

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ENERCOP SAND SOLUTIONS INC.
Petitioner,

v.

SPECIALIZED DESANDERS INC.,
Patent Owner.

Case IPR2018-01748

Patent No. 8,945,256

ORAL DEPOSITION OF HAROLD E. MCGOWEN III

August 7, 2019

Dallas, Texas

Reported by:

Daniel J. Skur, Notary Public

Job no: 25693

ORAL DEPOSITION OF HAROLD E. MCGOWEN

III, produced as a witness at the instance of the Petitioner, and duly sworn, was taken in the above-styled and numbered cause on the 7th of August, 2019, from 8:59 a.m. to 2:44 p.m., before Daniel J. Skur, Notary Public and Certified Shorthand Reporter in and for the State of Texas, reported by stenographic means, at the Westin Downtown Dallas, 1201 Main Street, Dallas, Texas, pursuant to the Federal Rules of Civil Procedure.

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DEPOSITION EXHIBITS
HAROLD E. McGOWEN III
August 7th, 2019

Number	Description	Page
Previously Marked Exhibits		
Exhibit 1001	United States Patent Number 8,945,256 11 pages	28
Exhibit 1004	United States Patent Number 6,982,852 B2 11 pages	47
Exhibit 1005	Annual Review of Fluid Mechanics, Volume 17, 1985 30 pages	176
Exhibit 1008	Engineering Data Book from the Gas Processors Suppliers Association (Retained by Counsel)	30
Exhibit 2001	Declaration of Harold E. McGowen III, PE 84 pages	8
Exhibit 2002	McGowen Curriculum Vitae (Retained by Counsel)	8

DEPOSITION EXHIBITS
HAROLD E. MCGOWEN III
August 7th, 2019

Number	Description	Page
Previously Marked Exhibits		
Exhibit 2003	Energy Data Book FPS Version, Volume 1 and 2, Sections 1-26 20 pages	147
exhibit 2004	Proven Methods For Design and Police Station of Gas Plant Liquid Slug Catching Equipment 33 pages	30
Exhibit 2006	Excerpt From the American Heritage Dictionary of Science (Retained by Counsel)	32
Exhibit 2007	McGraw-Hill Dictionary of Scientific and Technical Terms (Retained by Counsel)	34

1 P R O C E E D I N G S

2 HAROLD E. McGOWEN III,

3 having been duly sworn, testified as follows:

4 (8:59 a.m.)

5 EXAMINATION

6 BY MR. HALL:

7 Q. Good morning, Mr. McGowen.

8 A. Morning.

9 Q. My name is James Hall. You
10 understand I'm representing the petitioner,
11 EnerCorp Sand Solutions?

12 A. Yes.

13 Q. And you've been deposed before,
14 correct?

15 A. Yes.

16 Q. How many times?

17 A. About a dozen.

18 Q. About a dozen. Have you ever
19 testified in trial?

20 A. Once.

21 Q. When was that?

22 A. Probably in the -- probably around
23 1998 to maybe the 2000s, somewhere in there.

24 Q. Was that in state court?

25 A. That was in a federal court.

1 Q. Federal court?

2 A. Yeah.

3 Q. Have you ever been deposed in a
4 proceeding before the patent trial and appeal
5 board?

6 A. Not before the board, but related to
7 an IPR, I have been deposed.

8 Q. Okay. So in an IPR proceeding?

9 A. Yes.

10 Q. Just one time?

11 A. I think twice.

12 Q. So this will be number three?

13 A. I believe so, yes.

14 Q. Is there anything that would prevent
15 you from thinking clearly and testifying
16 truthfully today?

17 A. No.

18 Q. And you understand you're under
19 oath?

20 A. Yes.

21 Q. I'm going to assume you understand
22 the questions I ask you unless you tell me
23 otherwise; is that fair?

24 A. Yes.

25 Q. If you need to take a break, just

1 let me know.

2 I want to hand you Exhibit 2001.

3 (Exhibit 2001 introduced.)

4 BY MR. HALL:

5 Q. I have a copy, and I'll hand you
6 Exhibit 2002 as well.

7 (Exhibit 2002 introduced.)

8 BY MR. HALL:

9 Q. Exhibit 2001 is your declaration in
10 this matter; is that correct?

11 A. Appears to be, yes.

12 Q. And Exhibit 2002 is your CV?

13 A. Yes.

14 Q. Have you ever done any prior work
15 for Radulescu LLP?

16 A. No.

17 Q. Have you ever done any prior work
18 for any of the lawyers there?

19 A. I don't know all the attorneys at
20 the firm, but I don't think so.

21 Q. Okay. Have you ever done any prior
22 work for Specialized Desanders, Incorporated?

23 A. No.

24 Q. Do you know anyone at Specialized
25 Desanders?

1 A. No.

2 Q. Do you know Christopher Hemstock?

3 A. No.

4 Q. Were you familiar with him before
5 this case?

6 A. No.

7 Q. Your CV says, Exhibit 2002, that you
8 are the CEO of Navidad Energy Advisors and
9 Navidad Operating Company LLC; is that correct?

10 A. Yes.

11 Q. And so your declaration says -- you
12 don't have to look at it, but it says that
13 you're the CEO of Navidad Resources, LLC.
14 Which -- what's current?

15 A. Well, Navidad Resources, LLC or
16 Navidad Resources, II is the parent company of
17 Navidad Operating Company, LLC. So...

18 Q. Okay. So --

19 A. But I'm actually employed by Navidad
20 Operating Company.

21 Q. Okay. So --

22 A. I'm also the CEO of Navidad
23 Resources II.

24 Q. Got it. So Navidad Resources, LLC.
25 Oh, I see. Navidad Resources, LLC I is listed

1 here. Is that no longer going on in a --

2 A. Navidad Resources I is a -- the
3 company that I sold the assets of in 2013, and
4 it's -- has not been completely -- well, may be
5 as of the time I shut that -- at the time that
6 I wrote that I think it was still in existence.
7 I think I've already shut that entity down.

8 Q. Okay. So are all -- are these --
9 all these Navidad Resources and Navidad Energy
10 Advisors companies, do you control all of
11 those?

12 MR. KESACK: Objection, form.

13 A. I have partners in some of the
14 companies. There's -- these are -- some of
15 these entities are private equity-backed
16 companies and they'll have more than one entity
17 as part of the structure. So there's -- you
18 know, I have partners in some of the companies,
19 and some of the companies I don't have
20 partners.

21 Q. Okay. Are you the only employee of
22 these companies or do they have -- are there
23 other employees?

24 A. Navidad Operating Company has
25 multiple employees. As of today, I think we're

1 up to -- I think we have five employees and
2 then a number of contractors that work for
3 Navidad Operating Company right now. Navidad
4 Energy Advisors is just me. It's a sole -- I
5 own that entity completely.

6 Q. And then is Navidad Resources, is
7 that just like the -- like a holding company?

8 A. Well, I can explain the whole
9 structure if you'd like me to. I don't --

10 Q. That's okay. I'm just trying to --
11 what I'm trying to get at is, is that the
12 separate company that's doing work, you know,
13 like Navidad Operating Company, or is it simply
14 a part of the corporate form?

15 A. Yeah, I can explain the whole
16 structure if you'd like me to. I don't know
17 that it's relevant to the --

18 Q. Yeah.

19 A. -- any of this, but --

20 Q. I'm not sure it's relevant either,
21 so I'm not -- that's okay. I won't bother you
22 with it.

23 What I'm trying to get at is, you
24 know, how many people are involved--you already
25 answered that--with Navidad Operating Company.

1 A. Right.

2 Q. And what's the -- what sort of
3 business are you engaged in there?

4 A. Okay. Navidad Operating Company is
5 an oil and gas operating company. We basically
6 are in the exploration and production business.

7 Q. Okay.

8 A. So we take leases, drill wells,
9 complete those wells through hydraulic
10 fracturing typically, and then put those wells
11 into a pipeline and possibly build processing
12 facilities and pipeline as required to get our
13 product to market.

14 So Navidad Operating Company is
15 working with Navidad Resource Partners, which
16 is the entity that has the private equity
17 investment that's the backers for the current
18 projects. So that's -- that's the function of
19 Navidad Operating Company is to manage those
20 assets for the private equity group.

21 Q. Okay. So Navidad Energy Advisors,
22 you're the only employee?

23 A. That's -- that is my consulting
24 firm.

25 Q. That's your consulting firm. And

1 that's --

2 A. Correct.

3 Q. -- the entity that you're -- where
4 you do your expert consulting work?

5 A. That's right. It's a registered
6 professional engineering firm in the State of
7 Texas.

8 Q. Got it. So let's look at
9 Exhibit 2001 in your -- paragraph 5. This is
10 where you give your background and
11 qualifications.

12 So I want to -- it's about midway
13 through paragraph 5 there, you start to list
14 off some experience you have, and you say you
15 were involved in the design and
16 troubleshooting -- yeah, go ahead.

17 A. Which -- which --

18 Q. I'll wait for you to find it.
19 Paragraph 5.

20 A. Which -- which --

21 Q. It's page 2, paragraph 5.

22 A. Oh, okay. Yeah, yeah.

23 Q. And if I refer to the paragraph
24 numbers, you know what I'm referring to?

25 A. Yes, this number right here. Okay.

1 Q. So about midway through there,
2 you're -- you're -- you start to list off some
3 experience and you say you were involved in the
4 design and troubleshooting of midstream
5 gathering and processing system.

6 You see that sentence there?

7 A. Yes.

8 Q. Can you describe -- what I'm
9 specifically trying to get at is, is whether
10 this involved any separation facilities,
11 two-phase, three-phase, single-phase
12 separators.

13 A. Yes.

14 Q. So can you just go into that,
15 please. Go ahead.

16 A. Yes. Every well has -- in this
17 group of wells had a separator, a heater
18 treater, tanks. Typically, we would have a gas
19 lift system with a compressor, and then we
20 had -- we built pipeline to connect all those
21 up to our plant, and then we also have
22 separation at the plant ahead of -- you know,
23 you pull liquids out ahead of going into the
24 plant for compression, and then subsequent
25 removal of natural gas liquids from the gas

1 before we put it into the pipeline.

2 Q. Got it. So for the -- those wells,
3 did any of them involve or include desanders
4 specifically?

5 A. The desanders would be used or were
6 used after hydraulic fracturing operations. So
7 in that situation, you typically had temporary
8 separation equipment that you put on location,
9 and then you're likely to have sand flow back
10 during that portion of the completion of the
11 well, which is immediately after hydraulic
12 fracturing, and then you would run that
13 equipment until you felt like you had a stable
14 flow, and then you could put that into your
15 permanent facility.

16 So the desander was really used
17 during the flowback operations after hydraulic
18 fracturing on these wells.

19 Q. So that's a yes, you did use
20 desanders on these wells?

21 A. Yes.

22 Q. Okay. Do you remember what kind of
23 desanders those were?

24 A. I don't -- there weren't any of the
25 two entities that are involved in this. I

1 don't really know the manufacturer names or...

2 Q. Do you remember specifically what
3 type of desanders they were?

4 A. They were just -- we would use a
5 variety of desanders. Some of those were
6 provided by the flowback companies. So some of
7 them were, you know, vertical type vessels,
8 some of them were horizontal vessels, but I
9 couldn't give you specifications on any of
10 those.

11 Q. Were you involved in the design of
12 any of those desanders?

13 A. No.

14 Q. You just -- your -- you, your firm,
15 your company, rented those from the flowback
16 company or that was part of --

17 A. That's correct.

18 Q. Okay.

19 A. Yes.

20 Q. You mentioned the pipeline. Did the
21 pipeline -- and you mentioned some separation
22 facilities there. Did the pipeline include any
23 slug catchers?

24 A. The pipeline did not require those
25 type of slug catchers. We did have vessels

1 that were -- as part of that system that would
2 process various flow regimes, but we didn't
3 have a slug catcher of the type that you'd see
4 where you have, you know, a hundred foot long
5 pipes in a harp type of slug catcher. So we
6 didn't use those type. We used vessel-type
7 slug catchers.

8 Q. You would character them as slug
9 catchers though?

10 A. Some of the vessels would function
11 as slug catchers.

12 Q. Were you involved in the design of
13 any of those?

14 A. Just the specification and
15 installation of those. I didn't design the
16 vessels. We just purchased vessels from third
17 parties.

18 Q. And when you say "the
19 specification," what do you mean?

20 A. Well, basically trying to determine
21 what -- what type of vessels we needed. I
22 would approve as the PE -- as a registered
23 professional engineer with the company, I would
24 be approving the overall design of the whole
25 system, and that would include those different

1 types of vessels.

2 Q. So when you're providing the
3 specification, do those include the flow stream
4 composition and flow rate?

5 A. That would be part of the design
6 process would be trying to determine what the
7 -- we thought the flow regime would be, how
8 much oil, water, gas would be encountered
9 during the process of producing the wells.

10 Q. And you were directly involved in
11 that yourself?

12 A. Yes.

13 Q. And your bachelor of science degree
14 is in mechanical engineering, right?

15 A. Yes.

16 Q. And your professional engineering
17 certification is for mechanical engineering?

18 A. It's not really for a particular
19 discipline in Texas. It's just a -- you're
20 just a PE.

21 Q. Is there a specific exam for
22 mechanical engineering that you took?

23 A. No.

24 Q. It's just one exam no matter what
25 kind of engineer you are?

1 A. At the -- at the time that I did
2 this, I actually -- that was back in the '90s.
3 They just used my industry experience, and I
4 had enough industry experience to qualify as a
5 registered professional engineer.

6 Q. Okay. Well, congratulations on that
7 because I studied for that exam and I never
8 took it, but it's quite hard.

9 You said you -- going back to
10 paragraph 5. You said you designed,
11 implemented, monitored, and analyzed hundreds
12 of hydraulic fracturing treatments and flowback
13 operations which involved particle sand
14 proppant and other solids transport both during
15 and after treatment of the wellbore.

16 When you say you designed and
17 implemented those, describe what you mean.

18 A. Well, to perform the frac design,
19 you would be working as a completion engineer
20 and that's -- one of my specialties is
21 candidate selection, designing the downhole
22 completion in terms of perforations, then also
23 designing the frac in terms of rates, fluid
24 volumes, types of fluids, types of proppant,
25 use of acid, and then also specifying a

1 procedure for how to flow back the well so as
2 to optimize long-term production.

3 Q. Did any of that experience, is
4 that -- did any of that involve specifically
5 the design of desanding equipment?

6 A. I didn't design the vessels, but we
7 would use desanders to prevent damage to
8 surface equipment during flowback operations,
9 and then we also had some wells that would have
10 sand problems after we had released the
11 flowback equipment and we were in the process
12 of producing the wells. Sometimes you still
13 have sand production you have to deal with, so
14 I would be involved in trying to solve the sand
15 problem, but I didn't actually design vessels
16 myself.

17 Q. Have you ever designed a desander
18 yourself?

19 A. No.

20 Q. Okay. But you're familiar with the
21 types of particles that come from a hydraulic
22 fracturing operation --

23 A. Yes.

24 Q. -- flowback operation.

25 Yes?

1 A. Yes.

2 Q. You say at Signa -- and it says at
3 the very end of paragraph 5, at Signa
4 Engineering, you participated in a project to
5 design a four-phase separation system for
6 underbalanced drilling operations.

7 When you say "participated," what
8 does that mean?

9 A. I was the project manager for a
10 project to design a separation system for use
11 in underbalanced drilling offshore where they
12 required a fairly compact system that would
13 allow them to -- you're actually -- allow them
14 to flow the well while they were drilling and
15 then handle the drilling solids as well as the
16 solids generated from the drill bit from the
17 formation.

