11 of well development?

12 A Yes.

13 Q Is stimulation a part of well
14 treatment?

15 A Yes.

16 Q What about hydrocarbon
17 production, is stimulation a part of
18 hydrocarbon production?

19 A Production happens with a well
20 that is at the stage where the development
21 that people intended to reach has reached a
22 certain stage, which makes the well ready
23 for production.

24 Now, wells may be redeveloped.
25 For example, there may be refracturing,

1 there may be recompletion depending on how
2 the well fairs over time. But, typically,
3 one would say that you do one thing at a
4 time so that you can maintain some sanity
5 and do things well.

6 Q All right. And your technology
7 background section does not address
8 production operations, is that correct?

9 A My background -- I'm sorry, I
10 lost some part of your statement. Could
11 you repeat it?

12 Q Sure.

13 The technology background
14 section, that does not address production
15 operations, is that correct?

16 A In my declaration you mean?

17 Q Yes.

18 A I don't recall, but I don't
19 believe we spent -- I can check really
20 quickly.

21 Could I have a few seconds to
22 check?

23 Q Yes.

24 A So we do refer to production in
25 a few places in my discussion, my

1 declaration.

2 For example, in paragraph 33, we
3 talk about installing the wellhead in
4 production tree. But the emphasis is on
5 well stimulation, which is the focus of all
6 this discussion.

7 Q And why is well stimulation the
8 focus of your discussion versus production?

9 A Because that's what the '082
10 Patent is about.

11 Q And does --

12 A Let me check one more time,
13 please, to make sure that --

14 Q Certainly?

15 A -- I didn't misspeak. So...

16 Yeah. Okay. It's fine. Yes,
17 go ahead, please.

18 Q Sure.

19 And does production use
20 different equipment from stimulation?

21 A Stimulation uses its own
22 equipment. Production uses its own
23 equipment. That is correct.

24 Q What typically happens to the
25 stimulation equipment once production

1 operations have commenced?

2 A Again, that's a resource, a
3 location issue. So if you no longer need
4 that equipment in a particular well site,
5 you move it to another well site, you do
6 something else with it, maybe a nearby
7 well, maybe some other location maybe. It
8 depends on the situation.

9 Q And --

10 A But overall -- I'm sorry, go
11 ahead, please.

12 Q No, please. Overall?

13 A Overall, you have a certain role
14 for the equipment of either treatment or
15 stimulation or production. And in each
16 case, you use the equipment that is
17 required so you can accomplish certain
18 tasks.

19 Q And who typically owns the
20 production equipment?

21 A Again, typically, there will be
22 a lease by the operator, the company that
23 has the asset.

24 And who exactly owns the
25 equipment is a financial decision on which

1 I haven't spent much time, namely, is the
2 equipment leased, is it owned, is it
3 borrowed? Those are things on which I
4 don't have much experience, and I don't
5 believe I was asked to comment on these.

6 Q Sure.

7 Who typically -- does the same
8 company that provides the production
9 equipment to the site also provide the
10 stimulation equipment to the well site?

11 A Again, that's a financial
12 decision. Typically, as a matter of
13 practical division of labor, there are
14 service companies that do certain things to
15 prepare and complete wells, and there are
16 companies -- operating companies that own
17 or lease the well sites so they can do the
18 production.

19 And beyond that, whether these
20 technologies and the equipment stay with
21 either operating or service companies,
22 those are financial decisions. They may
23 change over time. It depends on what is
24 more profitable, more efficient and so
25 forth.

1 So, again, those are financial
2 decisions. So that are typically handled
3 in collaboration between the operating and
4 the service companies.

5 Q Does the same service company
6 that provides the production equipment,
7 though, usually also provide the
8 stimulation equipment?

9 A Again, that's a matter of
10 agreement and the location of assets. So I
11 haven't looked into that in detail.

12 From my general knowledge, that
13 may even change over time. For example, a
14 well-known trend is that operating
15 companies over the years have drifted
16 towards assigning additional tasks to
17 service companies in the whole business of
18 hydrocarbon production, mainly drilling the
19 wells and producing.

20 So those, again, are issues of
21 financial nature, not so much of technology
22 use. So I haven't paid much attention to
23 these as those were not the focus of this
24 discussion.

25 Q Is production a part of well

1 development?

2 A Production is an operation where
3 you actually use the well to produce
4 hydrocarbons.

5 So as you produce, the well may
6 actually change. For example, there may be
7 accumulation of debris near the well in the
8 pores of the rock. This is known as the
9 "skin effect" and the skin may have to be
10 treated so you can get back to good
11 production rates.

12 So production and development of
13 the well are certainly interrelated, and
14 one affects the other. But you try to do
15 either one or the other to maintain some
16 sanity, like I said.

17 Q All right. And is production a
18 part of well treatment?

19 A In production, the well -- like
20 I said, the well is there. So you would
21 prefer not to mix the two and treat the
22 well while you're producing, except in
23 exotic cases.

24 But I said those -- like
25 under-balanced drilling -- but this is not

1 for improving production. This is for
2 improving the drilling process. That's the
3 focus.

4 MS. CARTER: Well, Dr. Nikolaou,
5 we've been going about an hour now.
6 Would you like a break?

7 THE WITNESS: Sure. That would
8 be great.

9 MS. CARTER: And I know that
10 this isn't your first deposition and
11 you know the rules, but --

12 THE WITNESS: Of course.

13 MS. CARTER: -- just a reminder
14 to not discuss the substance of your
15 testimony with counsel during breaks.

16 THE WITNESS: Absolutely.

17 (Recess taken 8:52 a.m.)

18 (Resumed 9:04 a.m.)

19 BY MS. CARTER:

20 Q All right. Dr. Nikolaou, next,
21 I'd like to ask you some general questions
22 about some terms and technology relevant to
23 the '082 Patent.

24 The first is a well development
25 task fluid. What is a well development

1 task fluid?

2 A Are you referring to terms I use
3 in my declaration? And should I use
4 references to my declaration or shall I
5 repeat verbally how I understand those
6 terms?

7 Q However you think best.

8 Yes, these are terms that you do
9 use in your declaration. They're terms
10 that are used in the '082 Patent. And I'm
11 just trying to get a general understanding
12 of, you know, what a well development task
13 fluid is.

14 A Yes. So as we mentioned, when
15 one drills and develops a well, there are
16 fluids involved that have various
17 functions.

18 The first one which is classic
19 during the drilling of the well, if you
20 count that as part of the development, is
21 drilling mud. That's one fluid.

22 Also, during hydraulic
23 fracturing, which is for stimulation, which
24 is another part that you can consider for
25 developing a well, you will use a fluid,

1 typically water, along with other things
2 that are needed to create the fractures and
3 make sure that they stay there when you
4 remove the water.

5 Those are some classic examples
6 of fluids used in creating and completing a
7 well.

8 Q So during what specific stages
9 of the well are well development task
10 fluids used?

11 You mentioned drilling and
12 completion, stimulation. Are there any
13 other stages in which well development task
14 fluids are used?

15 A Well, there is cementing. When
16 you put -- when you put the casing, you put
17 cement between the casing and the rock.

18 So to make sure that the casing
19 stays in place, you inject a cement slurry
20 to the well, and that serves the purpose --
21 after it solidifies, it helps the purpose
22 of making sure that the casing stays there.

23 Q All right. And any other stages
24 in which well development task fluids are
25 used?

1 A For development purposes, those
2 are key fluids used.

3 Again, the idea with all of
4 these is that you have to have a way of
5 delivering -- first of all, creating a
6 fluid of appropriate properties, be that
7 drilling mud or cement slurry or water for
8 fracturing. So you prepare the fluid and
9 you deliver the fluid to the right
10 location.