18 Q. And so as a project manager, were
19 you -- were you the one actually designing the
20 separation system?

21 A. I was involved in -- in the
22 preliminary designs of that system starting
23 with the scoping of the system to determine
24 what characteristics it would require and then
25 putting forward different design ideas for how

1 we might go about configuring that -- that
2 vessel.

3 Q. Did you do any of the calculations
4 to determine the appropriate size of the
5 vessel?

6 A. I don't recall. It's been a long
7 time ago. I know that I did quite a bit of
8 work to determine what types of fluid streams
9 you could expect and I was trying to determine
10 what -- what 80 percent of the applications
11 would require in terms of total volume of
12 fluids and solids that would come into the
13 system. So I did some statistical work on the
14 front end on that.

15 Once we got into the portion of the
16 project where we would be actually specifically
17 designing the internals of the vessel, that was
18 going to be handled by the -- the service
19 company that engaged us to work on the design.

20 Q. Okay. You reviewed Mr. David
21 Simpson's declaration in this matter, correct?

22 A. Yes.

23 Q. Are you familiar with separators
24 that have only a single outlet that does not
25 require manual intervention?

1 MR. KESACK: Objection, form.

2 A. What type of separator?

3 BY MR. HALL:

4 Q. Separators that have only a single
5 outlet that does not require manual
6 intervention.

7 MR. KESACK: Same objection.

8 A. So there's only a single outlet.
9 What is being separated? Maybe you could help
10 me out on that.

11 BY MR. HALL:

12 Q. So do you recall in Mr. Simpson's
13 declaration where he used the term single-phase
14 separator?

15 A. I do recall him mentioning something
16 about that.

17 Q. So if you have only a single outlet
18 that does not require manual intervention, you
19 might be separating something that remains in
20 the vessel.

21 A. I wouldn't call that a separator.

22 Q. You would not?

23 A. No.

24 Q. Do you have any experience with
25 those types of separators?

1 MR. KESACK: Objection, form.

2 A. I don't --

3 BY MR. HALL:

4 Q. Excuse me. Do you have any
5 experience with those types of vessels, if you
6 wouldn't agree that it's a separator?

7 A. Well, there are vessels that
8 accumulate solids. I guess -- I'm assuming
9 that's what that's referring to.

10 Q. Yes.

11 A. But normally in the vernacular I'm
12 familiar with, a separator has multiple types
13 of fluids coming into it and it has multiple
14 outlets so that you actually achieve some sort
15 of separation in a continuous manner. It's
16 typically the -- what I understand a person of
17 ordinary skill in the art would think of when
18 you describe a separator.

19 Q. So you're familiar with those --
20 what I -- the term I was using was a
21 single-phase separator. I understand you don't
22 agree that's a separator. But you're familiar
23 with those types of vessels?

24 A. I'm familiar with the concept.

25 Q. Have you ever worked with one?

1 MR. KESACK: Objection, form.

2 A. Well, an example of a gun barrel
3 when you're separating oil and water is -- it's
4 a big tank. You flow into that vessel, you
5 allow it to sit, and the oil and the water
6 separate. But I've never heard anybody call
7 that a single-phase separator. It's called a
8 tank or a gun barrel.

9 BY MR. HALL:

10 Q. Okay. But you have worked with
11 two-phase and three-phase separators and
12 four-phase separators before?

13 A. Yes.

14 Q. So with regard to your experience in
15 your CV, is there any other experience you have
16 that you believe is particularly relevant to
17 desanding?

18 A. Well, also in horizontal drilling
19 there is a part of that where you need to
20 understand the settling of solids and the
21 removal of solids from the wellbore in
22 directional and in horizontal drilling.

23 So I've spent quite a bit of time
24 studying that problem relative to hole
25 cleaning, and also, there's the issue of trying

1 to remove solids when you -- from a horizontal
2 wellbore when you have plugs, which are
3 composite bridge plugs typically in the current
4 era, and you're trying to circulate out those
5 cuttings. So there's a solids issue there that
6 you're working with where you have a solid and
7 a cylindrical wellbore that you're trying to
8 remove.

9 So I have studied some of the issues
10 and the physics around that to try to optimize
11 removal of solids from wellbores.

12 Q. Do those applications for removing
13 solids from the -- let me rephrase that.

14 Do those -- are you -- you're
15 talking about removing solids from drilling
16 fluid?

17 A. No. In the case of the horizontal
18 wellbore, you have a situation where you're
19 drilling the well and your cuttings are going
20 to fall to the bottom of the well, which is
21 very different than in a vertical well where
22 the distance from the top of the wellbore to
23 the bottom of the wellbore is maybe thousands
24 of feet, and a horizontal wellbore it may only
25 be inches.

1 So there is some issues there with
2 trying to get hole cleaning where you actually
3 have solids banking up in the bottom of the
4 horizontal wellbore.

5 Q. And how do you remove those solids?

6 A. Well, partly through the flow of the
7 well, you can try to remove solids that way.

8 Q. When you say "flow of the well," you
9 mean flow of hydrocarbons?

10 A. It could be water. It could be
11 hydrocarbons. Whatever is coming out of the
12 well.

13 Q. Coming out of the formation itself?

14 A. Yes.

15 Q. Okay.

16 A. And then also through running
17 equipment in the hole to circulate and try to
18 lift that out of the hole, and then also lift
19 it up out of the vertical section back to the
20 surface.

21 Q. And when you're circulating fluid,
22 is that drilling fluid or is that another type
23 of fluid?

24 A. It depends on which mode you're in.
25 If you're in the drilling mode, that would be

1 drilling fluid. If you're in the completion
2 mode, that would be some type of completion
3 fluid, if you're inside casing, for example.

4 Q. Got it. So let's go back to your
5 declaration. This was signed, I think, on
6 May 22nd, 2019.

7 Are you aware of any changes to your
8 declaration after you signed it?

9 A. No.

10 Q. Take a look at paragraph 7. It
11 lists the documents that you considered. Do
12 you see that?

13 A. Yes.

14 Q. About how long did it -- did you
15 take to prepare your opinion or your -- prepare
16 your declaration in this matter? How much time
17 did you spend analyzing and revising?

18 A. Let's see.

19 MR. KESACK: Objection, form.

20 A. I don't really recall right now
21 what -- how many hours. It's more than 40 or
22 maybe as many as 80 hours.

23 BY MR. HALL:

24 Q. Okay. Yeah, that's close enough.

25 (Exhibit 1001 introduced.)

1 BY MR. HALL:

2 Q. On Exhibit 1001, that's the '256
3 patent. Did you read this entire document?

4 A. Yes.

5 Q. You reviewed -- do you know what I'm
6 referring to when I refer to the claims?

7 A. Yes.

8 Q. And you reviewed and considered --
9 well, strike that.

10 Looking at Exhibit 1004 or -- you
11 know, not looking at the exhibit, but look at
12 your description here. That's the '852 patent
13 to Hemstock?

14 A. Yes.

15 Q. And you reviewed this entire patent?

16 A. Yes.

17 Q. And just going forward, I'm going to
18 refer to this document as "Hemstock" and I'll
19 refer to the desander described, then, in there
20 as the "Hemstock desander."

21 Do you understand?

22 A. Yes.

23 Q. Okay. And if it's unclear what I'm
24 talking about in regard to a particular
25 desander or vessel, just let me know and I'll

1 do my best to make it clear.

2 A. Okay.

3 (Exhibit 1008 introduced.)

4 BY MR. HALL:

5 Q. Exhibit 1008 is the Engineering Data

6 Book from the Gas Processors Suppliers

7 Association, GPSA.

8 Were you familiar with this before

9 this case?

10 A. I'm not sure if I'm -- if I had

11 actually read this particular version of the

12 data book. I have a data book like this in my

13 records, but I'm not sure if it's the 10th

14 Edition.

15 Q. Sure. And that's fair enough.

16 So -- but you're familiar with the various

17 editions of the data book?

18 A. Yes.

19 Q. Exhibit 2004 is -- I'm sorry.

20 That's a different edition. Exhibit -- no.

21 I'm reading two different things here. Sorry.

22 (Exhibit 2004 introduced.)

23 BY MR. HALL:

24 Q. Exhibit 2004 is Rhinesmith, and this

25 is an article by Rhinesmith and others. Were

1 you familiar with this article before this
2 proceeding?

3 A. No.

4 Q. How did you -- how did this come to
5 your attention?

6 A. It's referred to in this Engineering
7 Data Book. The Exhibit 2003, it's referenced,
8 and I obtained a copy of it to use.

9 Q. How did it come to your attention?

10 MR. KESACK: Objection, form.

11 A. Counsel provided the -- a copy for
12 me to look at.

13 BY MR. HALL:

14 Q. Did you ask counsel for it or did
15 they offer it without you asking?

16 A. I actually don't remember if I did
17 some -- I did look through different literature
18 on slug catchers, so I don't really remember
19 whether I asked for this or whether they
20 provided it for me or how I came to have that.

21 Q. Okay. But you found this in the
22 process of looking for materials related to
23 this proceeding?

24 A. I don't recall. I know that I
25 reviewed it, but I really don't remember if

1 it -- this was part of the materials that I
2 looked at.

3 Q. Well, you earlier testified that you
4 were not aware of this before this proceeding.
5 So are you saying now that you were aware of it
6 before this proceeding?

7 A. Before today or you mean --

8 Q. Before the proceeding. Before you
9 began looking at materials and --

10 A. No. It was part -- it was part of
11 -- part of this process of providing a report,
12 I looked at this document.

13 Q. Okay. And were you aware of the
14 existence of that document before you were
15 retained to --

16 A. No.

17 Q. -- in this proceeding?

18 A. No.

19 (Exhibit 2006 introduced.)

20 Q. And Exhibit 2006 is an excerpt from
21 the American Heritage Dictionary of Science.

22 Do you own a copy of this
23 dictionary?

24 A. This is available online, so I use
25 the online version.

1 Q. The 1986 version is available
2 online?

3 A. I believe so. I...

4 Q. I'm just going to go ahead and hand
5 that to you. This is Exhibit 2006.

6 (Exhibit 2006 introduced.)

7 BY MR. HALL:

8 Q. So this appears to be a copy from a
9 book. Do you still -- after looking at this
10 Exhibit 2006, do you believe that you did look
11 at this online originally?

12 A. I looked at a number of materials.
13 I looked online for some definitions. I don't
14 really recall where this particular definition
15 came from.

16 Q. Where the particular dictionary came
17 from?

18 A. Correct.

19 Q. So to your knowledge, you don't own
20 a copy of this?

21 A. I don't believe so.

22 Q. You don't have one in your
23 possession?

24 A. I don't, no.

25 Q. But you don't know if this was

1 something you found or if counsel provided it
2 to you?

3 MR. KESACK: Objection, form.

4 A. I don't recall.

5 BY MR. HALL:

6 Q. So I have the same question about
7 the next one, Exhibit 2007.

8 (Exhibit 2007 introduced.)

9 BY MR. HALL:

10 Q. This is Exhibit 2007. This is the
11 McGraw-Hill Dictionary of Scientific and
12 Technical Terms.

13 So do you recall how this dictionary
14 came to your attention?

15 A. No.

16 Q. Had you ever consulted this
17 dictionary before you were retained in this
18 matter?

19 A. I don't really know.

20 Q. You don't recall?

21 A. I don't recall.

22 Q. How about Exhibit 2006; do you
23 recall ever consulting it before you were
24 retained in this matter?

25 A. It would be hard to say. I mean,

1 it's -- I've been practicing engineering for
2 30 years, so I'd be hard pressed to say whether
3 I ever looked at these books in the past.

4 Q. Sure. I'm not trying to do a memory
5 test. I just wanted to know whether you
6 recall.

7 A. I don't recall.

8 Q. Okay. What did you do to prepare
9 for your deposition today?

10 A. Reviewed my report and looked at the
11 patent, '256 patent, and had some discussions
12 with counsel, and that's about it.

13 Q. Okay. About how long did you review
14 your -- when -- back up.

15 When you say your report, I assume
16 you're referring to your declaration?

17 A. Yes.

18 Q. How long did you spend reviewing
19 your declaration?

20 A. About somewhere between four and six
21 hours.

22 Q. And how long did you spend reviewing
23 the '256 patent?

24 A. Probably about 30 minutes to an
25 hour.

1 Q. And how long did you spend
2 conferring with counsel?

3 A. Probably three or four hours.

4 Q. Was that yesterday?

5 A. Yes.

6 Q. Was there anyone else there?

7 A. No.

8 Q. Just you and Mr. Kesack?

9 A. Yes.

10 Q. Did you review any other documents?

11 A. No.

12 Q. None of the other exhibits in this
13 matter?

14 A. I might have looked at Miller.

15 Q. And that's Exhibit 1007?

16 A. I believe so.

17 Q. Did you look at the Hemstock patent,
18 the '852 patent?

19 A. I may have just browsed those two
20 documents, just looked at the drawings
21 primarily.

22 Q. Is it fair to say the documents
23 we've already discussed, the '256 patent and
24 your declaration, are the only ones you spent
25 any substantive length of time reviewing?

1 A. Yes.

2 Q. You might have reviewed other
3 documents but not very long?

4 A. Correct.

5 Q. Okay. What's the common definition
6 of the word "fluid" in the oil and gas
7 industry?

8 MR. KESACK: Objection, form.

9 BY MR. HALL:

10 Q. And I'm not -- I don't want you to,
11 you know, feel like you have to pull out a
12 dictionary definition. Just give it your best
13 shot.

14 MR. KESACK: Same objection.

15 A. Using the generic term, "fluid"
16 basically could be the entire stream coming out
17 of a well.

18 BY MR. HALL:

19 Q. Is it fair to say that fluid, as the
20 term is generally used in the industry,
21 includes both liquids and gases?

22 A. Yes.

23 Q. It would include mixtures of the
24 two?

25 A. Yes.

1 Q. Is that your understanding of how
2 the term is used in the '256 patent?

3 MR. KESACK: Objection, form.

4 A. Yes.

5 BY MR. HALL:

6 Q. Is that your understanding of the
7 way the term is used in the Hemstock patent?

8 MR. KESACK: Same objection.

9 A. Yes.

10 BY MR. HALL:

11 Q. Is that how you used it in your
12 declaration?

13 MR. KESACK: Same objection.

14 A. Yes.

15 BY MR. HALL:

16 Q. Let's look at paragraph 25 of your
17 declaration. Do you see that?

18 A. Yes.

19 Q. Just let me know when you're there.

20 Let's look at the second sentence.

21 So it starts out, The gas/liquid interface
22 needs to remain below the fluid outlet in the
23 Hemstock vessel so that gas can continue to
24 flow out of the fluid outlet. If the fluid
25 level were to reach or exceed the level of the

1 fluid outlet, only fluid would be able to exit
2 the vessel.

3 Do you see that?

4 A. Yes.

5 Q. When you say "only fluid would be
6 able to exit the vessel," did you mean fluid in
7 the way that we just discussed, including both
8 gases and liquids?

9 A. Actually, I meant in that context
10 that you'd primarily have liquid escaping.

11 Q. Okay. So this -- so it -- this
12 would read -- based on what you intended, it
13 should read only liquid would be able to exit
14 the vessel?

15 A. Let me just read this for a second.

16 Q. Yeah. Go ahead. Take your time.

17 A. You could -- you could interchange
18 the word "liquid," but that liquid could --
19 could also have, you know, some small amount of
20 gas entrained in it and it could be comprised
21 of hydrocarbons and water.

22 Q. And let's be clear. So there's --
23 in the last part of the sentence -- let me --
24 I'm just going to go through it.

25 So we have the term "fluid outlet"

1 in the very -- that's the first time we get to
2 the word fluid. So fluid outlet, I think we
3 can -- I'm not concerned with what that means
4 at this point.

5 And then we have fluid outlet again.
6 So that gas can continue to flow out of
7 the fluid outlet.

8 (Interruption by the reporter.)

9 BY MR. HALL:

10 Q. So that gas can continue to flow out
11 of the fluid outlet. And then we get to "if
12 the fluid level." So let's talk about what you
13 intended there.

14 A. That would be the mixture of
15 probably water and also the -- any hydrocarbons
16 that were in the -- mixed in with the water.

17 Q. So when you say "hydrocarbons"
18 there, I want to be specific about what we're
19 talking about, gas or liquid?

20 A. Liquid hydrocarbons.

21 Q. Liquid hydrocarbons.

22 A. And then there could be some small
23 amount of gas still in solution in the
24 hydrocarbons entrained in that miscible in the
25 hydrocarbons because the system is under

1 pressure.

2 Q. Sure. So -- but to -- assuming -- I
3 don't know how -- if there's an easy way to do
4 this. I understand there could possibly be gas
5 dissolved in a liquid, but it's -- for all
6 intents and purposes, it is a liquid, correct?

7 A. It is. It could be small gas
8 bubbles that would be entrained in that --

9 Q. Right. But it's totally --

10 A. -- which is --

11 Q. -- it's totally different than, say,
12 the gas phase above it, correct, where it's
13 primarily gas with...

14 A. Yeah. What I was trying to
15 communicate was that there is a gas -- a free
16 gas area and then there's an area where you
17 have -- you know, there'd be oil or condensate,
18 water, and then there could -- would be some
19 gas that's miscible in the hydrocarbons and in
20 the water and there could be some small gas
21 bubbles, but it's not free gas, to
22 differentiate that from free gas, so --

23 Q. Understood. Understood. So that's
24 what you're referring to with this first, "if
25 the fluid level were to reach or exceed the

1 level of fluid outlet"?

2 A. Yes. What I'm --

3 Q. It's predominantly liquid?

4 A. What I'm trying to describe is a
5 predominantly liquid phase of fluid in the
6 lower part of the vessel and then a free gas
7 phase in the upper portion.

8 Q. Got it. And so then let's go to the
9 next one. So it says, If the fluid
10 level--that's what we were just talking
11 about--were to reach or exceed the level of the
12 fluid outlet, only fluid would be able to exit
13 the vessel.

14 Is that the same definition you were
15 using just before?

16 A. I was trying to describe the -- that
17 phase that's predominantly liquid when I refer
18 to "only fluid."

19 Q. Got it. So if the fluid level
20 exceeds the level of fluid outlet in Hemstock,
21 and I'm using fluid as the predominantly liquid
22 definition you just provided, your
23 understanding is only the predominantly liquid
24 fluid would be able to exit the vessel?

25 A. Yes.

1 Q. So let's -- if there were gas still
2 coming into the vessel at this point, if the
3 liquid level had risen above the fluid
4 outlet --

5 A. Yes.

6 Q. -- and gas is still coming into the
7 vessel, is the gas trapped in the vessel?

8 MR. KESACK: Objection, form.

9 A. Well, you would have -- this being a
10 dynamic system, it's not going to be static, so
11 you'd have a situation -- you could have a
12 situation where the predominantly liquid
13 portion is pushed up above the outlet. It's an
14 incompressible fluid.

15 So then you have -- you wouldn't --
16 probably would have a full well stream coming
17 in on the other end from the inlet, so it
18 would include --

19 BY MR. HALL:

20 Q. I'm sorry. Did you say you probably
21 would or would not?

22 A. Would.

23 Q. Okay.

24 A. So you'd probably have a mixture of
25 gas, hydrocarbons, water, and -- with some

1 solids coming into the inlet. And so for some
2 period of time you would be forcing liquid out
3 the outlet until you -- until it -- you know,
4 for some reason it comes back down again.

5 Q. And then what would happen?

6 A. If you could -- if you can evacuate
7 the liquid fast enough, then I would assume
8 that eventually that you might be able to bring
9 the fluid level back down again. It depends on
10 the -- how much is coming in and how much is --
11 is exiting the vessel.

12 Q. Depends on how much liquid is coming
13 in and exiting the vessel?

14 (Interruption by reporter.)

15 BY MR. HALL:

16 Q. It depends on how much liquid is
17 coming in and exiting the vessel. I'm just
18 trying to understand what you -- when you
19 say --

20 A. Well --

21 Q. -- how much is coming --

22 A. -- how much --

23 (Interruption by reporter.)

24 BY MR. HALL:

25 Q. So you had said it depends on how

1 much is coming into and exiting the vessel. I
2 would like to understand what you meant when
3 you said -- what you're referring to when you
4 said "how much"?

5 MR. KESACK: Objection, form.

6 A. Well, you have a -- you have a
7 volume that's coming into the vessel of
8 whatever the well is delivering. So that could
9 be oil, water, gas, and solids.

10 And then you have a volume that's
11 exiting the vessel on the other end and that
12 can be a mixture of those components also.

13 So if it's not evacuating rapidly
14 enough, you're going to -- you're going to have
15 a situation where you're filling the vessel up
16 with fluid or filling the vessel up with more
17 of the predominantly liquid phase.

18 BY MR. HALL:

19 Q. So just to make sure I understand.
20 So if the fluid -- if a predominantly liquid
21 level -- and let's -- for going forward
22 purposes, can we understand there's going to be
23 some gas dissolved in liquid. But when I refer
24 to "liquid," I'm referring to that
25 predominantly liquid phase. And when I'm

1 referring to "gas," I'm referring to the
2 predominantly gas phase; is that fair?

3 A. Yes.

4 Q. Okay. So we can save ourselves some
5 adjectives.

6 So when the liquid level rises above
7 the level of the fluid outlet and you would
8 still have the well production stream coming
9 into the vessel, then at that point in time,
10 the only thing that could leave the vessel
11 would be the liquid phase?

12 MR. KESACK: Objection, form.

13 A. If -- I'm sorry. Could you maybe
14 restate the question? I'm sorry. I didn't
15 follow.

16 BY MR. HALL:

17 Q. I -- we'd have to go back and look
18 at what your exact testimony was. But when you
19 said when the liquid level rises above the
20 fluid outlet and you still have your well
21 production stream, which could have gas and
22 liquid and solids still coming into the vessel,
23 that that would then -- at that point in time,
24 the only fluid that could leave the vessel
25 would be the liquid phase; is that correct?

1 MR. KESACK: Objection, form.

2 A. Well, I'm making sure that we're
3 talking about the same situation, but it's -- a
4 dynamic system is what I'm visualizing is the
5 well is continually flowing into the vessel.
6 If the liquid rises above the outlet, the
7 pressure is going to be applied to the -- to
8 the liquid phase. It's going to force that out
9 the outlet.

10 If there's back pressure generated
11 from the outlet, it's going to take longer for
12 that liquid to evacuate the vessel. So the --
13 at that point you're basically just evacuating
14 liquid until you finally -- either the --
15 either the level has to drop down to the point
16 that the gas could then enter or you're
17 continually pushing liquid out.

18 BY MR. HALL:

19 Q. So -- well, that's fair enough.
20 That's what I was trying to figure out.

21 So let's look at the Hemstock
22 desander. I'm sorry. Make sure that I'm
23 handing you the right thing. So I've handed
24 you Exhibit 1004.

25 (Exhibit 1004 introduced.)

1 BY MR. HALL:

2 Q. So do you have a -- are you familiar
3 with the operation of the Hemstock desander as
4 is described in the patent?

5 A. Yes. Yes.

6 Q. So I want to run through how I
7 understand, based on this document, how the
8 Hemstock desander works, and I want to make
9 sure we're on the same page.

10 So -- and I want to figure out from
11 you what -- how you think a person of ordinary
12 skill in the art would understand this to work.
13 You understand?

14 A. Yes.

15 Q. Okay. So a person of ordinary skill
16 in the art would understand Hemstock to
17 disclose a system that, 1, discharges a
18 particulate laden gas and liquid stream into a
19 vessel.

20 That's from the wellhead; is that
21 fair?

22 A. Yes.

23 Q. Okay. And then the vessel has an
24 increased cross-sectional area and it reduces
25 the fluid velocity such that a portion of the

1 particulates fall along a curved downward
2 trajectory into a liquid level; is that fair?

3 A. Yes.

4 Q. Okay. And then the particulates
5 travel through the liquid where they accumulate
6 on the vessel bottom; is that fair?

7 A. Yes.

8 Q. And then in a -- at least in a
9 steady state mode, liquids near the fluid
10 outlet are picked up by the primarily gas phase
11 stream and re-entrained for discharge from the
12 fluid outlet; is that fair?

13 A. Yes.

14 Q. Okay. So let's look at column 4, 55
15 through 59. Just let me know when you're
16 there.

17 A. Okay. That would be the bottom of
18 page 9?

19 Q. Well, you've tricked me now. Yes,
20 that's correct. Sorry. I'm not using the
21 numbered version, so I'm looking at the column
22 numbers.

23 A. Okay.

24 Q. So you see column 4, line 55?

25 A. Yes.

1 Q. Okay. So this says, Typically,
2 liquid L out of the fluid stream F accumulates
3 in the belly portion 32 to a steady state level
4 and then is re-entrained for discharge with
5 fluids exiting the outlet 13 without affecting
6 the capability of the vessel 11 and belly
7 portion 32 to continue to accumulate
8 particulates S.

9 Do you see that?

10 A. Yes.

11 Q. So does this mean that liquids are
12 re-entrained, picked up, and carried out of the
13 vessel?

14 MR. KESACK: Objection, form.

15 A. Well, there would be a particular
16 state when that occurs.

17 BY MR. HALL:

18 Q. Right. The steady state?

19 A. But that doesn't mean that it's
20 going to occur all the time.

21 Q. Fair enough. So as this -- this
22 describes that as steady state level, and I'm
23 just trying to understand what this means. So
24 when it says "re-entrained," what does that
25 mean to you?

1 A. That means that there is the -- an
2 optimal mixture of gas flow and liquid flow
3 such that it picks up the liquids as opposed to
4 the liquids blocking the gas from reaching the
5 outlet.

6 Q. Okay. So re-entrained means the gas
7 picks up liquid and carries it -- with it out
8 of the fluid outlet?

9 MR. KESACK: Objection, form.

10 A. Correct.

11 BY MR. HALL:

12 Q. Again, at steady state, is it fair
13 to say that liquid is entering and leaving the
14 belly portion of the vessel continuously?

15 A. I would say it's leaving the -- at
16 the interface.

17 Q. Okay.

18 A. If it's being re-entrained by the
19 gas, it has to be picked up by the gas that's
20 in the gas phase and then there has to be
21 sufficient velocity for it to pick up the fluid
22 and carry it out of the vessel.

23 Q. So when the -- before the liquid is
24 picked up, where is it?

25 A. Well, there's some liquid in the

1 bottom of the vessel, but the vessel that the
2 liquid is being re-entrained is going to be
3 right at that interface.

4 Q. But it -- so it's at the -- it's at
5 the -- it's still in the liquid phase but at
6 the very top of the liquid phase?

7 MR. KESACK: Objection, form.

8 MR. HALL: You're right. That's a
9 bad question.

10 BY MR. HALL:

11 Q. So we have the liquid level which is
12 the gas/liquid interface; is that fair?

13 A. Yes.

14 Q. Okay. So at the very surface of the
15 liquid, you're saying that's where you're
16 picking the liquid up from, the very surface of
17 that liquid level?

18 A. I'm visualizing that the gas is
19 exiting through the -- has sufficient --
20 there's sufficient space for it to exit out the
21 outlet and that at the same time it's -- it's
22 picking up fluid off the interface that's below
23 it and pulling that out of the vessel.

24 Q. Okay. So when it's picking up fluid
25 off of the interface, that -- or picking up

1 liquid off of the interface, that liquid is at
2 the very surface of the liquid in the vessel --
3 the liquid level in the vessel; is that fair?

4 MR. KESACK: Objection, form.

5 A. I'm -- yes, I'm assuming that it's
6 at the interface.

7 BY MR. HALL:

8 Q. And the interface again is the
9 liquid level in the vessel?

10 MR. KESACK: Objection, form.

11 A. Well, it would be the liquid level,
12 you know, proximate the outlet.

13 BY MR. HALL:

14 Q. So the interface include -- it only
15 includes the area around the outlet?

16 MR. KESACK: Objection, form.

17 A. Well, there's an interface along the
18 entire vessel.

19 BY MR. HALL:

20 Q. Okay.

21 A. There's another component which is
22 this -- typically, they're running a downcomer
23 in this design and that's forcing the gas to
24 flow under the downcomer and then out the
25 outlet. So they're trying to create this --

1 they're trying to maintain this freeboard above
2 the liquid interface, and then it would be
3 picking up liquid at the outlet, and as the gas
4 moves out, it's picking up some of the fluid
5 droplets and carrying them out with it as it
6 exits the vessel.

7 Q. I understand. What I'm trying to
8 understand -- when you say it's picking up
9 liquid, I'm just trying to figure out where is
10 that liquid before it's picked up?

11 A. It's below the outlet. I mean,
12 it's -- it's not pulling liquid from the inlet
13 end of the vessel, it's picking up liquid from
14 the outlet end of the vessel and it's below
15 the -- it's the liquid that lies below the
16 outlet.

17 Q. And -- fair enough. Specifically,
18 I'm trying to figure out where is the liquid in
19 terms of the gas/liquid interface? Very
20 surface of the liquid, is it coming from above
21 that or is it coming from below the gas --

22 A. Well, when you look at the drawings
23 that are provided, they actually show that the
24 gas is creating an indentation in the fluid
25 level at the outlet, and then the gas is

1 exiting and pulling the fluid out. So it's
2 not -- it's not actually at the same level in
3 these drawings as it is throughout the rest of
4 the vessel so that the -- again, it's the
5 liquid that's below -- the liquid interface
6 that's below the outlet is where the -- is the
7 liquid that's being picked up and carried out
8 of the vessel.

9 Q. Right. So I understand -- now I
10 think I understand why I'm having trouble
11 getting this -- the answer I'm looking for from
12 you is because you're not -- you're considering
13 the fact that the liquid level is not uniform
14 throughout the vessel; is that fair?

15 A. Correct.

16 MR. KESACK: Objection, form.

17 BY MR. HALL:

18 Q. Okay. So you have -- you might have
19 waves in the liquid level indentations where
20 the -- at some points in the vessel it's higher
21 and some points it's lower; is that fair?

22 A. Well, specifically the -- with the
23 downcomer installed, and probably even without
24 the downcomer installed, the gas is going to
25 tend to push the liquid down and then make its

1 exit because it has to go perpendicular to go
2 out of the vessel. So that's where the liquid
3 below the outlet would then be carried out with
4 the gas as it exits the --

5 Q. Okay.

6 A. -- vessel.

7 Q. So when I talk about the belly
8 portion of this vessel, I'm going to be
9 talking -- and what I'm referring to is the
10 portion below the gas/liquid interface,
11 wherever that might be. Is that fair?