11 Q Okay. And are development task
12 fluids used during production?

13 A Production is a process that may
14 use fluids that are usually of different
15 nature. As the tasks are different, you
16 have hydrocarbons, oil and gas, flowing
17 from the well to the surface, so you want
18 to make sure that this process is done as
19 efficiently and economically as possible.

20 So use whatever it takes to
21 accomplish that. Namely, you create the
22 fluids and deliver a technology so that,
23 again, you can develop the right fluid to
24 the right location so that can accomplish
25 the task for which the fluid has been

1 designed.

2 Q But are well development task
3 fluids, are those used during production?

4 A Well development fluids, for
5 example -- let's be more specific --
6 fracturing water with all the additives
7 that it has? No, this is for a particular
8 task. It's to create fractures.

9 So when you produce, you have
10 removed that water that you used for
11 fracturing, so you need different fluids of
12 different nature so that you can deliver
13 them and let them do their job for which
14 they have been designed.

15 Q Okay. Well treatment fluids,
16 what is a well treatment fluid?

17 A It's a fluid that you use so
18 that you can accomplish a treatment of the
19 well.

20 If you want to do something to
21 the well that you just did, then,
22 typically, as I explained and I gave some
23 examples a moment ago, you may typically
24 have to use some fluids.

25 Like if you want to put a

1 casing, you want to have a cement slurry,
2 if you want to create fractures you will
3 use water. You know, these are some
4 classic examples of fluids that are used to
5 treat a well in a certain way and complete
6 it so it can be ready for production.

7 Q During what stages of the well
8 are well treatment fluids typically used?

9 A Well, that may vary, but
10 commonly, you first complete the well so
11 you can initiate production. You don't
12 want to start production without having
13 completed your well, at least to the best
14 of your understanding for the particular
15 design that you think is going to deliver
16 good production.

17 Further down, as production
18 proceeds, you may have to re-complete the
19 well in a number of ways depending on
20 whether the production has dropped to a
21 point that the well needs to be
22 restimulated, or you may need to fix
23 problems that may have emerged as a result
24 of say debris collecting near the interface
25 at the bottom of the well where the

1 hydrocarbons flow to the well, and so
2 forth.

3 Q So well treatment fluids --

4 A This particular -- I'm sorry, I
5 think --

6 Q I'm sorry, I'm experiencing some
7 delay.

8 A Yes. Sorry, my apologies.

9 Let me try it. One, two, three.
10 One, two, three. Can you hear me okay?

11 Q Yes. It seems to have resolved
12 itself.

13 A One, two, three. Okay. Are we
14 in sync?

15 Q Got it.

16 A Okay. Good.

17 Q I think we're good.

18 A Let's try that again. Okay.

19 Q So the question was, well
20 treatment fluids, so those are typically
21 used during production?

22 A Well treatment fluids are used
23 to treat the well to prepare it for
24 production.

25 Q But are they typically used

1 during production?

2 A There is no need to treat the
3 well during production. So during
4 production, you use other fluids that are
5 relevant to production.

6 Q How are well treatment fluids
7 different from well development task
8 fluids?

9 A Treatment and development, I
10 consider those terms to refer to similar
11 things in the sense that you do something
12 to the well which prepares it for
13 production.

14 So I would consider that these
15 two terms, treatment and development, I
16 would consider those terms to encompass
17 similar things, being different terms to
18 denote a similar thing basically.

19 Q Are well treatment fluids and
20 well development task fluids the same?

21 A Well, like I said, there are
22 various tasks. And if these two terms
23 encompass the same activities, then the
24 fluids are the same by default.

25 It's a matter of semantics,

1 right? It's not that the two are similar
2 in nature and all that. They refer to the
3 same thing.

4 Q So well treatment fluids and
5 well development task fluids can be the
6 same?

7 A They can be the same, I think,
8 in the context that I described.

9 So you develop the well, of
10 course, initially, and you treat the well
11 so that you can initiate the good
12 production, and you may have to repeat some
13 of these things to improve the well or fix
14 the well if there is a problem and all
15 that.

16 So those are things that may
17 happen over time.

18 Q But can you provide an example
19 of an instance to where the well treatment
20 fluids and the well development task fluids
21 would be the same?

22 A If well development means
23 stimulating the well, then well treatment,
24 well development refers to stimulation. So
25 it's the same process.

1 It's not like you do different
2 things with different -- with the same
3 fluid. It's that they refer to the same
4 thing.

5 Q So stimulation fluid can be both
6 a well treatment fluid and a well
7 development task fluid?

8 A Well, if these -- if there is
9 agreement that these two terms are
10 referring to the same thing, development
11 and treatment, then, obviously, it's the
12 same substance that is used in the same
13 thing.

14 It's a matter of semantics, of
15 course, namely, what one understands by
16 each of these terms.

17 It is reasonable to me to assume
18 that development and treatment refer to the
19 same thing.

20 I should also point out that
21 this may not be universal. Some people may
22 say development is early on. Treatment may
23 refer to fixing things down the road, later
24 on.

25 So it's in this context that I

1 interpret these terms. But I believe I
2 explained in what context I understand
3 these terms.

4 Q Who is it at the well site who
5 typically handles the well treatment
6 fluids?

7 A Well, there is a crew, and, you
8 know, there is a whole organization there,
9 a number of people.

10 There's a lot of automation
11 these days, actually. There is typically a
12 separate room where data collected through
13 various sensors and various places, either
14 downhole or at the surface, those are fed
15 to the computer systems.

16 The computer systems will tell
17 you what is happening, what you may want to
18 do next, what the computer recommends that
19 will happen next and all that.

20 And there's the typical
21 hierarchy that you would find in any
22 industrial operation. There is a manager.
23 There are people who actually execute
24 various tasks that have to be done
25 manually. And there's continuous

1 monitoring either manually or by a
2 computer, or it's usually a combination of
3 both.

4 Q And so just to be clear, when I
5 refer to these terms, I'm referring to how
6 they're used in the '082 Patent.

7 So in the context of well
8 development task fluids and well
9 development treat fluids, can they be the
10 same thing with respect to the '082 Patent?

11 A Yes. The '082 Patent is
12 concerned mainly with the fracturing -- or
13 stimulation, rather, of a well, which is an
14 extremely important operation and very well
15 described, and the patent describes it also
16 very well.

17 Q The next term is recovered well
18 treatment fluids.

19 What is a recovered well
20 treatment fluid?

21 A So when you do something to the
22 well using certain fluids, the fluids will
23 want to remain there forever because you
24 want to make room for the -- typically,
25 for -- you want to make room for the

1 hydrocarbons to flow through the well.

2 This is the very reason why you're creating
3 the well.

4 So if we are talking about, say,
5 drilling mud, for example, very quickly, I
6 would say, Well, once drilling is stopped,
7 obviously, there's no drilling mud to speak
8 of. You remove the mud.

9 If there is stimulation, you use
10 water, you pressurize it, you initiate the
11 fractures, and when it's all done, you
12 remove the water. You have included
13 proppants, something like sand, for
14 example, that keeps the fractures open
15 after you remove the water so that the
16 fractures can provide a highway, a freeway
17 to the hydrocarbon -- for the hydrocarbons
18 to reach the well and then zoom to the top.

19 So recovering the fluids is
20 typical because you don't want to leave
21 them there.

22 And then there may be more to
23 that, namely, as you recover -- namely, to
24 be more specific, as the fluid comes --
25 whatever fluid you use, as it comes back to

1 the top, what do you do with that fluid?

2 In drilling, drilling mud, for
3 example, it's expensive, and it's called
4 "mud," but it's actually hi-tech fluid
5 containing all kinds of exotic additives
6 and things that -- most of it -- many of
7 those are actually proprietary to, in part,
8 insert properties into the mud.

9 Now, the mud carries cuttings,
10 so you would want to remove these cuttings
11 and retain the mud, use it again.

12 If you use, say, water to do
13 fracturing, when that water comes back to
14 the top, you want to do something with it
15 to use it again.

16 You may want to clean it up if
17 it contains contaminants and it's cheap
18 enough to remove those contaminants that
19 were picked up by the water through its
20 circulation downhole and through the rock.
21 So you may do that.

22 If not -- if it's not
23 economical, you may want to dispose of that
24 water in a way that is not environmentally
25 threatening.

1 And environmental threats may
2 include contamination all the way to
3 creating small earthquakes and things like
4 that.

5 So there is an entire series of
6 considerations you want to look at when you
7 use these fluids downhole and you pick them
8 up back at the top. And the general idea
9 is you're not free to just do anything you
10 want with these fluids. There are
11 constraints, environmental, economical,
12 safety and such constraints, and you want
13 to do something sensible like recycling or
14 cleaning up and recycling or disposing of
15 the fluid in an environmentally known
16 threatening...

17 Q So in the context of your
18 drilling example, what would be the
19 recovered well treatment fluid?

20 A Really, we are drilling mud. In
21 fact, you recover it continuously. There's
22 a circuit of circulating this mud
23 throughout during the drilling process.
24 And because the mud -- it actually operates
25 at a rather high velocity, so high speed,

1 so it carries the cuttings to the top, and
2 you want to remove these and circulate that
3 mud back to the well.

4 So it's a typical reuse of a
5 fluid that you use in an operation that had
6 to do with creating the well.

7 Q So in the context of your
8 drilling example, what would be the
9 difference between the well treatment fluid
10 and the recovered well treatment fluid?

11 A In the case of drilling mud?

12 Q Yes.

13 A Drilling mud, when it goes into
14 the well, it's clean. It doesn't have
15 cuttings in it. It may have other things
16 to, in part, viscosity properties, thermal
17 stability properties, specific gravity to
18 make sure you don't let hydrocarbons
19 migrate to the top and blow up and ruin
20 your whole day.

21 And when it comes back to the
22 top, it contains basically cuttings. There
23 may be other stuff that the mud picked up,
24 but it always contains cuttings. That's
25 the very purpose of using the -- well, one

1 of the very purposes of using the mud, as I
2 mentioned a little earlier.

3 So you clean it up. You pass it
4 through. There are various ways to clean
5 it up. And then you circulate it back.

6 Q And then in the terms of your
7 stimulation example, what would be the well
8 treatment fluid versus the recovered well
9 treatment fluid?

10 A So the well treatment fluid is
11 water, plus whatever additives you have.
12 And you use it so that you can create the
13 fractures. And then you want to make sure
14 that after you remove the fluid, the
15 fractures stay open.

16 So when you inject the fluid, it
17 has additives that give it certain flow
18 properties. For example, to make sure that
19 you don't lose some of that fluid through
20 natural fractures or pores or any other
21 waste to the formation, you want to keep it
22 pressurizing the rock.

23 Now, when you remove the water,
24 you want something to stay behind and keep
25 the fractures open. That's why you include

1 the sand, typically. That's the idea.
2 It's called "proppant." So that it can
3 describe the act of propping the fracture
4 open after the water is removed.

5 And what you get at the top is
6 what is left from this operation.

7 Q Can production fluid be
8 recovered well treatment fluid?

9 A Production fluid is the
10 hydrocarbons that are produced, and to
11 facilitate the production of hydrocarbons,
12 you may inject things that prevent gelling,
13 prevent solidification, prevent hydrate
14 formation. They -- or improve the
15 viscosity.

16 I mean -- excuse me -- they
17 impart properties to the hydrocarbons
18 solution, essentially, that are beneficial
19 for production. But that fluid is not
20 stimulation fluid, which is of different
21 nature, it has a different task, it has
22 different properties, and it is designed to
23 be injected again, do the job and be picked
24 up at the top at the end.

25 Q So the production fluid is

1 different from the recovered well treatment
2 fluid?

3 A The production fluid is mainly
4 hydrocarbons. The treatment, the
5 stimulation fluid, is water with additives
6 minus the proppants that stay in the rock
7 after you pick up your water.

8 Q What components does the
9 production fluid usually have?

10 A The production fluid has the
11 hydrocarbons. That's the main thing. And,
12 of course, along with hydrocarbons, you may
13 have other things, typically water.

14 There are wells that have, you
15 know, 90, 95 percent water. They still --
16 people still make money with the small
17 percentage of hydrocarbons being produced
18 in such wells.

19 And if you have additives to
20 facilitate production, those will be picked
21 up at the top.

22 Q During what stages of the well
23 are well production fluids typically
24 present?

25 A Well, when it's needed.

1 Q Production fluids --

2 A Okay. So let me continue.

3 So you are producing, and if you
4 assess that you could improve production,
5 for example, you could improve the
6 production rate by -- or you could make it
7 safer and avoid having a clogged line, or
8 anything like that, you may add something
9 to the fluid at the bottom typically so
10 that you can have the right flow and
11 produce the hydrocarbons from your well.

12 You use those when you think
13 they are needed and beneficial.

14 Q So previously, you had said that
15 production fluid is primarily hydrocarbons
16 and could include some water, but then you
17 were referring to some other components.

18 Are those -- are there
19 additional components included in the
20 production fluid other than water and
21 hydrocarbons?

22 A Yes. As we explained, for
23 example, in natural gas production, you may
24 have acids, you may have CO2, you may have
25 hydrogen sulfite.

1 Whatever mother earth put down
2 there is not -- has not been built to
3 specifications. It has been built by
4 whatever time produced for us, created for
5 us down there. So you pick up those things
6 at the top -- you move them to the top and
7 you just try to use whatever is worth using
8 for a certain task.

9 I refer to water that you
10 mentioned to make the case that some --
11 many, many wells, actually, will produce an
12 amount of water -- that is extremely
13 common -- and in some wells may produce
14 very large amounts of water. Because those
15 are all wells and people can still make
16 money because they just are a rudimentary
17 operation, they produce -- it's not very
18 costly to just lift that fluid to the top.
19 It's only, let's say, 5 percent
20 hydrocarbons, 95 percent water, but it can
21 still make a little bit of money. So
22 they'll do that.

23 It's a matter -- as I've said
24 several times, from that point on, we know
25 how to do the engineering, it's a matter of

1 cost/benefit of whether I'll keep producing
2 and lifting up all that water or whether
3 I'll just abandon the operation, do
4 something else, move on.

5 But it's -- as you pointed out,
6 and I'll agree with that, that water, it
7 comes from the rock. It's what the rock
8 produces. That water flows through the
9 well in the direction that return water
10 would flow after you complete a stimulation
11 process.

12 So you injected the -- in
13 stimulation, in creating fractures, you
14 injected water, you did the fracturing,
15 created the fractures, let the sand stay
16 back, and then you pick up the water back
17 naturally so that you can proceed with the
18 next steps and reach production.