12 A. Yes.

13 Q. Okay. So is it your understanding
14 that liquid -- so we were just talking about
15 liquid being picked up by the gas from the
16 belly portion and carried out of the vessel.

17 Is it your understanding that liquid
18 is entering and leaving the belly portion of
19 the vessel continuously at least in the steady
20 state mode?

21 MR. KESACK: Objection, form.

22 A. Yes.

23 BY MR. HALL:

24 Q. And is that the normal operation of
25 the vessel in steady state mode?

1 A. I'm visualizing it more as the
2 interface is disrupted at that point during
3 steady state flow, and you've got droplets that
4 have been picked up by a turbulent flow of the
5 gas and they're being carried out during steady
6 state so that you are pulling liquid out at the
7 same time that you're pulling gas out.

8 Q. I guess what I'm -- what I was
9 trying to get at with that question was whether
10 that is an abnormal mode of operation for this
11 vessel or is it -- what is it -- is it how it's
12 intended to work?

13 MR. KESACK: Objection, form.

14 A. I believe it's intended for you to
15 remove the liquids and the gas and leave the
16 solids.

17 BY MR. HALL:

18 Q. So that's not exactly my question.
19 We were just discussing about how it was
20 picking up liquid and carrying out the gas. Do
21 you recall that?

22 A. Yes.

23 Q. So is that how this vessel is
24 intended to work?

25 A. Yes.

1 Q. Well, we talked a little bit about
2 the steady state mode and I want to suss that
3 out a bit. And you had mentioned that you
4 expected the vessel to operate in--I don't
5 remember the words you used--several different
6 ways. So can you explain for us what your
7 understanding of steady state means at least as
8 it's used here in the Hemstock patent?

9 MR. KESACK: Objection, form.

10 A. If the vessel is sized properly for
11 the output of the well, I would expect in
12 steady state to see that the solids are
13 dropping to the bottom of the vessel and that
14 the gas is exiting and then it's carrying some
15 fluid out with it as it exits the vessel in
16 steady state.

17 BY MR. HALL:

18 Q. What happens to the liquid level if
19 you're remaining in steady state?

20 A. It should be fairly constant.

21 Q. Okay. So it means that you have the
22 same amount of liquid leaving as you do
23 entering?

24 A. Yes.

25 Q. So you might -- you could still be

1 accumulating sand during steady state mode,
2 again, as this term is used here, but you're
3 not accumulating liquid; is that fair?

4 MR. KESACK: Objection, form.

5 A. Yes.

6 BY MR. HALL:

7 Q. Let's talk about nonsteady state.
8 So let's assume we're starting at the Hemstock
9 desander. We're placing it in operation. Is
10 it your understanding that there's any liquid
11 in the vessel at start-up?

12 A. No.

13 Q. So when you first start up, liquid's
14 coming into the vessel and it's accumulating
15 and the level is slowly rising; is that
16 correct?

17 MR. KESACK: Objection, form.

18 A. Yes.

19 BY MR. HALL:

20 Q. Okay. And then as it continues to
21 come in and accumulate, it finally reaches a
22 certain height, which we've just been
23 discussing, and that's when it begins to be
24 re-entrained; is that accurate?

25 MR. KESACK: Objection, form.

1 A. I'm not sure if in the transition
2 from filling I could see some liquid being
3 pulled out with the gas, so there -- I think
4 it's designed so that it's -- it's basically a
5 steady state process where you've got a
6 continuous flow through the vessel.

7 Maybe you can ask the question
8 again. I'm sorry.

9 BY MR. HALL:

10 Q. Sure. All I'm trying to get at is
11 before you reach steady state, when you don't
12 have enough liquid in the vessel to get up
13 close to the fluid outlet where it can be
14 picked up by the gas. You know, we were just
15 discussing that, right? There's a period in
16 time before the liquid reaches that where
17 liquid is accumulating and the liquid level is
18 rising; is that correct?

19 A. Yes.

20 Q. And so I want to talk, then, about
21 the other side which we touched on a little bit
22 earlier. If you had a large liquid slug
23 event -- so we have a very large amount of
24 liquid coming in where there's no gas. It's
25 just a liquid slug to a vessel that -- the

1 Hemstock vessel where it was in steady state.
2 Okay. So it started out -- Hemstock vessel
3 starts out in steady state. Everything is
4 working as we've been discussing, and then you
5 have a very large liquid slug.

6 What is your understanding of what
7 would happen to the liquid level in that case?

8 MR. KESACK: Objection, form.

9 A. The liquid level would probably rise
10 temporarily until it was -- the liquid is
11 forced out of the -- the outlet and then it
12 would recover and go back to steady state.

13 Q. And when you say "forced out of the
14 outlet," do you mean forced out by a gas?

15 A. Well, by the -- the liquid pressure
16 and the gas pressure entering the vessel, and
17 there would be a pressure drop -- there would
18 be a lower pressure outside the vessel and a
19 higher pressure inside the vessel. So any
20 liquid at the outlet would be forced out or
21 tend to flow out of that outlet.

22 Q. If you had a very large liquid slug
23 with no gas coming into the vessel, the vessel
24 would fill up with liquid; is that correct?

25 MR. KESACK: Objection, form.

1 A. Temporarily, yes.

2 BY MR. HALL:

3 Q. And if the liquid slug continued,
4 would you then -- the liquid coming into the
5 vessel would then push out the liquid that's
6 already in the vessel; is that fair?

7 MR. KESACK: Objection, form.

8 A. Yes.

9 BY MR. HALL:

10 Q. And then you would need -- in order
11 for the liquid level to then drop after this
12 type of event, you would need gas to start
13 coming into the vessel; is that fair?

14 MR. KESACK: Objection, form.

15 A. Well, there would be gas entrained
16 in the liquids that would probably break out
17 inside the vessel. So I don't know that it
18 necessarily has to -- requires a totally
19 separate gas slug, but, you know, you'd have
20 a -- you'd have gas coming -- if you have more
21 gas coming in, that would help to push the
22 fluid level down, but you could also have gas
23 in the liquid itself that breaks out of
24 solution and creates freeboard in that way.

25 BY MR. HALL:

1 Q. Fair enough. So you would -- you
2 would need gas to either come out of solution
3 with the liquid or -- or come out of
4 entrainment with the liquid or to enter the
5 vessel itself before you had any freeboard in
6 the vessel; is that fair?

7 A. Yes.

8 Q. In that situation, if you had the
9 liquid -- if you had a liquid slug -- strike
10 that.

11 If you fill the liquid up with -- or
12 if you fill the vessel up with liquid, the
13 situation we were just discussing, is it
14 possible that it could carry accumulated sand
15 in the bottom of the vessel out of the fluid
16 outlet?

17 MR. KESACK: Objection, form.

18 A. It's possible if you've undersized
19 the vessel relative to the amount of influx
20 that you have. If it's designed appropriately
21 for the influx, you should have the sand still
22 fall to the bottom of the vessel. So that
23 would be dependent on the situation, I think.

24 BY MR. HALL:

25 Q. Sure. But if you had an event where

1 the vessel was completely full of liquid with
2 sand accumulated to the bottom, and then you
3 still had more liquid coming in, is it possible
4 that that's going to pick up sand and carry it
5 out of the outlet?

6 MR. KESACK: Objection, form.

7 A. It's possible.

8 BY MR. HALL:

9 Q. Would you expect the Hemstock vessel
10 to stay in steady state mode for long periods
11 of time --

12 MR. KESACK: Objection.

13 BY MR. HALL:

14 Q. -- during a real world operation?

15 A. I'd say it would be close to steady
16 state. I mean, I think there could be
17 fluctuations above and below. I think that
18 they've deployed that design and it's worked in
19 the field, so there's some evidence that it
20 does operate in a -- pretty close to a steady
21 state situation in normal conditions.

22 Q. So the deployment in the field, why
23 do you think that indicates that the vessel
24 operates in steady state mode for any period of
25 time?

1 MR. KESACK: Objection, form.

2 A. Well, there's -- it's -- well, by
3 design, to start with, that it's -- it would be
4 sized such that the inflow doesn't overwhelm
5 the vessel, and then the -- I'm just basically
6 using some empirical information that was in
7 the patent where they were showing that they
8 had particulate free -- relatively particulate
9 free fluids coming out of the vessel. So that
10 indicates to me that it was -- that it was in
11 steady state flow.

12 BY MR. HALL:

13 Q. Well, you're assuming that it -- the
14 vessel is operating as it's described in the
15 patent.

16 A. Yes.

17 Q. It is fair to say that as the flow
18 rate and the composition of the well production
19 stream change, the vessel is going to move in
20 and out of the steady state mode of operation.

21 MR. KESACK: Objection, form.

22 A. I could see that, yes.

23 BY MR. HALL:

24 Q. So on the discussion we've had about
25 steady state mode and the -- kind of the

1 general way that Hemstock desander works, I
2 would like to understand if that's generally
3 how the '256 patent desander works, without
4 having to repeat our entire discussion.

5 I understand there are differences
6 in the design, but generally speaking, is it
7 your understanding that the '256 patent
8 desander works by taking a fluid stream and
9 allowing the sand to fall out of the fluid
10 stream and then re-entrain liquid out of the
11 fluid outlet?

12 MR. KESACK: Objection, form.

13 A. I think it differs in that the fluid
14 level is at the outlet and that it intersects
15 it at an angle. So I think the re-entrainment
16 process would be different in that situation.

17 BY MR. HALL:

18 Q. How so?

19 A. Well, you don't have to -- in the
20 Hemstock design, it has to make a -- you got to
21 make a 90-degree turn with gas and the fluid,
22 and the -- with the fluid level at an interface
23 at the outlet, you should have more efficient
24 removal of the liquid that's at that -- at that
25 interface.

1 Q. But generally, you're -- you are
2 re-entraining liquid. It's just -- in your
3 opinion, it's more efficient in the '256
4 desander?

5 A. I think part of that fluid could
6 just be flowing out of the outlet at that
7 interface because of that impinging on the
8 outlet at an angle.

9 Q. Are you aware of anything in the
10 '256 patent that indicates that?

11 MR. KESACK: Objection, form.

12 A. I didn't memorize all the text, but
13 as I understand it, I believe that it was
14 thought that that would -- there would be a
15 more efficient removal of liquid hydrocarbons
16 with the '256 design, which would be
17 floating -- probably be floating on top of the
18 water or tend to be -- tend to be lighter than
19 the water.

20 So when you -- at that interface,
21 when the fluid level hits or, you know,
22 intersects the outlet, you would pull all those
23 fluids out, and some of those should just flow
24 out, I think, through that outlet.

25 MR. HALL: Objection, nonresponsive.

1 Move to strike.

2 BY MR. HALL:

3 Q. So you don't recall anything in the
4 '256 patent that supports liquid flowing?

5 A. Can I look at -- I could look at the
6 patent and see if I can...

7 Q. I'm not going to make you do a
8 memory test, and what I'm -- I don't want to
9 spend all day while you read it again.

10 You don't recall anything, sitting
11 here, specifically that supports the idea that
12 liquid is flowing out of the fluid outlet, do
13 you?

14 MR. KESACK: Objection, form.

15 A. Only that portion -- I believe it's
16 in the '256 patent that says that one feature
17 would be more efficient recovery of the
18 hydrocarbons.

19 BY MR. HALL:

20 Q. Okay. Take a look at Exhibit 1001
21 and see if you can find that section.

22 A. I believe I talk about that --

23 MR. KESACK: Does he have 1001?

24 THE WITNESS: Yes. I believe I
25 referred to this when I was -- I talk about

1 this in my report at the --

2 MR. HALL: I thought he did.

3 BY MR. HALL:

4 Q. I'm sorry. I thought I had handed
5 you this already. Let me hand you
6 Exhibit 1001. I apologize. So look at your
7 petition, or you can look at the patent itself.

8 A. Let's see.

9 (Witness reviews document.)

10 BY MR. HALL:

11 Q. And you're looking at your report
12 right now?

13 A. Yes. I'm just remembering where I
14 had discussed that in my report. I was trying
15 to see if I was referencing that someplace in
16 the patent.

17 Q. Let me direct your attention to
18 Exhibit 1001, column 4, line 65. It's the very
19 bottom there. Let me know when you're there.

20 A. Yes.

21 Q. So this says, At a steady state, the
22 maximum level of the interface 32 is controlled
23 at the distal end 33, set by eventual liquid
24 entrainment and discharge at the fluid outlet
25 26. Gas G discharges at the fluid outlet 26.

1 At steady state when the liquid level reaches
2 the fluid outlet 26, any oil and other liquids
3 are re-entrained with the gas G exiting at
4 fluid outlet 26.

5 That indicates that liquids at the
6 fluid outlet are re-entrained; is that correct?

7 A. That's what that says. I also
8 referred to, I guess, the manner of the
9 re-entrainment is different.

10 Q. Sure.

11 A. So if -- let me -- you mind if I
12 just look at this for just a minute?

13 Q. And what do -- I just want to be
14 clear about what we're looking for. You're
15 looking for something that supports the idea
16 that liquid is not being re-entrained but is
17 flowing out of the liquid outlet?

18 MR. KESACK: Objection, form.

19 A. Well, I guess that depends on how
20 you define "re-entrained." I think there'd be
21 a mixture of gas and liquid. I think that that
22 would be more efficient and you'd have more
23 liquid pulled out with the gas which is, you
24 know, moving through that outlet and carried
25 out. So it's flowing out, but there's a -- it

1 would probably be a mixture of gas and liquid.

2 But I was thinking, in my mind and
3 from what I've read in the patent, one of the
4 ideas was that you were -- that was a different
5 mechanism than you find in the Hemstock or a
6 different -- a different level of
7 re-entrainment, I guess you could say, than you
8 find in Hemstock because of the fact that the
9 interface intersects at the -- at the outlet as
10 opposed to using a downcomer and having to make
11 a 90-degree turn and then pick up those fluids
12 and carry them out of the vessel vertically.

13 BY MR. HALL:

14 Q. And do you think that this is
15 something that is in the '256 patent explicitly
16 or is this something that you believe you have
17 understood by reviewing the '256 patent,
18 something that you've inferred, in other words?

19 A. Can I just take a moment and...

20 Q. Not yet. So I would like to know if
21 you think this is something that's expressly
22 written in the patent or is this something that
23 you understood after you read the patent?

24 MR. KESACK: Objection, form.

25 A. Well, they do refer in the '256

1 patent to basically the fluid and the gas
2 exiting in a different manner than in the
3 Hemstock patent. That's what I was trying to
4 look up, based on my references in my report.

5 BY MR. HALL:

6 Q. Let's talk about what re-entrainment
7 means. So what is an entrained -- what does it
8 mean when we say a liquid is entrained in a
9 gas?

10 A. Well, the gas is -- is carrying the
11 liquid with it. So there can either be more
12 liquid or less liquid. There can be larger
13 droplets or smaller droplets. It can be -- it
14 can be a -- you know, a larger percentage of
15 gas or a lesser percentage of gas, larger
16 percentage of fluid or lesser percentage of
17 fluid. So there's...

18 Q. Sure. So -- but when we say --

19 A. All that can be considered
20 re-entrainment.

21 Q. So when we say -- let's be clear.
22 I'm just talking about entrainment, not
23 re-entrainment. So entrainment.

24 When liquid is entrained in gas,
25 then you have distinct particles or droplets of

1 liquid that are being carried along by the gas
2 stream; is that accurate?

3 A. Yes.

4 Q. Okay. So when the Hemstock patent
5 or the '256 patent used the word
6 re-entrainment, that indicates that liquid
7 which was once entrained became no longer
8 entrained and then has now become re-entrained
9 or it's entrained again to be carried out of
10 the fluid outlet; is that fair?