19 Q So what is the difference
20 between production fluid and recovered well
21 treatment fluids?

22 A I'm sorry, you broke up again.
23 Could you repeat?

24 Q Yes.

25 What is the difference between

1 production fluid and recovered well
2 treatment fluids?

3 A So recovered well treatment
4 fluids are fluids that you inject and you
5 pick up, and you do these for a certain
6 purpose, as we explained through a number
7 of examples a few moments ago.

8 Production fluids are fluids
9 that mother earth gives us when we let her
10 do that by creating a well and let those
11 fluids move to the top.

12 Perhaps along with some -- well,
13 there are issues with secondary production
14 and -- recovery, rather -- secondary
15 recovery and tertiary recovery, in which
16 case you inject water from a well, the
17 water travels through the rock and pushes
18 the hydrocarbons, along perhaps with water,
19 to be produced at another well at the other
20 end.

21 It's more difficult to do -- or
22 it's not much more difficult to do for
23 horizontal wells. People have been doing
24 quite a bit for a long time in vertical
25 wells. This is a technology under

1 development. It's quite exciting,
2 actually.

3 Q All right. I would like to
4 introduce Exhibit 1005.

5 (Exhibit 1005, Pub. No. US
6 2009/0114392 A1, was referenced.)

7 A 1005. Let me see if I can open
8 it.

9 Okay. That's the Tolman patent,
10 right?

11 Q That's correct, yes.

12 So Exhibit 1005 is a patent
13 application, publication to Tolman, et al.

14 A Yes.

15 Q Is that correct?

16 A That is correct.

17 Q And can you scroll to Figure 2,
18 please?

19 A Figure 1. Figure 2, yes.

20 Q So Figure 2 illustrates a
21 configuration for stimulation operations,
22 is that correct?

23 A Correct.

24 Q And you primarily rely on this
25 configuration illustrated in Figure 2 for

1 both of your grounds in your declaration,
2 is that correct?

3 A That is correct. In summary, my
4 position is that there is a pretty good
5 description of how to coordinate
6 stimulation from a central location, and
7 that means how to prepare, deliver and
8 recover fluids for that operation for which
9 some additional help may be mustered from
10 the other two patents that I mentioned so
11 that I won't just use hand waving in the
12 arguments that this was well-known or it
13 was well-understood and everybody knew it
14 and all that.

15 Instead of that, we use two
16 specific references to be more specific.

17 Q And more specifically, you rely
18 on Tolman's stimulation fluid storage
19 system marked as 204 in Figure 2 as part of
20 your combination, is that correct?

21 A That is correct, yes. That's
22 where the fluid is stored and prepared for
23 use in the stimulation process.

24 Q And the stimulation fluid
25 storage system, that's a piece of

1 stimulation equipment, is that fair?

2 A I'm sorry, you broke up just for
3 a moment. Could you repeat?

4 Q Sure.

5 The stimulation fluid storage
6 system, it's a piece of stimulation
7 equipment, is that fair?

8 A Yes.

9 Q And the stimulation fluid system
10 stores stimulation fluid?

11 A Yes, it stores stimulation
12 fluid.

13 Q And what type of stimulation
14 fluid -- what type of fluid is stimulation
15 fluid in terms of the '082 Patent?

16 A It's mainly water and sand and
17 what other additives you may use so that
18 you can have the right properties for flow,
19 avoiding losses, have an easy operation and
20 so forth -- easy flowback, for example, and
21 all that.

22 Q Is the stimulation fluid a well
23 development task fluid?

24 A It is indeed a well development
25 task fluid, yes.

1 Q Is it also a well treatment
2 fluid?

3 A Yes. So to the extent that
4 treatment and development mean the same
5 thing, it's a fluid that you use to develop
6 or treat the well in a certain way so that
7 it has the right properties that you want
8 when you start production.

9 Q Does Tolman's stimulation fluid
10 storage system store any other type of
11 fluid than stimulation fluid?

12 A I'll have to look it up. I
13 don't believe that they refer to any other
14 fluid being stored there.

15 But would you give me a moment
16 to check to see how they describe that?

17 Q Sure. Certainly.

18 A Thank you.

19 So this is block 204. So let me
20 see the details.

21 And the reason why I'm looking
22 it up, by the way, is that this is not
23 centrally in the operation in the sense
24 that they accept that it is very well-known
25 how to prepare a stimulation fluid,

1 although this may well be proprietary
2 information, but all companies doing this
3 business of stimulation have their own
4 recipe so they can prepare stimulation
5 fluids there for the purpose.

6 So let me look at what Tolman
7 says about 204.

8 Okay. So there is a
9 description. Yeah, I can -- I refreshed my
10 memory. It's on page 10 of 18 in
11 Exhibit 1005.

12 Towards the bottom, Tolman
13 says -- it's paragraph 0029, and I'll just
14 read it for the record: "To provide a
15 stimulation treatment, the JITP system may
16 include the stimulation fluid pumping
17 system 202 and stimulation fluid storage
18 system 204."

19 204 is the system we are looking
20 at right now.

21 "The stimulation fluid pumping
22 system 202 couples to the stimulation fluid
23 storage system 204 via piping 203, which
24 may be high pressure still lines or low
25 pressure hoses depending on the specific

1 application. The stimulation fluid storage
2 system 204 is a vessel that holds a
3 sufficient volume of fluid for the planned
4 stimulation treatments. It is noted that
5 the stimulation fluid storage system 204
6 may include tanks located on the surface
7 pad 102, at pit dug on the surface pad 102,
8 and/or a pond, lake, river or water storage
9 facility located in close proximity to the
10 surface pad 102."

11 So Tolman basically says I
12 somehow manage to have this fluid stored
13 and ready for use, and I start from there
14 basically.

15 Q All right. So the only fluid
16 that is stored in the stimulation fluid
17 storage system is stimulation fluid,
18 correct?

19 A Yeah. Yeah, the term suggests
20 that. It says, "stimulation fluid," yes.

21 Q So you also rely on the
22 stimulation fluid pumping system marked as
23 202 in Figure 3 -- or Figure 2, excuse me.

24 A Figure 2, yeah, let me go there.

25 Q As part of your combination.

1 A Sorry, relying on the
2 stimulation fluid pumping system to deliver
3 the fluid -- the stimulation fluid -- is
4 that what you mean?

5 Q Let me reask it.

6 So you also rely on the
7 stimulation fluid pumping system 202 in
8 Figure 2 as part of your combination in
9 your declaration, is that correct?

10 A Yes, this is part of my
11 declaration explaining that, in the context
12 of preparing and delivering a fluid
13 relevant to this operation -- stimulation,
14 that is -- you start with a fluid that you
15 pick up from somewhere -- this is 204, the
16 stimulation fluid storage system -- and
17 then you have to deliver that system to the
18 right place at the right time.

19 So this delivery, as described
20 in Figure 2, starts with the stimulation
21 fluid pumping system, and there are valves
22 shown further down in various pipes and so
23 forth so that the fluid can be delivered to
24 the right location on a timely basis.

25 Q And at what pressures would the

1 stimulation fluid pumping system pump

2 stimulation fluid downhole?

3 A Usually high. How high I
4 deliver it, it depends on the kind of rock
5 and how hard you need to push the rock to
6 fracture it.

7 It's typically thousands of PSI.

8 Q So anywhere from 10 to 15,000
9 PSI sounds about right?

10 A What was the number again?

11 Q Anywhere from 10 to 15,000 PSI
12 sounds about right?

13 A On order of magnitude, yes. And
14 I don't remember specific numbers, to be
15 honest with you. And like I said, those
16 depend on the kind of rock you have.