11 MR. KESACK: Objection, form.

12 A. Yes.

13 BY MR. HALL:

14 Q. Okay. So let's move on. If you see
15 the reference that you're talking about later
16 regarding a different manner in which liquid is
17 carried out in the '256 patent, please feel
18 free to bring it up, but I just want to move on
19 at this point. Okay?

20 A. Okay. I discuss that in paragraph
21 25.

22 Q. Paragraph 25. Let's take a look at
23 it.

24 A. And...

25 Q. What are you specifically referring

1 to in paragraph 25 at this...

2 A. Well, it's the difference between
3 using this downcomer as a flow barrier or a
4 weir and the liquid interfacing directly into
5 the outlet, and I was...

6 Q. So but in both -- I guess what I'm
7 trying to understand is are you -- are you
8 saying that there is another mechanism by which
9 liquid is leaving the '256 patent's vessel that
10 does not involve re-entrainment?

11 A. Well, when you say that it's flowing
12 out of the -- of the vessel -- if I were to say
13 it's flowing out of the vessel, either way, if
14 it's pure liquid or whether it's liquid and
15 gas, it's still flowing. It's moving out of
16 the vessel. So --

17 MR. HALL: Objection, nonresponsive.

18 Move to strike.

19 BY MR. HALL:

20 Q. So are you saying there's another
21 mechanism besides re-entrainment where liquid
22 is leaving the vessel in the '256 patent?

23 A. In certain situations, yes. We
24 discussed earlier the situation where the fluid
25 level is higher than the outlet and it was pure

1 fluid leaving the vessel, so in that case
2 that's not re-entrainment.

3 If -- the point I was making is that
4 there's -- it's a different mechanism or a
5 different manner, would be a better way to
6 describe it, that the re-entrainment is
7 occurring in the '256 patent than it is in the
8 Hemstock patent.

9 Q. I understand that's your assertion,
10 that there's a different way that that's
11 happening.

12 But what I'm wanting to get to is,
13 does the end result look different? Is liquid
14 entrained in the gas leaving the vessel or is
15 it flowing out in a different way in the steady
16 state mode?

17 A. No. They're both -- they're both --
18 they're going to have an element of
19 entrainment.

20 Q. Okay.

21 MR. KESACK: If you find a time to
22 take a break. Been going over an hour now.

23 MR. HALL: Okay.

24 THE WITNESS: I could use a bathroom
25 break, actually.

1 BY MR. HALL:

2 Q. Okay. Let me just ask one more
3 question. So when we talked about the Hemstock
4 patent and the liquid level building up, you
5 remember that?

6 A. Yes.

7 Q. In the nonsteady state mode, when
8 we're starting up --

9 A. Yes.

10 Q. -- does that discussion apply
11 equally with the '256 patent desander?

12 MR. KESACK: Objection, form.

13 A. (No response.)

14 BY MR. HALL:

15 Q. And when you're starting up the '256
16 desander, there's no liquid in it. Liquid has
17 to accumulate in the vessel before it reaches
18 steady state mode; is that fair?

19 A. Yes.

20 Q. Okay. Sorry. One more question.
21 Let's look at paragraph 33, the top of page 19
22 of your -- of your declaration. It's paragraph
23 33.

24 You say, The '256 patent, rather
25 than avoiding placing the gas/liquid interface

1 at the fluid outlet, requires that the gas at
2 the interface --

3 (Interruption by the reporter.)

4 BY MR. HALL:

5 Q. The '256 patent, rather than
6 avoiding placing the gas/liquid interface at
7 the fluid outlet, requires that the gas/liquid
8 interface be at the fluid outlet in order for
9 the vessel to operate properly.

10 So in this start-up mode or the
11 gas/liquid interface is not at the fluid
12 outlet, is it your understanding that the
13 vessel described in the '256 patent will not
14 operate properly?

15 MR. KESACK: Objection, form.

16 A. Well, the start-up is a normal part
17 of operation. It's -- I don't know that it's
18 not -- I don't see how it's not operating
19 properly if you're just in the start-up
20 portion. The part of the process you're
21 concerned about is continuous flow.

22 BY MR. HALL:

23 Q. So is it fair to say that the '256
24 patent does not require that the gas/liquid
25 interface be at the fluid outlet in order for

1 the vessel to operate properly?

2 MR. KESACK: Objection, form.

3 A. No.

4 BY MR. HALL:

5 Q. It's not fair?

6 A. No.

7 Q. So this vessel would not remove sand
8 from the fluid stream unless the gas/liquid
9 interface is at the fluid outlet.

10 MR. KESACK: Objection, form.

11 A. I believe that the way that it's
12 designed, it's going to be a natural result of
13 the design that you're going to end up with the
14 liquid interface at the outlet. So that's the
15 way it's going to operate. That's the way it's
16 designed to operate.

17 BY MR. HALL:

18 Q. Will the vessel remove sand from the
19 incoming fluid stream at any time when the
20 gas/liquid interface is not at the fluid
21 outlet?

22 A. Well, there could be some sand that
23 would fall out before you reach steady state.
24 That wouldn't be much use to anybody because
25 it's only for an instant, maybe a fraction of a

1 second or a few seconds until the thing fills
2 up and then goes into operation where you're
3 removing the gas and the liquid.

4 Q. So doesn't the amount of time it
5 takes to fill up depend on the composition of
6 the fluid coming in?

7 A. It would depend on the rate of flow
8 of the well rather than the composition of the
9 fluid, I think.

10 Q. So if there's no liquid coming into
11 the vessel, say it's a gas stream with no
12 liquid at all, would the -- the vessel would
13 fill up?

14 A. If there was only gas coming in and
15 we don't have any liquid, that's the situation
16 you're describing?

17 Q. Uh-huh.

18 A. So if there happened to be solids in
19 the gas, I could see the gas falling -- I could
20 see the solids falling through the gas directly
21 to the bottom of the vessel and the gas exiting
22 the vessel -- sorry. I've lost track of what
23 the question was.

24 Q. I'm really trying to get at your
25 statement here in your declaration that says,

1 The '256 patent requires that the gas/liquid
2 interface be at the fluid outlet in order for
3 the vessel to operate properly.

4 I'm wanting to know if you think
5 that the vessel will not actually work to do
6 its -- its intended function is to remove sand
7 from the well production stream. That's
8 correct -- that's accurate, right?

9 A. Correct.

10 Q. So I'm wanting to understand if it's
11 really your understanding that the vessel will
12 not work to remove sand from the well
13 production stream unless the gas/liquid
14 interface is at the fluid outlet?

15 MR. KESACK: Objection, form.

16 A. Well --

17 BY MR. HALL:

18 Q. Does that make sense?

19 A. In the context of its intended use,
20 which is when you are flowing back a well after
21 a frac, there's going to be liquids because you
22 cannot frac the well without liquids. So I'm
23 having a hard time imagining a situation where
24 that occurs.

25 Q. Where what occurs?

1 A. Where you just have gas.

2 Q. Okay. Well, that was not the
3 question. The question is -- again, we're
4 going back to start-up. If the liquid level
5 has not yet risen to the gas/liquid interface,
6 this vessel will still separate sand from the
7 well production stream; is that fair?

8 A. I could see some sand dropping out,
9 yes.

10 Q. So if the liquid level has not risen
11 there to the gas/liquid -- it has not risen to
12 the fluid outlet, the vessel will not work very
13 well to remove sand? Is that what you're
14 saying?

15 MR. KESACK: Objection, form.

16 A. Well, the vessel has more than one
17 purpose. It's -- it's to remove -- it's to
18 accumulate the sand, but you also want the
19 liquids and the gas to come out of the vessel
20 and go downstream to the next stage in your
21 processing. So --

22 BY MR. HALL:

23 Q. Okay.

24 A. -- it's -- that's what it's designed
25 to do, and that's the application that it would

1 be applied in.

2 So I'm not sure if I understand in
3 your hypothetical when that would occur or I'm
4 a little confused as to -- as to the question.

5 Q. I'm simply trying to understand if
6 we're not in steady state mode yet, right,
7 because the gas/liquid interface is not at the
8 fluid outlet, if the vessel will operate
9 properly, will it remove sand as it's intended
10 to do?

11 MR. KESACK: Objection, form.

12 A. Okay. So if its -- if its function
13 is to be used in a particular application,
14 which I believe that it is, if you say that
15 its -- is it functioning properly, it's not in
16 the situation it was designed for, so I don't
17 think it's functioning because of the situation
18 and the way it was designed to operate.

19 BY MR. HALL:

20 Q. Okay. And earlier you had said that
21 start-up was part of the normal operation.

22 A. Correct. I mean, you have to turn
23 the well on and you fill the vessel up and then
24 you start -- it would start operating as it's
25 designed to operate.

1 Q. Okay.

2 MR. HALL: All right. Let's go
3 ahead and take a break.

4 (Recess held.)

5 BY MR. HALL:

6 Q. Take a look at paragraph 26 of your
7 declaration. It's on page 12. I wanted to
8 make sure I was understanding your testimony
9 here. So you testified that, Because the
10 vessel is inclined -- this is the third line up
11 from the bottom, page 12 there.

12 Because the vessel is inclined, sand
13 and liquid are forced to the outlet side of the
14 vessel.

15 What are they forced by? What
16 forces the sand and liquid to the outlet side
17 of the vessel?

18 A. Gravity.

19 Q. And that's because the vessel is
20 inclined, sand and liquid will flow to the
21 lowest point?

22 A. I don't know if it will go all the
23 way to the end, but the sand would tend to move
24 toward the outlet.

25 Q. Fair enough. In paragraph 26,

1 continuing, you state that, This process is
2 increased as sand builds up. As with more
3 solid in the belly portion, there's less
4 liquid, and the smaller amount of liquid causes
5 the liquid to travel towards the outlet side of
6 the vessel at a higher velocity.

7 What did you mean when you -- you're
8 referring to a higher velocity? Higher --
9 higher than what?

10 A. Well, as the -- in an area of the
11 vessel where you have a smaller cross-sectional
12 area, for the same volume of fluid to move
13 through that, the velocity has to increase
14 because you caused a smaller cross-sectional
15 area above the -- above the sand or the
16 proppant that's built up in the bottom of the
17 vessel.

18 Q. Sure. So I guess I want to
19 understand that. It's your understanding that
20 there was a -- there is some velocity -- and,
21 again, we're on the '256 patent.

22 There's some liquid velocity in the
23 bottom of the vessel, in the belly portion of
24 the vessel when it's working in steady state?

25 A. Well, there would be a gradation in

1 velocity from the bottom, which is probably
2 zero, to the -- to the interface. So the
3 liquid should be moving at a higher velocity at
4 the interface with the gas moving across it
5 than the liquid that's in the bottom of the
6 vessel.

7 Q. And when we say -- as you were
8 explaining that, it occurred to me that it may
9 not be clear. When I'm using the word
10 "velocity" and the way you were using it here,
11 I'm talking about velocity -- horizontal
12 velocity versus vertical velocity, and let me
13 explain.

14 When I say "horizontal," I mean from
15 the inlet side of the vessel to the outlet side
16 of the vessel. And when I say "vertical," I
17 mean from the top of the vessel to the bottom
18 of the vessel. You understand that?

19 A. Yes.

20 Q. So when I'm talking about whether
21 there's velocity in the liquid or belly
22 portion, at least for this question, it's your
23 understanding there is horizontal velocity in
24 the liquid portion?

25 A. Again, it would be -- it's very

1 similar to what you would see in a
2 horizontal -- you know, a wellbore, as you
3 would see a difference of velocity --
4 horizontal velocity between the bottom of the
5 vessel particularly when it's full of solids
6 and the interface, and if you've got a small
7 cross-sectional area, I would expect to see the
8 fluid move more rapidly across that -- through
9 that cross-sectional area than it would if the
10 whole vessel's open.

11 So as you build up sand or proppant
12 or solids in the bottom of the vessel, there'd
13 be some point in there where you'd have a
14 smaller cross-sectional area and would expect
15 the fluid to accelerate in the horizontal
16 direction.

17 Q. Okay. So is that discussion also
18 true in the Hemstock vessel? Do you also have
19 the liquid velocity moving from the inlet to
20 the outlet?

21 A. Well, in the Hemstock vessel, I
22 don't think it'd be exactly the same. It'd be
23 a similar -- might be a similar phenomenon, but
24 I would expect that the -- the sand to
25 accumulate more evenly across the bottom --

1 Q. Uh-huh.

2 A. -- than if it's at an angle and
3 you've got some movement of the solid by
4 gravity downwards, you might -- you would tend
5 to end up with a mound of solids toward one end
6 and a smaller cross-sectional area at that
7 point. So I think it would have a different
8 velocity profile -- horizontal velocity
9 profile.

10 Q. Fair enough. All right. So I guess
11 my -- my question in regards to the Hemstock
12 vessel--I understand it's not tilted--is that
13 you would still expect there to be horizontal
14 velocity in the liquid?

15 A. In the -- in the liquid portion.
16 That's not liquid that's in the -- between the
17 grains of the solids.

18 Q. Right. So in other words, the --

19 A. There might be some movement there,
20 but it seems like it'd be very small even in
21 the solid --

22 Q. You mean, in between the solid
23 particles?

24 A. Correct.

25 Q. So -- right. So in the bulk phase,

1 liquid that's above the solids in the belly
2 portion --

3 A. Yes.

4 Q. -- you would expect there to be at
5 least some liquid velocity. It's not -- it's
6 not a quiescent fluid?

7 A. Correct.

8 Q. And by "quiescent" I mean still.

9 A. Correct.

10 Q. Is that your understanding of that
11 word?

12 A. Yes.

13 Q. Okay. I heard it for the first time
14 when Mr. Kesack used it in the last deposition.

15 Look at paragraph 33 of your
16 declaration.

17 A. Page 33?

18 Q. Page 18. Sorry. I forgot to ask
19 you when we came back from the break. Did you
20 consult with Mr. Kesack regarding the substance
21 of your testimony?

22 A. We just discussed the claims of the
23 patent and, you know, sort of -- he asked me to
24 -- told me to, you know, answer the questions
25 honestly, listen to the question, think about

1 my answers, that kind of thing.

2 MR. KESACK: Let me clarify. You
3 meant the break we just took, right?

4 MR. HALL: Yes, sir.

5 BY MR. HALL:

6 Q. Is that what you're referring to?

7 A. No, we didn't talk about it at all
8 actually.

9 Q. So during the break we just took,
10 y'all didn't talk at all?

11 A. No. We talked about nuclear
12 engineering.

13 Q. Got it. Okay.

14 MR. HALL: Thank you, Mr. Kesack.

15 BY MR. HALL:

16 Q. Paragraph 33. So let's look at the
17 second sentence here. You say, As described
18 above, the prior art Hemstock desander vessel
19 requires a flow barrier to ensure that the
20 freeboard portion of the vessel is maintained.

21 Do you see that?

22 A. Yes.

23 Q. And you say that it's -- so it's
24 maintained below the fluid outlet so the gas
25 can always escape through the fluid outlet.

1 And I think we touched on this a bit
2 at the very beginning. It's your understanding
3 that if the liquid level does rise above the
4 fluid outlet, that at that point, no gas will
5 be able to -- at that point in time, no gas
6 will be able to escape through the fluid
7 outlet; is that accurate?

8 A. I guess I would say free gas. We...

9 Q. Understood. So obviously not
10 including gas that might be dissolved in the
11 liquid?

12 A. Or small gas bubbles --

13 Q. Sure.

14 A. -- that are entrained in the liquid.

15 Q. Right. And that's a fair point.

16 Again, when I'm talking about gas or if you --
17 but if you feel the need to make that
18 distinction going forward, please continue to
19 do so. But it's difficult to a -- to draw a
20 sharp line in my question.

21 So if the fluid level rises above
22 that fluid outlet, it's fair to say no free gas
23 can then at that point in time escape?

24 A. Correct.

25 Q. And in order for the free gas, the

1 substantially gas phase portion in the
2 freeboard section to escape, it's going to have
3 to push that liquid -- any liquid above the
4 fluid outlet level out; is that fair?

5 MR. KESACK: Objection, form.

6 A. I would expect it to push the fluid
7 level down, and some of the fluid would be
8 pushed out and it would also push the interface
9 down so that it's below the outlet so that then
10 the gas could then make a 90-degree or a
11 180-degree turn to exit the vessel.

12 BY MR. HALL:

13 Q. So I want to make sure I understand
14 that because it -- if the -- you had earlier
15 mentioned that the liquid is incompressible.
16 So the gas can't push the liquid; is that fair?
17 Is that what you meant? I mean, I want to make
18 sure I understood what you're saying when
19 you're saying the gas was pushing the liquid.

20 A. Well, gas --

21 MR. KESACK: Objection, form.

22 A. The gas can push liquid.

23 BY MR. HALL:

24 Q. When you say "push it," you mean
25 move it.

1 A. Correct.

2 Q. But it cannot compress it?

3 A. Well, there is some small
4 compressibility, but it would be negligible.

5 Q. Okay. So I'm trying to get the --
6 you know, kind of the visual picture of what
7 happens in that situation where this liquid
8 level is above the fluid outlet and you'd have
9 the gas phase there.

10 And eventually, the pressure in the
11 gas phase is going to be enough to cause liquid
12 to flow out of the vessel, is that correct,
13 assuming that you still have gas coming into
14 the vessel?

15 A. Yes.

16 Q. And so if the liquid level rises
17 above the fluid outlet inside the vessel,
18 there's going to be some liquid inside the
19 fluid outlet; is that fair?

20 MR. KESACK: Objection, form.

21 A. I would expect there to be a stream
22 of fluid inside the outlet.

23 BY MR. HALL:

24 Q. All right. I mean, let's just
25 assume that there's nothing -- there's no flow

1 for purposes of trying to set up my question.

2 So there's no flow. You just fill
3 this thing up with liquid. To a certain point,
4 you have a -- your fluid outlet extends down
5 into the vessel. Okay? So then you fill it up
6 above that fluid outlet. Above the very bottom
7 of the pipe, the fluid outlet pipe, there's a
8 liquid level in that fluid outlet, right?

9 A. If the vessel is shut in and not
10 operating, then there could be a -- and you
11 filled it up with liquid, there could be a
12 liquid level inside the outlet.

13 Q. Okay. But if it was operating, you
14 don't think that that would also be true?

15 A. I believe that it's a dynamic
16 system, so it would be flowing. So there would
17 be a stream of fluid exiting the vessel.

18 Q. Okay. Stream of liquid.

19 A. Stream of liquid.

20 Q. Okay. So the -- in order for the
21 gas/liquid interface to drop back down below
22 the fluid outlet, the liquid level -- the
23 liquid that is -- the liquid level -- let me
24 start over.

25 In order for the gas/liquid

1 interface to drop down below the fluid outlet,
2 the gas is going to have to push liquid out of
3 the fluid outlet?

4 A. It's going to --

5 MR. KESACK: Objection, form.

6 A. It would -- yeah, it would apply --
7 the gas pressure would be applied to the
8 surface of the liquid, the liquid that would be
9 flowing in a stream out of the outlet as the
10 gas pushes the liquid back down until the gas
11 then makes that turn and goes out the outlet.

12 BY MR. HALL:

13 Q. Okay. So have I handed you -- I
14 think I've handed you Hemstock. Have I handed
15 you Hemstock, Exhibit 1004?

16 A. I think it's the '852?

17 Q. Yes.

18 A. Yes.

19 Q. You do have that?

20 A. Yes.

21 Q. Okay. Take a look at column 5, line
22 10 or thereabouts. You see -- it's the first
23 full paragraph there in column 5. It starts
24 out, The flow barrier 40.

25 Do you see that?

1 A. Yes.

2 Q. So this says, The flow barrier 40 --
3 the next sentence. The flow barrier 40 has a
4 lower edge 41 which sets the maximum depth of
5 the belly portion 32.

6 So it's your understanding that the
7 41 is the bottom edge of the flow barrier 40?

8 A. Correct.

9 Q. And so when it says "the maximum
10 depth of the belly portion 32," is that
11 referring to the maximum level of the
12 gas/liquid interface?

13 A. Measured from the top down, I
14 believe, yes.

15 Q. Okay. So another way to say it is
16 that the liquid level can rise to the bottom of
17 the lower edge 41.

18 MR. KESACK: Objection, form.

19 BY MR. HALL:

20 Q. I mean, is that fair or not?

21 A. Well, the -- you still have gas
22 passing under that flow barrier, so I would
23 assume there would be some gap between the
24 bottom of the flow barrier and the actual
25 liquid.

1 Q. Okay. So take a look at paragraph
2 47 of your declaration. I'm sorry.

3 A. Sorry.

4 Q. No, I'm giving you the wrong number.
5 I just have the wrong number in my notes. I'm
6 sorry.

7 MR. HALL: Let's go off the record.

8 (Pause.)

9 BY MR. HALL:

10 Q. So look at paragraph 9 of your
11 declaration.

12 A. Paragraph 9?

13 Q. Paragraph 9. Have you found that?
14 It's on page 4.

15 A. Yeah. Okay.

16 Q. Okay. So here you say--it's at the
17 very end of paragraph 9 on page 5--that a
18 person of ordinary skill in the art would be
19 familiar with hydraulic -- hydraulic fracturing
20 flowback operations issues related to
21 separating particles from the fluid stream
22 (sand or other proppant and possibly rock
23 particles from a geologic formation).

24 Do you see that?

25 A. Yes.

1 Q. So you mention here sand, proppant,
2 and rock particles. Are there any other types
3 of particles which you're aware of that one
4 might want to separate from the production
5 stream?

6 A. You might have chunks of rubber or
7 pieces of downhole tools that you drilled up.
8 There might be pipe scale. There could be
9 carbon fiber from a ground-up composite bridge
10 plug, for example, something like that.

11 Q. Okay.

12 A. There could be some of those
13 particles. Should have cleaned those out prior
14 to the flowback operation, but that's also a
15 possibility.

16 Q. Take a look at Hemstock patent.
17 This is the --

18 A. This one? Okay.

19 Q. -- '852. I've got to find it.

20 Look at column 120 right there at
21 the Background of the Invention. Do you see
22 that?

23 A. Yes.

24 Q. So this paragraph talks about
25 particulates in production from wells in the

1 oil and gas industry, and it mentions part of
2 the formation particulates that are part of the
3 formation from which the hydrocarbon is being
4 produced that would correspond with rock
5 particles.

6 Do you see that?

7 A. I'm sorry. Where is that?

8 Q. Column 1, line 21.

9 A. Yeah. 21. Yeah. Yes.

10 Q. That's rock particles?

11 A. Right.

12 Q. Okay. And then introduced
13 particulates from hydraulic fracturing.

14 A. Correct.

15 Q. And would that include --

16 A. Yes.

17 Q. -- the bridge plug particulates that
18 you're referring to?

19 A. I think he's really talking about
20 sand or proppant --

21 Q. Okay.

22 A. -- more than likely.

23 Q. Then we have fluid loss material
24 from drilling mode or fracturing fluids.

25 What is that referring to, do you

1 think?

2 A. You could have walnut hulls, cotton
3 seed hulls. There's materials that are
4 sometimes used -- cellophane flakes, for
5 example, that are sometimes used in drilling
6 fluids.

7 Q. And you're putting that into the
8 fluid loss material?

9 A. That would be fluid loss material to
10 prevent losing filtrate into the formation or
11 to try to control fluid leak-off during the
12 hydraulic fracturing operations into the
13 formation.

14 Q. Is that different from proppant
15 itself?

16 A. It can be or it could be -- you can
17 use like a hundred mesh or extremely fine small
18 particles of calcium carbonate that you could
19 also use as a fluid loss material.

20 Q. You said hundred mesh. What is
21 that -- what are you referring to?

22 A. It's just a very, very fine grain
23 sand.

24 Q. What is mesh?

25 A. It's the -- it's one way of

1 measuring particle size is what -- mesh screen,
2 when you use to put the material through, what
3 falls through that -- that screen to the other
4 side, so...

5 Q. So when you say "hundred mesh,"
6 that's -- is that a standard...

7 A. It's a standard term for measuring
8 very small particles.

9 Q. Okay. So one of skill in the art
10 would be able to go figure out how big a
11 particle a hundred mesh would be?

12 A. Correct. It would be some
13 distribution particle size.

14 Q. And there are different mesh sizes?

15 A. Correct.

16 Q. And then moving on here and going
17 back to the '852, it says, Other sources of
18 particulates could be from a phase change of
19 produced hydrocarbons caused by changing
20 conditions at the wellbore. Then it says
21 (asphalt or wax formation).

22 Are you familiar with particulates
23 of that nature?

24 A. You could have some precipitates of
25 asphalt or paraffin that you might get small

1 particles. I don't know that these -- those
2 type of particles are particularly -- the
3 primary thing you're trying to avoid is erosion
4 of equipment and it's the larger particles of
5 hard material that you're more concerned about,
6 but you could have some of that type of
7 material in the -- in the flowback.

8 Q. Okay. So what sizes of particles
9 are we talking about that -- I guess I'm trying
10 to look for a range of particle size that he's
11 referring to here in this section.

12 MR. KESACK: Objection, form.

13 A. Which -- which section in the --
14 BY MR. HALL:

15 Q. The one we were just looking at, the
16 one that starts out at, you know, line 21 --
17 column 1, line 21. We talked about the
18 different types of particulates, you know, the
19 sand, the proppants.

20 MR. KESACK: Same objection.

21 A. Well, there's a -- going to be a
22 distribution of particle sizes, so there's not
23 "a" particle size.

24 BY MR. HALL:

25 Q. Okay. So do you have any idea or

1 can you make an estimate of the range of
2 particle sizes where -- that one might see in a
3 typical flowback operation?

4 MR. KESACK: Objection, form.

5 A. Well, the particles that you're
6 concerned about are primarily going to be, for
7 example, 40/70 sand or 20/40 sand or formation
8 particles of -- of either -- from sandstone or
9 from limestone or from shales that are on the
10 order of that size, because what you're mainly
11 concerned about is erosion of equipment and
12 causing a failure of your equipment. So I
13 think that's -- that would be the range of
14 particles, I think, that's -- you're primarily
15 designing this system to work to remove.

16 BY MR. HALL:

17 Q. Okay. So forgive me. I didn't hear
18 you give a range, and you probably did because
19 I didn't understand what you were saying. You
20 said 40/70 sand and 20/40 sand?

21 A. Right.

22 Q. What does that mean?

23 A. Well, those are typical size
24 proppants used in hydraulic fracturing.

25 Q. What does 40/70 mean?

1 A. It's referring to a mesh, and you
2 can -- there is a conversion from that. You
3 can convert from those mesh sizes to a
4 distribution of particle sizes.

5 Q. So 40 -- 40/70 sand refers to 40
6 mesh sand to 70 mesh sand?

7 A. Correct. And you can look at -- I
8 don't -- I don't remember the exact micron
9 sizes that are in those ranges, but those are
10 just typical size proppants that are used in --

11 Q. But you can take these mesh sizes
12 and convert them to microns.

13 A. To a distribution.

14 Q. Right. So if I understand properly,
15 the mesh size says it's -- it gives you a
16 maximum essentially; is that fair?

17 A. Yeah, I think that's fair that it's
18 a -- a particle can't pass through the mesh if
19 it's larger than that.

20 Q. So -- but it would let anything that
21 size or smaller through?

22 A. Correct.

23 Q. So 40 mesh --

24 A. Well, they're --

25 Q. Go ahead.

1 A. Actually, they're filtering out both
2 ends. You don't -- you may not want a lot of
3 fine, fine particles in there. You may not
4 want a lot of larger particles in there. So
5 it's -- you're trying to create a distribution.
6 It's the distribution that you want for that --
7 where the predominant particle size is within
8 that range.

9 Q. And you're referring to in a
10 hydraulic fracturing operation?

11 A. Correct.

12 Q. Okay. But when we just say -- let's
13 say if we just say a hundred mesh sand, that
14 alone only tells you that the particles will
15 pass through a hundred mesh screen. It doesn't
16 give you a bottom number or a -- let me
17 rephrase that.

18 If you just have a designation of a
19 hundred mesh sand, there's no range of sizes.
20 It's -- it gives you a maximum size; is that
21 fair?

22 A. I would say in the common
23 vernacular, there's going to be an expectation
24 for what that distribution looks like, but it
25 shouldn't be greater than the hundred mesh. So

1 there --

2 Q. Okay. Fair enough. So when you
3 say -- so when you use the term 40/70 sand,
4 you're referring to sand between 40 mesh and 70
5 mesh?

6 A. Yeah, that's the distribution that
7 I'm referring to.

8 Q. Okay.

9 A. You can have larger -- you can have
10 a distribution where the mean or the mode is
11 larger and the mean or the mode is smaller,
12 right, depending on what you're -- how you
13 design a hydraulic fracturing process.

14 Q. Right. Right. I'm just trying to
15 understand your terminology.

16 So is -- when you're talking about
17 mesh sizes, so 70 mesh, is that a smaller sand
18 particle than a hundred mesh or a larger
19 particle?

20 A. The higher the measure number, the
21 smaller the particle. There's more squares in
22 the mesh, if you will.

23 Q. It's a finer screen, finer --

24 A. Correct.

25 Q. I'm thinking of a screen door.

1 That's a...

2 A. Correct. So the hundred mesh is
3 some of the smallest that you would pump.

4 Q. Okay. But when we're looking back
5 at the particles, the types of particles here,
6 so you gave -- I'm sorry. You gave 40 to 70
7 sand, and did you say 20/40 sand as well?

8 A. Correct.

9 Q. So that's even -- that's even bigger
10 particles of sand?

11 A. Correct.

12 Q. Okay. So -- and then you just said
13 that hundred mesh is some of the smallest you
14 would pump?

15 A. Correct.

16 Q. Okay. So would you have
17 particulates potentially in the stream that are
18 smaller than a hundred mesh?

19 MR. KESACK: Objection, form.

20 A. They may be, but you're not actually
21 concerned about those particles in this
22 desanding operation because they don't have
23 enough mass to damage your equipment.

24 BY MR. HALL:

25 Q. Okay. So particles smaller than a

1 hundred mesh you wouldn't be concerned about
2 from -- removing in a desander?

3 A. I would not be concerned about
4 those. That's really small particles.

5 Q. Because they don't pose a risk of
6 abrasion?

7 A. And erosion, yes. Right.

8 Q. So let's discuss Hemstock. Go to
9 Exhibit 1004, column 4, 15 to 43. So this
10 paragraph starts off describing Figure 3. Do
11 you see that?