17 But down there, to open up the
18 rock, you definitely need, let's say, a few
19 thousand PSI at least.

20 So 10 to 15,000, I don't --
21 again, I don't remember specifics, but it
22 doesn't look unrealistic, let me say that
23 in honesty.

24 Q And the pressure that the
25 stimulation fluid pumping system pumps

1 stimulation fluid downhole, would that be
2 lower or higher than the pressures at which
3 production additives would be pumped
4 downhole?

5 A Production additives have to be
6 added downhole. They have to withstand
7 basically the hydraulic head pressure and
8 whatever friction the production fluids
9 experience as they move up.

10 So the pressure at which these
11 additives would be added would be somewhat
12 lower. And I believe that is a fair
13 statement to say, that these -- the
14 pressure of these additives would be
15 somewhat lower.

16 Q How much lower?

17 A Well, it depends on the shape of
18 the well, the depth of the well, the width
19 of the well, the kind of the fluids that
20 you have. It's a number of factors that
21 basically determine how much pressure you
22 need to provide to that fluid that you
23 inject at the bottom so it can move with
24 the remaining fluids to the top.

25 Here, we don't try to fracture a

1 rock. So when you try to fracture a rock,
2 typically, you have to withstand the
3 strength of the rock, which is why
4 hydraulic fracturing typically works at
5 higher pressures.

6 Q At what rates would the
7 stimulation fluid pumping system pump
8 stimulation fluids downhole?

9 A That varies because -- there is
10 a nice curve, actually, that shows that you
11 start injecting the fluid and then, you
12 know, there is flow rate because the well
13 absorbs -- not absorbs -- receives the
14 fluid.

15 So you start pumping and the
16 well receives a lot of fluid. And you
17 reach a point where you have filled up the
18 well and now you start pushing so you can
19 start breaking the rock. And you need to
20 push a lot.

21 And once you initiate the
22 breakup of the rock, you initiate the
23 fracture, then you can start pumping a bit
24 more. And you keep going until you have
25 pumped enough to open up the rock enough

1 and then you stop the pump.

2 And those are very
3 well-prescribed parts of the curve that is
4 taught in standard courses for hydraulic
5 fracturing, how to infer properties of the
6 rock and how to design the process and all
7 that.

8 Q Typically, though, what are
9 stimulation fluid pumping rates?

10 A I don't remember off the top of
11 my head. But like I said, the rate is
12 initially high because you fill up the
13 well.

14 Then you start pressurizing so
15 you can break the rock. In that part,
16 there's not much fluid flowing. It's just
17 the pressure that increases.

18 Then eventually, the pressure
19 increases so much that it starts breaking
20 the rock, then flow starts again through
21 the fractures that you are initiating.
22 It's a small flow, but nevertheless, it's a
23 flow that you can monitor and measure.

24 And you keep with that until you
25 have your fractures to the length -- at the

1 length that you want. And then you stop,
2 you stop the pumps, you retrieve the water,
3 and you move on.

4 Q Would a rate on the order of
5 barrels per minute sound about right for
6 the rate at which stimulation fluids are
7 typically pumped downhole?

8 A Frankly, I don't remember
9 specific numbers. So I don't have a
10 specific number off the top of my head.

11 Q Now, you also rely on flowback
12 manifolds as part of your combination in
13 your declaration, is that correct?

14 A Well, which part in my
15 declaration are you referring to?

16 Or in that figure, if you can
17 just guide me a little bit to make sure I
18 didn't miss anything --

19 Q Certainly.

20 So the flowback manifolds in
21 Figure 2 of Tolman are labeled as 230A
22 through C.

23 A Oh, yes. Okay. Yes.

24 Q So you rely on those flowback
25 manifolds as part of your combination in

1 your declaration, correct?

2 A In fact, indeed. And, in fact,
3 Tolman is more general. They say, I
4 deliver the fluids, and then after that,
5 after I have delivered the fluids, I have
6 the flowback lines and then I can deliver
7 these fluids anywhere it makes sense. I
8 can pick them up, clean them up, dispose of
9 them.

10 They have a discussion on what
11 the 236, 234 and 238 lines do in -- they
12 have a discussion in the text, and we have
13 part of the discussion in my declaration.

14 Q I believe what you're
15 referencing is paragraph 28 of Tolman.

16 If you could go there on
17 page 10.

18 A Stay on Tolman, paragraph 28,
19 right? Not my declaration.

20 Q Yes, sir.

21 A Okay. Very good.

22 So paragraph 28, yes, I'm there.

23 Q And in the second-to-last
24 sentence of paragraph 28, it says: These
25 flowlines may be coupled to flowback pits,

1 flow test units, sales lines, tankage,
2 oil/gas/water separating and processing
3 units and/or other similar devices.

4 Is that correct?

5 A Yes.

6 Q These flowback pits, flow test
7 unit, sales lines, tankage, oil/gas/water
8 separating and processing units and/or
9 other similar devices, those are not
10 located in the same location as the
11 stimulation fluid storage system that we
12 discussed earlier, is it?

13 Excuse me?

14 A Which ones again?

15 Okay. Sorry. Which ones are
16 not located in the same location?

17 Q Any one of those structures in
18 paragraph 28 that we just discussed, are
19 any one of those structures located in the
20 same place as the stimulation fluid storage
21 system?

22 A Well, paragraph 28 refers to
23 hydrocarbon production through piping. So
24 the flowback manifolds are used to channel
25 production to the right place.

1 And further down, as you
2 correctly pointed out, the flowback
3 manifolds may be coupled one or more
4 flowlines, which may be coupled to flowback
5 pits, flow test units, sales lines,
6 tankage, oil/gas/water separating and
7 processing units and other similar devices.

8 So depending on what you want to
9 do with the flowback fluid, you can use it
10 in -- use the flowback capability in the
11 corresponding way.

12 Q Right. But any one of these
13 structures mentioned, the flowback pits,
14 flow test units, sales lines, tankage,
15 oil/gas/water separating and processing
16 units, or any other similar devices, those
17 are not located in the same location as the
18 stimulation fluid storage system of
19 Figure 2, is it?

20 A No. They may be near it.

21 They talk about flowback pits,
22 for example, or flow test units. Sales
23 lines will be perhaps anywhere. Tankage
24 may be anywhere.

25 Oil/gas/water separating and

1 processing units may be very close. I
2 mean, once the hydrocarbons come out, first
3 thing you do is separate those into oil,
4 gas and water.

5 So those are placed wherever it
6 makes sense. Some are very near the
7 production line, some may be further out.

8 MS. CARTER: So we are getting
9 towards another hour. Would you like
10 to take another 10-minute break,
11 Dr. Nikolaou?

12 THE WITNESS: That would be
13 great. Thank you so much.

14 So come back in 10 minutes?

15 (Recess taken 9:54 a.m.)

16 (Resumed 10:05 a.m.)

17 BY MS. CARTER:

18 Q Dr. Nikolaou, next, let's go
19 through Means, Exhibit 1006. I'll post
20 that into the chat.

21 (Exhibit 1006, Pub. No. US
22 2005/0166961 A1, was referenced.)

23 BY MS. CARTER:

24 Q Let me know when you have it
25 open.

1 A It's downloading.

2 1005. Let me open it.

3 Apologies for the delay. It's
4 not being -- hold on, let me see if there
5 is a corruption --

6 Q No problem.

7 A Let me close the other files in
8 case something is holding me back.

9 Okay. Got it.

10 Q Great.

11 All right. So Exhibit 1006,
12 that is patent application publication to
13 Means, is that correct?

14 A Correct.

15 Q Let's head down to Figure 3 of
16 Means.

17 A Figure 3 of Means.

18 Figure 3, yes, I'm there.

19 Q And Figure 3 illustrates a well
20 site additive injection system for a
21 producing well, is that correct?

22 A That's correct, yes.

23 Q And you combine this equipment
24 illustrated in Figure 3 with some of the
25 equipment in Tolman for both of your

1 grounds in your declaration, is that
2 correct?

3 A That is correct.

4 Our idea is that this figure in
5 Means shows the capability to deliver
6 fluids when you want them and where you
7 want them using remote control and
8 automation technologies.

9 So this is the piece that we are
10 selecting from Means to combine with
11 Tolman, which is the basic reference.

12 Q And all of the additive
13 injection system equipment illustrated in
14 Figure 3 is production equipment, is that
15 correct?

16 A Yes, this is the site of
17 production. There is a well in production,
18 that's correct, yes.

19 Q Now, let's go to paragraph 5 on
20 page 7 of Exhibit 1006.

21 Let me know when you get there.

22 A Paragraph 5 in Means, right?

23 Q Yes.

24 A Okay. I'm there.

25 Q All right. In this paragraph 5

1 of Means, Means introduces a variety of
2 additives, is that correct?

3 A Yes.

4 Q Those additives are offered to
5 control, among other things, corrosion,
6 scale, paraffin, emulsion, hydrates,
7 hydrogen sulfide, asphaltenes and the
8 formation of other harmful chemicals, is
9 that correct?

10 A That is correct, yes.

11 Q And Means describes that these
12 additives are used in production, is that
13 correct?

14 A Yeah, they're used to facilitate
15 production, indeed.

16 Q The additives are added to the
17 production fluid in the well, is that
18 correct?

19 A Correct, they're added to the
20 place where you want them at the time that
21 you want it, and in this case, the place
22 where you want them is the production
23 fluid, and that's where you inject them.
24 Indeed, that is correct.

25 Q So these additives used in

1 production would not be used in stimulation
2 operations, is that correct?

3 A This is a general statement. So
4 I would answer this as follows: If those
5 additives do not provide an advantage or
6 facilitate in general the stimulation
7 operation, no, they would not be used.

8 If it happened to provide a
9 benefit, they might be used. In general,
10 there are typically different challenges in
11 production and in stimulation.

12 So what you may use to -- and
13 the fluid that you inject in production
14 will likely not coincide with additives
15 that you use in stimulation, although there
16 may be something that may be uncommon, for
17 example, viscosity adjustments or something
18 like that.

19 But it's a first statement
20 that -- to say that did those coincide?
21 No, they do not coincide completely.

22 Q At what rates would these
23 additives in Means be pumped downhole?

24 A It's on an as-needed basis.

25 Q And roughly on an as-needed

1 basis, what would the rates be added into
2 the well?

3 A I can't recall off the top of my
4 head what these ranges would be. But, in
5 general, those rates would vary with the
6 production rate, the kind of fluids you
7 have in production, the kind of well you
8 have, the geometry, the opening of the
9 well, the depth of the well. There are
10 many, many, many factors that you take into
11 account.

12 So those rates -- excuse me --

13 Q Bless you.

14 A -- those rates would vary. And
15 like I said, I don't have a complete -- a
16 specific number off the top of my head at
17 this time.

18 Q Would the rate be lower or
19 higher than an injection rate for a well
20 treatment fluid?

21 A Again, the well treatment fluid
22 is pumped at different rates. What I can
23 say -- during the various stages of the
24 stimulation process.

25 What I can say is that the

1 stimulation fluid will fill up the whole
2 well pretty much, the space that's
3 available then, so that eventually the
4 fluid, the water -- that is, the fracturing
5 water -- would be pressurized enough to
6 open up the rock, create fractures and then
7 leave the fractures behind when it's
8 removed.

9 The additives added to
10 production fluids, oil and gas, that is,
11 obviously, they want to fill up the whole
12 well, because there is production fluids.
13 So it would be -- though the additives
14 would be part of the production.

15 At what rate those would be
16 added, it depends on a number of things
17 that I already mentioned, the kinds of
18 production fluids, the geometry of the
19 well, the depth, many things.

20 Q So based on your explanation,
21 would it be fair to say that the rates at
22 which Means' additive injection system
23 pumps additives downhole would be much
24 higher than the rates used to pump a well
25 treatment fluid downhole?

1 A Well, I would say that the
2 amount of fluid that you find in
3 stimulation, the stimulation water that you
4 find -- the stimulation fluid that you find
5 in the well, is larger than the amount of
6 fluid that you inject in a well during
7 production as an additive for the simple
8 reason, like I said, that the production
9 operation involves fluids that need to move
10 up the well to be produced, oil and gas
11 that is.

12 So certainly, there would be
13 less amount of injected fluids inside the
14 well.

15 Now, at what rate those would be
16 injected, those are not -- I would have to
17 check this again. Because in stimulation,
18 the rate is not constant. It varies based
19 on what the pressure is, at what stage of
20 the operation you are, and so forth.

21 And similar considerations have
22 to be looked at for the production
23 injection fluids, how much you need, how
24 much you're allowed to inject, and so
25 forth.

1 Q Would a rate of quarts per day
2 for Means' additive injection system sound
3 about right?

4 A I -- I don't remember these
5 numbers, to be honest with you, off the top
6 of my head at all.

7 Q Similarly, with pressures, at
8 what pressures would Means' additive
9 injection system pump the additives
10 downhole?

11 A The pressure downhole would have
12 to be enough so that when you add those
13 additives, they can travel to the top along
14 with the production fluids.

15 Q And would that pressure be lower
16 or higher than the pressure you used to
17 inject a well treatment fluid downhole?

18 A Typically, lower. Typically,
19 lower.

20 The stimulation fluid needs to
21 reach higher pressures because it has to
22 overcome the strength of the rock so that
23 it can break the rock. So stimulation will
24 reach higher pressures, yeah.

25 Q Would a rate of 10 to 1500 PSI

1 for Means' additive injection system for
2 injecting additives downhole surprise you?

3 MR. BORDER: Objection. Form.
4 Outside the scope.

5 A So I need a lot more information
6 to answer that.

7 I can say -- again, I can state
8 that the pressure would be -- would have to
9 be high enough to make sure that the
10 additive does flow along with production
11 and doesn't get stuck there.

12 Q So I'd like to turn back to your
13 declaration, Exhibit 1003.

14 Do you still have access to
15 that?

16 A I do. Let me open it again.
17 Yes, yes, ma'am. Let me open it again,
18 1003. Give me just one second to open it.

19 Okay. So I have that file open.
20 We can continue when you're
21 ready.

22 Q Can you go to paragraph 72 of
23 your declaration, please.

24 A 72.

25 Okay. I'm there.

1 Q Right. So in paragraph 72, you
2 state that a POSITA might have recognized
3 that Means' additive system would increase
4 cost, but that cost may be mitigated based
5 on the improved well efficiency attained by
6 fine tuning the mixture of additives.

7 A Paragraph 72 reads almost like
8 it, but it's slightly different.

9 Are we looking at the same
10 thing?

11 Q Let's see.

12 A It's on page 50 of 184, right,
13 Exhibit 1003, correct?

14 Q Yes. In Exhibit 1003,
15 paragraph 72 of your declaration.

16 A Yeah. And it starts: "A POSITA
17 would have also recognized that using
18 Means' closed looped additive system in
19 place of Tolman's system would have been a
20 design choice."