12 A. This is at line 15?

13 Q. Yes, sir.

14 A. Yes, I see line 15 there.

15 Q. So if you read down to
16 approximately -- it's line 21. There's a
17 sentence that starts off with, Accordingly, the
18 velocity of the fluid stream F slows to a point
19 below the entrainment elutriation velocity of
20 at least a portion of the particulates S and
21 the fluid stream.

22 Do you see that?

23 A. Yes.

24 Q. Is that your -- does that -- well,
25 strike that.

1 And then it goes on to say --
2 skipping the next sentence, it goes on to say,
3 As the area of the freeboard portion 30
4 increases.

5 A. Where is that? I'm sorry.

6 Q. It's around line 28. As the area of
7 the freeboard portion 30 increases.

8 Do you see that?

9 A. Yes.

10 Q. A velocity of the fluid stream F
11 slows and a lesser fraction of the particulates
12 remain entrained. A greater fraction of
13 particulates S falling out of suspension from
14 the fluid stream F.

15 Then it goes on to state, the next
16 sentence, The particulates S are discharged
17 horizontally from the nozzle 21 along path P,
18 and as they fall from suspension, they adopt a
19 downwardly curved trajectory under the
20 influence of gravity.

21 Is that your -- do you agree that
22 the -- when the particulates come into the
23 vessel, they will adopt a downwardly curved
24 trajectory?

25 A. Yes.

1 Q. And this section here uses -- it
2 says, Those of skill in the art are able to
3 determine and apply the parameters of the fluid
4 stream F, fluid stream velocity, and those of
5 the particulates S so as to determine the
6 elutriation characteristics.

7 What's your understanding of what is
8 meant by elutriation characteristics?

9 A. I think he's talking about the
10 relationship between the velocity of the fluid
11 and the mass of the particles such that the
12 particles will fall out of the fluid stream and
13 not be carried along with it.

14 Q. Out of the inlet fluid stream?

15 A. Correct.

16 Q. The -- so it says those of skill in
17 the art are able to do that. Are you capable
18 of doing that?

19 A. Yes.

20 Q. Okay. What factors determine for a
21 given -- say, a given particle, what factors
22 determine, once it comes into the vessel,
23 whether it's going to remain entrained or fall
24 out of suspension?

25 MR. KESACK: Objection, form.

1 A. The velocity of the fluid, the mass
2 of the particle, possibly the shape of the
3 particle, the viscosity of the fluid would be
4 the -- I think the primary things.

5 BY MR. HALL:

6 Q. Okay. So for a given velocity,
7 would you expect -- well, all other things
8 being equal, would you expect a smaller
9 particle to travel further before it falls out
10 of suspension than a heavier particle?

11 MR. KESACK: Objection, form.

12 A. Yes.

13 BY MR. HALL:

14 Q. Was that yes?

15 A. Yes.

16 Q. Okay. And I probably phrased that
17 poorly. I said smaller and heavier.

18 So let's assume the particles are
19 the same shape and size, but one has more mass.
20 So you would expect the more massive particle
21 to travel further before falling?

22 A. No.

23 Q. You would not?

24 A. The particle with the greater mass
25 is going to fall out earlier. The particle

1 with the smaller mass is going to fall out
2 later.

3 Q. Very good. That was not an
4 intentional test, but yes, you're right.

5 A. Okay.

6 Q. So the less massive particle will
7 travel further?

8 A. Correct.

9 Q. Okay. And so let's take a look at
10 '256, the '256 patent real quick. I'm going to
11 keep the '852 handy. I just want to look at
12 Figure 4 here. You see Figure 4 there?

13 A. Yes.

14 Q. So it has some arrows that are drawn
15 in or lines that are drawn in and I believe
16 showing, you know, the downwardly curved
17 trajectory we were talking about with regard to
18 Hemstock.

19 So the ones that travel the furthest
20 here, the ones closest to the top of the
21 vessel, those would be lighter particles?

22 A. Where are we talking about on this
23 drawing?

24 Q. Well, you see as you're coming in,
25 in the inlet, from the inlet you have --

1 there's an arrow drawn in the middle of the
2 vessel.

3 A. Yes.

4 Q. Do you see that? And then there's
5 several lines -- there's like four lines drawn
6 there showing what I presume is to be the path
7 of liquids and particles as they come into the
8 vessel and then intersect with the gas/liquid
9 interface. Do you see that?

10 A. Yes.

11 Q. So this shows there's a distribution
12 of where the liquids and solid particles will
13 intersect the gas/liquid interface.

14 MR. KESACK: Objection, form.

15 BY MR. HALL:

16 Q. Is that fair?

17 MR. KESACK: Same objection.

18 A. I think that's reading a lot into
19 that simple drawing.

20 BY MR. HALL:

21 Q. Okay.

22 A. I mean, I don't know that I can say
23 that that's what -- exactly what those lines
24 mean. He's just trying to show that he's got
25 particles striking that interface.

1 Q. Okay. Fair enough. So going back
2 to -- I was just trying to find a handy
3 representation of our discussion.

4 So going back to our discussion of
5 Hemstock, and so if you have a less massive
6 particle and a more massive particle, you would
7 expect the less massive particle--again, all
8 things being equal--to travel further
9 horizontally before it hits the gas/liquid
10 interface?

11 A. Yes.

12 Q. Okay. And so there would be a
13 distribution of points, depending on particle
14 size, where the particles intersect with the
15 gas/liquid interface?

16 A. Assuming that -- ignoring turbulence
17 at that interface.

18 Q. So yes, ignoring turbulence at that
19 interface?

20 A. Yes.

21 Q. Okay.

22 A. Because I think you would have
23 turbulence at that interface.

24 Q. Well, the turbulence, you mean in
25 the gas phase?

1 A. Well, you have particles striking at
2 the liquid interface.

3 Q. Uh-huh.

4 A. So the kinetic energy of those
5 particles is going to be converted to heat
6 probably, and that energy is going to be
7 imparted into that fluid right there. So I
8 would assume that fluid's going to move and not
9 be static at that interface.

10 Q. Okay. But that doesn't give them
11 where the particles come down into the
12 interface, does it?

13 A. Well, this is a -- this is a full
14 well stream coming in.

15 Q. Right.

16 A. I guess the assumption is that where
17 they initially land may not be where they end
18 up, I guess is what I'm saying.

19 Q. Fair enough. So I'm wanting to talk
20 about where they initially land.

21 A. Okay.

22 Q. So is it fair to say that the --
23 there's a distribution -- they're not all going
24 to -- all the particles are not going to strike
25 the gas/liquid interface at the same point?

1 A. I don't think so. At very, very
2 high velocities, I'm not sure there'll be much
3 difference. But in principle, in theory, it
4 seems like the larger particles would end up at
5 the -- you know, striking at the bottom and the
6 lighter particles might hit at the top.

7 Q. And when you say "at the bottom,"
8 you mean...

9 A. Your bottom line on your drawing --

10 Q. Okay.

11 A. -- for the sake of discussion.

12 Q. Okay. So let's go back to the
13 Hemstock because I want to get away from the
14 tilted version here. I mean, the -- we don't
15 have any lines like that in any of the Hemstock
16 drawings, but the physics are the same,
17 correct? I mean, you're going to have
18 particles -- lighter particles are going to
19 tend to travel further?

20 A. That's correct.

21 Q. And the -- it's actually a concern
22 here. And if we go back to Hemstock at around
23 line 34, it says, Preferably to avoid
24 impingement-type erosion.

25 Do you see that?

1 A. I'm sorry.

2 Q. Column 4, line 34.

3 A. I'm in '852?

4 Q. Yes, sir.

5 A. What page?

6 Q. It's column 4 --

7 A. Column 4.

8 Q. -- on top.

9 A. Line?

10 Q. Line 32. Or 34. I'm sorry.

11 A. 34. Okay. Along --

12 Q. Where it says, Preferably.

13 Do you see that word?

14 A. Yes.

15 Q. Preferably to avoid impingement-type
16 erosion, the length of the vessel is sufficient
17 to permit the particulates to fall out of
18 suspension before impinging internals of the
19 vessel 11.

20 A. Correct.

21 Q. So this is saying that you want the
22 vessel preferably to be long enough to allow
23 your particulates to fall out of the freeboard
24 portion before they strike anything internal in
25 the vessel; is that fair?

1 A. In the Hemstock --

2 Q. Yes, sir.

3 A. -- design, yes.

4 Q. Okay. So if the vessel is not long
5 enough, you might have some impingement-type
6 erosion?

7 A. Correct, which is one of the reasons
8 they have this downcomer in the -- this design.

9 Q. Right. So you could have particles
10 impinging on the downcomer itself if the vessel
11 is not long enough?

12 A. Correct.

13 Q. In that situation, let's say that
14 the particles strike the downcomer or the weir,
15 they're going to impinge on it and potentially
16 cause erosion?

17 A. If they have enough mass and
18 velocity.

19 Q. Right. That's the worry?

20 A. Correct.

21 Q. So particles that strike that,
22 what -- you would expect those to then fall
23 into the liquid, correct?

24 MR. KESACK: Objection, form.

25 A. Yes.

1 BY MR. HALL:

2 Q. And Hemstock teaches in this section
3 we've been going through that there are some
4 particles that are going to remain entrained,
5 correct?

6 MR. KESACK: Objection, form.

7 A. Entrained in the liquid?

8 BY MR. HALL:

9 Q. In the gas phase.

10 A. If they were small enough and a
11 small enough mass, I could see how they could
12 remain in the gas phase.

13 Q. So let's imagine we're following a
14 single particle of sand coming in the Hemstock
15 vessel in the well production stream. So it
16 comes into the -- it has a certain velocity in
17 the inlet piping, it comes into the vessel, and
18 the velocity of the fluid stream around the
19 particle slows down, correct?

20 A. Correct.

21 Q. Right. It's not moving as fast
22 because it has a bigger area to flow through?

23 A. Is that a question?

24 Q. Yes, sir.

25 A. Yes.

1 Q. Then because of that and the
2 particle has a certain mass, the particle then
3 begins to fall, correct?

4 A. Correct.

5 Q. But it still has a forward velocity
6 as well?

7 A. Correct.

8 Q. So let's just assume that this
9 particle is heavy enough to fall out of the gas
10 phase. So the particle's mass and its shape
11 will determine how far it travels before it
12 completely falls and hits the gas/liquid
13 interface?

14 A. Correct.

15 Q. And once it hits the gas/liquid
16 interface, it will then travel through the
17 liquid to the bottom of the desander.

18 A. Yes.

19 Q. Or the surface of wherever the sand
20 is accumulating.

21 A. Yes.

22 Q. Okay. So going back to -- take a
23 look at the '256 patent again, Figure 4 or
24 Figure 2. I just want to understand these
25 figures a little bit.

1 The nozzle on the outlet, the fluid
2 outlet nozzle.

3 MR. KESACK: James, 2 or 4?

4 MR. HALL: Either one. Either one.

5 They both show the same thing. So you can
6 look at either one.

7 BY MR. HALL:

8 Q. Do you see the drawing of the fluid
9 outlet 26? It has a stylized -- it has a
10 rectangle and then it has a -- or let me start
11 over.

12 It has a vertical rectangle and then
13 it has two horizontal rectangles and then it
14 has another vertical rectangle on top of it.
15 Do you see that?

16 A. Are we talking about 26?

17 Q. Yes, sir.

18 A. Yes.

19 Q. So when I look at that, with my
20 background, that's showing to me that there's a
21 nozzle attached to this vessel that ends in a
22 flange, and then there's a piece of pipe,
23 whatever you're connecting to, that also has a
24 flange, and that's how you're connecting the
25 vessel to the outlet piping.

1 Is that what this -- is that your
2 understanding of what this is -- is showing?

3 A. I'm assuming that you're also
4 cutting the -- you're going to trim that piece
5 of pipe that connects to the top of the vessel
6 such that it's at an angle so that you can weld
7 it onto the vessel right there.

8 Q. Fair enough. So look at Figure 2
9 specifically. You're -- you're referring to
10 the fact that this rectangle that's closest to
11 the vessel, it doesn't look like it's attached?

12 A. You're talking about where it has
13 the 26?

14 Q. Yes, sir. Right where it's pointing
15 to 26, it looks like it's just kind of floating
16 above the vessel?

17 A. It's -- yes, I'm assuming it's
18 welded onto the vessel at that point.

19 Q. Right. And that there's a --
20 there's a -- obviously a hole in the middle
21 that allows fluid to escape?

22 A. Yes.

23 Q. Okay. So that is welded to the
24 vessel, and that's what I would refer to as a
25 nozzle. Is that how that's usually referred

1 to?

2 A. I don't think that's a nozzle.

3 Q. Okay. Who word would you use?

4 A. I just think it's an outlet.

5 Q. Okay. What do you -- what word do
6 you usually use to describe, for no -- for want
7 of a better term, holes in the vessel where you
8 have -- where you have a connection?

9 A. I would just call that an outlet
10 since it's where the fluid's exiting.

11 Q. Okay. Take it out of the context of
12 the outlet. So generically speaking, if you
13 have a pressure vessel, what are those called
14 where you have connections to a vessel where
15 you might have to weld an opening into a vessel
16 and you have a connection there?

17 MR. KESACK: Objection, form.

18 A. I would call that an outlet.

19 BY MR. HALL:

20 Q. Okay. What if it's an inlet? Would
21 you call it an outlet then?

22 A. Well, we were talking in the context
23 of 26 over here, correct?

24 Q. We were. But I asked you to leave
25 that context aside. I'm just trying to -- I'm

1 trying to find the right verbiage. And so if
2 you have a pressure vessel and it has openings
3 in it for fluid to come in or come out or
4 perhaps even a person to go in to inspect it,
5 you have to cut a hole in the side of the
6 metal, right?

7 A. Correct.

8 Q. So then during operation, you either
9 connect those to piping or you cover them with
10 a flange to -- so that what's inside the vessel
11 can't come outside the vessel; is that correct?

12 MR. KESACK: Objection, form.

13 A. You would have a -- you would have
14 some way to connect it. It might -- it could
15 be threaded, I suppose, but it's probably a
16 flanged connection on the outside of the
17 vessel, and then you would have that -- it
18 either protrudes into the vessel or it ends at
19 the wall of the vessel, one or the other.

20 BY MR. HALL:

21 Q. Okay. So the -- what I'm trying to
22 figure out, what you would call those types of
23 fittings connections in the holes in the vessel
24 wall.

25 A. I guess openings.

1 Q. Openings?

2 A. Uh-huh.

3 Q. Is that your understanding of the
4 term you would use as a mechanical engineer?

5 A. I would normally refer to them as
6 either inlet or outlet.

7 Q. Okay. All right. So it's an
8 opening in the vessel wall. And it could --
9 going back to Figure 2 here. You would expect
10 this is -- this opening is welded to the
11 vessel?

12 A. Correct.

13 Q. Okay. And then it ends in a
14 rectangle -- there's a -- there's kind of a
15 horizontal rectangle attached to another
16 horizontal rectangle. That's what I understand
17 to be a flange; is that fair?

18 A. The two -- the two that are in this
19 drawing, Figure 2, you're referring to these --
20 these two little stacked rectangles?

21 Q. Right. The two stacked rectangles
22 forming -- that are in the fluid outlet.

23 A. I think that's trying to represent,
24 in a cartoon fashion, a flange.

25 Q. A flange. Okay. And then -- so

1 above the -- the top rectangle is the flange of
2 the pipe connecting to the vessel?

3 A. Correct.

4 Q. Okay. And the bottom rectangle is a
5 flange connected to the outlet that's welded to
6 the vessel?

7 A. Correct.

8 Q. Okay. And you had pointed out that
9 you would expect that the angle of the bottom
10 rectangle here would -- in reality, it's going
11 to be cut so that it -- it will accord with
12 the -- or that -- so that it could be welded
13 directly onto the vessel?