21 And then next sentence: "A
22 POSITA would have weighed" -- blah, blah,
23 blah.

24 Is that where you read?

25 Q Yes, sir.

1 And let's focus on the third
2 sentence here, that says: "Such a person
3 might have recognized that Means' additive
4 system would increase cost, but that cost
5 may be mitigated based on the improved well
6 efficiency attained by fine-tuning the
7 mixture of additives."

8 A Correct.

9 Q What specific costs would be
10 increased here?

11 A It's the cost of the materials
12 and the operation.

13 So you have to have a means --
14 no pun intended here again -- to -- a way
15 to deliver the fluid, you have to have the
16 fluid itself, and you have to do this
17 operation over time.

18 So all that would have a certain
19 cost. People actually do it extensively
20 because the benefit is usually higher and
21 it makes sense to do that.

22 Q How much money would be saved by
23 using Means' additive injection system or
24 substituting that --

25 MR. BORDER: Objection. Form.

1 BY MS. CARTER:

2 Q Let me rephrase.

3 So how much would the cost
4 increase or decrease based on use of Means'
5 additive injection system in your proposed
6 combination?

7 MR. BORDER: Objection. Form.

8 A First of all, in our proposed
9 combination, the way we use Means is to
10 explain that a technology is known so that
11 someone can deliver fluids in the well --
12 into the well at the place and at the time
13 and following a profile that is desired and
14 makes sense for the designer and operator
15 on the system.

16 Now, for a particular operation,
17 how much the cost increases and what is the
18 benefit and all that, that varies wildly
19 depending on what you're producing, what
20 you are injecting, what exactly you are
21 doing and all that.

22 So I cannot possibly give a
23 fixed number or even a range -- a narrow
24 range for a number.

25 Q And in terms of the efficiencies

1 that you're discussing in this paragraph,
2 how specifically would the efficiency be
3 improved by fine-tuning the mixture of
4 additives?

5 A So these additives help mitigate
6 all these problems -- I think you read
7 those already in a certain passage, either
8 in this patent or a previous one.

9 There may be issues with very
10 high viscosity, with corrosion, a whole
11 bunch of things that could go wrong.

12 People have developed good
13 recipes to add those additives, which is
14 why the term "additive" is currently widely
15 used. It's a standard term.

16 Those additives can add and
17 impart properties that are beneficial for
18 maintaining production, increasing
19 production, making production safer,
20 improving the lifetime of equipment,
21 preventing corrosion in the equipment, a
22 whole bunch of things, like I said, which
23 is what everybody also discusses in the
24 three patents that we use in my
25 declaration.

1 Q Okay. So the next exhibit I'd
2 like to talk about is Exhibit 1007, which
3 I'm going to add to the chat.

4 (Exhibit 1007, Patent No. US
5 6,236,894 B1, was referenced.)

6 A All right. Let me pick it up.
7 I'm opening up that file right
8 now.

9 So this is the patent with
10 inventor Richard F. Stoisits, but for all
11 intents and purposes, we'd be calling this
12 the "Crawford patent" in my declaration and
13 discussions.

14 Q That's correct.

15 Then Crawford, Exhibit 1007, is
16 entitled "Petroleum Production Optimization
17 Utilizing Adaptive Network and Genetic
18 Algorithm Techniques." Is that correct?

19 A That is correct.

20 Q So Crawford is directed to
21 production operations, is that correct?

22 A That is correct.

23 Q Crawford is directed to later
24 stage production operations, is that fair?

25 A Production operations in

1 general.

2 "Later," what do you mean, later
3 in the life of the well?

4 Q Yes. So later life of the
5 well -- for example, can you go to
6 paragraph 1 -- or column 1, line 26?

7 A Let me go there. Give me just
8 one second, please. So it's column 1,
9 line 26.

10 Yes, please.

11 Q All right. So column 1, line 26
12 of Crawford states that: "While the
13 primary production phase of operation may
14 be effected in a relatively straightforward
15 manner, later life operation of the
16 production field requires important
17 decisions for optimum production and
18 economic return."

19 A Indeed. This is very much in
20 line with what we discussed. And I
21 mentioned that there is an original --
22 initial, rather, phase of production and
23 then things happen to the well, to the
24 equipment. You may need to do something to
25 the well, something to the equipment.

1 Things can be addressed because -- a
2 restimulating or a re-completing the well,
3 doing all kinds of things like that.

4 Q And Crawford is specifically
5 addressing later stage of production
6 operations, is that correct?

7 A Well, he says that the primary
8 production phase operation may be effective
9 in a relatively straightforward manner.
10 That says it's not likely that you
11 immediately would have a dire need to
12 implement very sophisticated methods early
13 on.

14 But the later life operations of
15 the production field would almost certainly
16 require important decisions for optimum
17 production and economic return.

18 Q But the optimization techniques
19 that are applied in Crawford, those are
20 addressing later stage production issues,
21 is that fair?

22 A Well, you can do it at any stage
23 of the production. It's only that early
24 on, there isn't much to do. You cannot
25 optimize much earlier on.

1 It's a fixed system. You design
2 it in a certain way. It's going to run for
3 some time in the way that you anticipated.
4 So even if you try to optimize it, it's not
5 likely that there would be much benefit
6 expected.

7 But according to this author,
8 there would be a lot more benefit to expect
9 if you are at later stages, in which case
10 you would almost certainly have to make
11 decisions that would improve your
12 production.

13 For example, they say, this is
14 a -- she talks further down on line 33 --
15 or 34: "Processes may include
16 waterflooding of the field."

17 We mentioned that in our
18 discussion about an hour or so ago, namely,
19 after your primary production, when the
20 well does not have enough pressure to push
21 enough hydrocarbons out, namely, to the
22 well and to the top, you may have to push
23 those hydrocarbons doing what we'll call
24 "waterflooding."

25 So you push these hydrocarbons

1 by injecting water from one well or one set
2 of wells and picking up hydrocarbons from
3 another set of wells.

4 It's unlikely -- it's very
5 unlikely you would do that immediately when
6 you have the early stages of production,
7 early enough that the well has enough
8 pressure, it produces enough hydrocarbons
9 and then once the pressure, let's say, is
10 low -- too low or when the skin effect that
11 we referred to, mainly the increase in
12 resistance to flow near the well, is high,
13 then you may have to do something to fix
14 that.

15 So the benefit of doing this
16 exercise would be much higher. That's what
17 this whole exercise is about in this
18 patent.

19 Q The optimization techniques
20 disclosed in Crawford, those would not
21 apply to stimulation operations, is that
22 correct?

23 A No, no, no. He's talking about
24 optimization in general. So he's using
25 algorithms that have fairly universal

1 applicability.

2 The idea is, I define an
3 objective function that I want to maximize.
4 I then have some variables that affect the
5 value of that objective function. And I
6 know -- I have a model that tells me how
7 these variables, whose values my
8 optimization will select, so I have a way,
9 via a model to predict how selection of
10 certain values where these variables
11 affects my objective function.

12 How I eventually select optimal
13 values for these decision variables can be
14 done in a number of ways.

15 I think, if I recall
16 correctly -- I can do a quick search, if we
17 have time -- they talk about neural
18 networks, they talk about genetic
19 algorithms, they talk about general
20 optimization methods, classical
21 optimization methods that they can use
22 here.

23 So it's a general application
24 of -- rather, it's a specific application
25 of general methods to this particular

1 context.

2 And the reason we brought this
3 reference to our discussion is that it
4 explains that if you want to optimize,
5 rather than saying and using hand-waving
6 arguments, well, people now how to do that,
7 there are lots of ways to do that, we
8 picked something specific that says, you
9 know, here is an example, here is how
10 somebody does that.

11 Q Got it.

12 And Crawford -- so Crawford's
13 optimization methods are about optimizing
14 production fluid, is that correct?

15 A It's about -- his main concern
16 is about optimizing production. And I can
17 quickly read the abstract, whether he has
18 any secondary concerns. But yes, that's
19 what I recall.

20 So it's about petroleum
21 production optimization. And let me go
22 through the abstract really quickly to see
23 if there are any secondary things that he
24 optimizes.

25 Yeah, so he's concerned mainly

1 with production. That's his main concern.

2 Q Does Crawford disclose well
3 development task fluids?

4 A Well development -- I'll have to
5 check again to see what are the decision
6 variables that he considers.

7 So do I have some time to do a
8 quick check to see what decision variables
9 he is using in his optimization?

10 Q I can just move on to the next
11 question.

12 A Okay.

13 Q Does Crawford -- just from your
14 general knowledge and use of Crawford based
15 on the declaration, I'm asking, does
16 Crawford disclose well development task
17 fluids?

18 A Again, whether his optimization
19 includes that, namely, for example,
20 refracturing a well, or his optimization
21 may include re-completing using it for
22 production tubing or whatever else may be
23 involved.

24 That, in principal, could be
25 part of his optimization. He leaves it

1 very general in the sense that he's mainly
2 concerned about how to do the optimization
3 and he leaves the approach of genetic
4 algorithms and neural networks and the
5 number of algorithms that he considers good
6 and useful for the purpose.

7 The particular application of
8 those can be anything related to the oil
9 field.

10 Q Now, let's discuss Figure 1 of
11 Crawford.

12 If you could scroll to that and
13 let me know when you get there?

14 A Yes, I'm there.

15 Q Figure 1 is a schematic of a
16 production field, is that correct?

17 A Yes. And I believe we have a
18 comparable figure in my declaration or a
19 similar figure in my declaration. Is that
20 correct?

21 Q Yes, we do.

22 A Okay. Very good.

23 Okay. Go on, please.

24 Q All right. And you can combine
25 some of the equipment illustrated in

1 Figure 1 of Crawford with equipment from
2 Tolman and Means for your combination under
3 both of your grounds, is that fair?

4 A Well, the idea, again, is that
5 if combination of Tolman and Means involves
6 optimizing a decision for actually doing
7 stimulation using various options,
8 technology exists to do this kind of
9 optimization.

10 And, in fact, such technology is
11 used in the oil field. Here is an example
12 of how this technology can be used, the
13 optimization technology.

14 Q And the equipment illustrated in
15 Figure 1 is production equipment, is that
16 correct?

17 A Yes, it's -- yes, indeed, it's
18 production.

19 Q And the equipment illustrated in
20 Figure 1 flows production fluid, is that
21 correct?

22 A As shown there, yes. Those are
23 the lines by which production fluids would
24 go to collection sites, the DS sites there,
25 and from there, the manifolds would go to

1 the central processing facility and from
2 there, out.

3 Yes, indeed.

4 Q Next, I'd like to go to the last
5 reference, Lehman, Exhibit 1008.

6 I'll stick that in the chat for
7 you.

8 (Exhibit 1008, Pub. No. US
9 2004/0050550 A1, was referenced.)

10 A I'll download that.

11 And that was Exhibit 1008, you
12 said, right?

13 Q Yes.

14 A To Lehman. Yeah, let me open
15 it.

16 Okay. Very good. "Re-Use
17 Recovered Treating Fluid," that's what
18 you're referring to, right? That's the
19 patent.

20 Q Yes.

21 Do you have it open?

22 A Yes.

23 Q Great.

24 So Exhibit 1008 to Lehman is
25 entitled Reuse of Recovered Treating Fluid,

1 is that correct?

2 A Yes.

3 Q Let's go to Figure 1 of Lehman.

4 Just let me know when you have

5 Figure 1 in front of you.

6 A Yes, I can go there.

7 I have Figure 1 in front of me,

8 yes. It's one that says, "First Fracturing

9 Fluid," "Fracturing Fluid Residual," et

10 cetera.

11 Q Yes. So Figure 1 is a picture

12 of -- or a diagram of fracturing fluid

13 going into the well and fracturing fluid

14 residual coming out of the well, is that

15 correct?

16 A Correct, yes.

17 Q And this figure is

18 representative of what is disclosed in

19 Lehman, which is limited to well treatment

20 operations, is that fair?

21 A That is indeed fair. In fact,

22 in well treatment operations, they look at

23 the very specific part, which is how to

24 recover, clean out the fracture fluid and

25 reuse it and all that.

1 Q Lehman is not related to
2 production operations, is that also fair?

3 A Indeed. This is something that
4 you do when you prepare the well for
5 production, namely, when you fracture it.

6 So it's before production.

7 MS. CARTER: Dr. Nikolaou, I'm
8 nearing towards the edge of my
9 questions. Would you like to take a
10 quick break and then reconvene for the
11 last bit?

12 THE WITNESS: That would be
13 great.

14 Come back in 10 minutes?

15 MS. CARTER: That works.

16 THE WITNESS: Okay. I'll be
17 back in 10 minutes.

18 (Recess taken 10:42 a.m.)

19 (Resumed 10:53 a.m.)

20 MS. CARTER: So I actually have
21 no further questions and will pass the
22 witness.

23 THE WITNESS: You can't be
24 heard.

25 MS. CARTER: You can't hear me?

1 THE WITNESS: No. Let me see.

2 Can you hear me?

3 MS. CARTER: I can hear you,
4 yes.

5 THE WITNESS: Let me try again.

6 Can you say something now,
7 please?

8 MS. CARTER: Yes. Hello?

9 THE WITNESS: Okay. I can hear
10 you now.

11 MS. CARTER: Great.

12 I actually have no further
13 questions and will pass the witness.

14

15 (Continued on next page to
16 include signature and jurat.)

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1 MR. BORDER: And I have no
2 questions.

3 (Time noted 10:54 a.m.)

4 * * *

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7

8 DR. MICHAEL NIKOLAOU

9

10

11 Subscribed and sworn to

12 before me this day

13 of , 20__

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16 NOTARY PUBLIC

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----- I N D E X -----

WITNESS	EXAMINATION BY	PAGE
DR. MICHAEL NIKOLAOU		
	MR. CARTER	4

----- EXHIBITS REFERENCED -----

EXHIBIT 1004	Curriculum Vitae for Michael Nikolaou; 23 pages	8
EXHIBIT 2002	Deposition transcript of Dr. Michael Nikolaou, dated June 6, 2024; 240 pages	18
EXHIBIT 1003	Declaration of Michael Nikolaou, filed October 3, 2023; 184 pages	19
EXHIBIT 1005	Pub. No. US 2009/0114392 A1	66
EXHIBIT 1006	Pub. No. US 2005/0166961 A1	81

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(Exhibits Referenced, Continued)

EXHIBIT 1007	Patent No. US 6,236,894	95
	B1	
EXHIBIT 1008	Pub. No. US 2004/0050550	105
	A1	

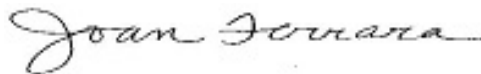
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IN WITNESS WHEREOF, I have hereunto
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JOAN FERRARA, RMR, CFRR

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