14 A. I believe that's what that's trying
15 to represent.

16 Q. Are the general principles for
17 particle settling we were discussing, are they
18 the same in both a gas phase and a liquid
19 phase?

20 A. Well, obviously, the liquid is more
21 viscous. The liquid's going to be more
22 impacted by -- I mean, you can have a turbulent
23 flow in a gas, but the turbulent flow -- or
24 turbulent flow in the liquid would probably
25 impact the movement of the particles a bit more

1 because of the viscosity and the density of the
2 liquid phase.

3 Q. Right. Sure. So the -- but the
4 general principles here -- I mean, I guess
5 I'm -- I'm referring back to the kind -- of the
6 basic equations that govern particle settling.
7 They don't change when we're talking about a
8 gas or a liquid. The properties of the fluid
9 change, but not the general principles; is that
10 fair?

11 MR. KESACK: Objection, form.

12 A. Not totally sure on that. I think
13 it's -- generally, I would say that's true.
14 I'd have to -- I'd have to think about that
15 some more --

16 BY MR. HALL:

17 Q. Okay.

18 A. -- in terms of the specific
19 mechanics of gases moving particles versus
20 liquids moving particles, but generally
21 speaking, I think the principles are similar.

22 Q. Okay. That's fair enough. I
23 understand there could be some forces that
24 might act differently in a liquid versus a gas.

25 A. That's what I was --

1 Q. But generally speaking, you think
2 they're -- the starting point is the same?

3 A. They're similar.

4 Q. Okay. You start out with the same
5 equations?

6 A. You could, but you would have to
7 take into account the differences in the -- in
8 the behavior of the -- of the liquid versus the
9 gas and the behavior of the -- you know, the --
10 I guess you would say the viscosity and the
11 mass.

12 Q. Those are all properties of the
13 fluid though?

14 A. Correct.

15 Q. What is laminar flow?

16 A. Well, laminar flow is where you
17 basically have a -- I guess a simple
18 description would be it's a smooth,
19 uninterrupted flow of the particles or the
20 molecules of the liquid or the gas that's a
21 predictable smooth flow as opposed to turbulent
22 flow where you would have some chaotic movement
23 and some movement that may not be in the same
24 direction as the general flow of the fluid
25 stream.

1 Q. You said "predictable." What did
2 you mean?

3 A. That it's all moving in the same
4 direction at a given velocity with a given
5 velocity profile.

6 Q. Take a look at paragraph 82 of your
7 declaration. It's on page 48. Do you see
8 that?

9 A. Yes.

10 Q. So you say that analysis of the
11 transport of particles such as proppant starts
12 with Stokes' Law as described below.

13 What did you mean when you said it
14 starts with Stokes' Law?

15 A. Well, if you've got a particle
16 moving through a fluid in a laminar flow in a
17 Newtonian fluid, you can, you know, start with
18 this -- these assumptions, but then you have to
19 take into account the flow regime that you're
20 actually in. Does it -- do these same
21 equations work in another -- in a different
22 flow regime?

23 Q. So let's -- you had mentioned that
24 this is a Newtonian fluid and it's laminar
25 flow; is that...

1 A. Well, which situation are we talking
2 about?

3 Q. Well, you said -- well, what you
4 were just describing. You said -- I asked you
5 if -- why you described it as analysis starting
6 with Stokes' Law, and then you said that
7 Stokes' Law was applicable only to a Newtonian
8 fluid or a laminar flow. I believe that's what
9 you said.

10 A. Yeah.

11 Q. Is that -- so is this -- this
12 equation is only applicable to a Newtonian
13 fluid and laminar flow?

14 A. That's my understanding, yes.

15 Q. But then you said that you would
16 have to take into account the flow regime. So
17 if you're not in a laminar flow regime, would
18 you still start with Stokes' Law or would you
19 start somewhere else?

20 MR. KESACK: Objection, form.

21 A. Well, if you're -- at some point in
22 the process -- you know, at some point in the
23 fluid movement it could be in laminar flow and
24 then at other points in other parts of the
25 system it might be in turbulent flow. So you

1 could look at it at both places if you wanted
2 to. But that doesn't mean you can -- you can
3 predict -- you can use correlations for laminar
4 flow when you're in turbulent flow.

5 BY MR. HALL:

6 Q. So you're saying you cannot do that?

7 A. You cannot do that.

8 Q. Are you aware of -- are there any
9 equations that can be used to predict turbulent
10 flow?

11 A. Well, you can calculate the Reynolds
12 number if you've got enough data. I think in
13 this application that would be -- you could
14 make an approximation perhaps, but it's a
15 fairly complex interaction at some points in
16 the system. So...

17 Q. Right. Let me ask my question
18 differently because I realized it was poor
19 based on your answer.

20 So you were referring to -- you can
21 figure out whether your flow is turbulent?

22 A. Correct.

23 Q. What I'm asking is if your flow is
24 turbulent, are you aware of any equations that
25 are used to predict how a fluid will flow in a

1 turbulent flow regime?

2 MR. KESACK: Objection, form.

3 A. I think there may be correlations
4 for fluid flow, but I think it would be
5 difficult to determine proppant settling in
6 that situation.

7 BY MR. HALL:

8 Q. In a turbulent flow regime?

9 A. Right. You might need to do some
10 more sophisticated analysis or use some sort of
11 empirical correlation.

12 Q. Is that because the math is simply
13 too difficult?

14 A. I'm sure there's somebody that can
15 figure that out or try to figure that out with
16 finite element analysis or some sophisticated
17 techniques like that. I'm not familiar with
18 the application of those type techniques in
19 this situation.

20 Q. So generally in the industry, you're
21 using empirical correlations --

22 A. Generally, yes.

23 Q. -- in the turbulent flow regime?

24 A. If I was designing this particular
25 type of vessel, I probably would use some

1 empirical correlations.

2 Q. Okay. Let's take a look at
3 paragraph 23 of your declaration. It's on page
4 9 to 10. Now, look at -- it's at the very
5 bottom of page 10. I wanted to ask you a
6 question about this sentence.

7 It says, Specifically for the
8 desander of the '256 patent, the volume is a
9 cross-sectional area of the freeboard portion
10 of the vessel which does not include the belly
11 portion of the vessel because fluid and
12 especially gas cannot flow in the belly portion
13 of the vessel.

14 Did you mean to say here that there
15 is no fluid flow in the belly portion of the
16 vessel?

17 A. Well, you have the -- the portion of
18 the vessel that's full of solids in the belly,
19 so there might be some movement of fluid
20 through the particles, but it seems like that
21 would be minimal. You should have some
22 movement of fluid at the interface between the
23 gas and the -- and the liquid, and then I would
24 expect at the bottom of the vessel to see
25 basically almost a zero velocity or zero

1 velocity at the bottom of the vessel. So the
2 majority of the movement should be in the --
3 near that interface and along the top of the
4 vessel in the freeboard section.

5 Q. So is it fair to say that there's a
6 velocity profile from top to bottom in that
7 belly portion?

8 A. I would assume it would be. I'm not
9 sure if it's -- if it's moving at all on the
10 inlet end.

11 Q. Okay. So let's just say the middle
12 of the vessel, left to right or --

13 A. At least not moving horizontally at
14 the --

15 Q. Right.

16 A. -- front end of the vessel.

17 Q. And you would assume that there's
18 probably places where there's no flow at all?

19 A. Correct.

20 Q. And then there's other places where
21 there is flow?

22 A. Well, as the solids in the -- as the
23 fluid stream containing the solids enters the
24 vessel, it's going to either -- if it's --
25 depending on which device we're talking about.

1 Are we talking about the '256 or the --

2 Q. Well, why don't we talk about both
3 of them, and if you -- if there's a difference,
4 why don't you point it out.

5 A. Okay. So I'm visualizing that the
6 fluid stream is entering the vessel. It
7 strikes the -- either the downcomer or in this
8 case it strikes the interface of the fluid.
9 Everything upstream of where it's impacting,
10 you'd have the most quiescence, I would think,
11 on the end towards the inlet. And then where
12 the fluid's actually impinging and -- with the
13 fluid, that's where I would expect to see some
14 settling there, and I would expect to see some
15 turbulence in that area.

16 Q. Okay. And then so previously we had
17 discussed the horizontal velocity in the
18 liquid. Do you recall that?

19 A. Right.

20 Q. So you would expect -- so the --
21 here you -- the reason I wanted to go back to
22 this is because you had testified there's no
23 fluid flow -- or fluid cannot flow in the belly
24 portion of the vessel. So...

25 A. I guess I'm saying at the very

1 bottom of the vessel, it's not moving. I
2 expect it to be zero.

3 Q. Okay. So at the very bottom of the
4 belly portion?

5 A. Correct.

6 Q. So perhaps in the middle or the --
7 closer to the top of the belly portion, you
8 would have some fluid flow?

9 A. You'd have some fluid movement at
10 the interface because that's how it's actually
11 being pulled out of the vessel. It's at the
12 top.

13 Q. Okay. And are you -- have you done
14 any analysis to determine where, top to bottom,
15 that there's going to be -- that that velocity,
16 that horizontal velocity will drop to nothing?

17 MR. KESACK: Objection, form.

18 A. That's -- well, I think just the
19 theory of fluid flow in a pipe, you typically
20 have a profile. And, of course, this is not a
21 full -- a full flow through the pipe. You're
22 only -- you're only -- you've got a nozzle at
23 the top and you're -- or an inlet and you're
24 bringing the fluid in. If there's nothing --
25 there's no forces acting on the fluid at the

1 very bottom of the belly, I would expect it to
2 be basically zero at the very bottom --

3 BY MR. HALL:

4 Q. Uh-huh.

5 A. -- but where the particles are
6 coming into the fluid in high velocity, I would
7 expect there to be turbulence in that area
8 where the particles are impinging.

9 Q. Okay. So the turbulence is stirring
10 up the particles?

11 A. That's what I'm assuming, yes.

12 Q. Okay. And then you would also have
13 the -- just the gas flow over the top of the
14 surface would itself affect the liquid --

15 A. Generates -- I would -- I'm sorry.
16 Is there a question?

17 Q. Yes. I'm asking if that's correct.
18 You would expect -- whenever I'm imagining this
19 system, I'm -- I kind of think of, you know,
20 the ocean in a storm. So you have, you know,
21 your liquid levels going all over the place and
22 you might have some sea spray that's -- or some
23 wind that's picking up the liquid and spraying
24 everywhere. This is pretty -- there's -- it's
25 chaotic in the -- at least in the -- at the top

1 in the freeboard portion. Is that fair?

2 MR. KESACK: Objection, form.

3 A. And at the interface.

4 BY MR. HALL:

5 Q. And at the interface.

6 A. And in some -- at some depth below
7 that.

8 Q. Some depth below that. But you
9 don't -- you're not -- you can't say where that
10 depth -- where it ceases to be turbulent and
11 goes to laminar or quiescent?

12 A. I'd say you'd have to have some
13 sophisticated modeling to figure out where that
14 is -- in portions of the vessel, it seems very
15 likely that if you've got a solid buildup and
16 you're impinging on that solid buildup that you
17 would likely have a lot of turbulent flow
18 there.

19 Q. You likely would?

20 A. Likely would.

21 Q. Okay.

22 MR. HALL: I'm trying to figure out
23 how much more time. Let's go off the
24 record real quick.

25 (Discussion held off the record.)

1 BY MR. HALL:

2 Q. Mr. McGowen, did you discuss the
3 substance of your testimony with patent owners'
4 counsel during the break?

5 A. No. No.

6 Q. Take a look at your declaration,
7 paragraph 98, on page 57.

8 A. Yes.

9 Q. Do you see that?

10 A. Yes.

11 Q. So you testified, To the extent a
12 POSITA would incline Hemstock at all based on
13 the teachings of Davis, it would do so in a
14 manner that would provide the wall closest to
15 inlet for settling.

16 And then you say, The only way in
17 which to accomplish this would be to incline
18 the vessel so that the fluid outlet was higher
19 than the fluid inlet as depicted below in
20 Figure 3 below.

21 So there's three Figure 3 belows,
22 below that paragraph, and that -- you're
23 referring to the one in the middle, the one at
24 the top of page 58?

25 A. Let's see.

1 MR. KESACK: Objection, form.

2 MR. HALL: What's the objection?

3 MR. KESACK: It's not clear that
4 he's only referring to one of the three
5 figures below.

6 MR. HALL: Okay.

7 BY MR. HALL:

8 Q. Are you referring to only one of
9 three figures below?

10 A. I think I was trying to use them all
11 together to try to make the explanation, but...

12 Q. Okay. So in which one of these is
13 the vessel inclined so that the fluid outlet is
14 higher than the fluid inlet?

15 A. Okay. So the one at the top of the
16 page, the fluid outlet is higher than the fluid
17 inlet.

18 Q. The vessel is not inclined, correct?

19 A. I'm looking on the next page, the
20 Figure 3 on the next page.

21 Q. Oh, okay. So you're looking at the
22 top of page 58?

23 A. Yes.

24 Q. Okay. So that one's inclined so the
25 fluid outlet's higher than the fluid inlet?

1 A. Yes.

2 Q. Okay. So what would happen with
3 the -- if you were to tilt this vessel or
4 incline the vessel in this manner, what would
5 happen under the liquid level?

6 A. Well, the liquid level would be
7 parallel to the horizon.

8 Q. Okay. It would -- it would be level
9 in other words?

10 A. Yes.

11 Q. Okay. So where would it be? Would
12 it -- I guess what I'm trying to get at is if
13 you tilted it this way, wouldn't the liquid
14 level be above the fluid inlet?

15 A. It would, yes.

16 Q. And depending on how much sand you
17 had in the vessel, it's possible that the fluid
18 inlet would be covered by sand as well,
19 correct?

20 A. That's correct.

21 Q. Okay. If you did this and you
22 continued to operate the vessel, what -- what
23 would happen?

24 A. Well, just to be clear, I'm not
25 saying that you should operate it in this way.

1 Q. Understood.

2 A. I don't think it would operate
3 effectively if you tilted it in that direction.

4 Q. Why not?

5 A. Well, as you just mentioned, the --
6 you would have sand pile up around the inlet
7 and you would have -- the fluid level would be
8 somewhere along the vessel downstream of this
9 outlet until it reached the outlet, but you
10 wouldn't have the freeboard that you're looking
11 for for separation of the liquid from the gas.

12 Q. So if you continued to operate,
13 though, with the -- in this tilted manner, the
14 one that's at the top of page 58, what would --
15 would the vessel continue to function as a
16 desander? Would it effectively remove sand
17 from the fluid inlet stream?

18 A. You might end up with some sand
19 collecting, but I think it would -- it would be
20 an ineffective way to do this.

21 Q. Is it fair to say that if you tilted
22 it this way that gas entering the vessel would
23 pick up large volumes of liquid and sand and
24 carry it out the fluid outlet?

25 A. Well, at some point the sand would

1 build up down to this end.

2 Q. You're talking about the inlet end?

3 A. Well, because you've -- you don't
4 have the advantage of increasing the
5 cross-sectional area to slow the fluid down so
6 that if it moves at high velocity across the
7 top of this -- this body of sand and actually,
8 you know, basically pushing it out of the way
9 and then you'd have turbulence all around the
10 inlet, I would think it's very possible it
11 would just carry it out the outlet.

12 Q. The sand?

13 A. Yes.

14 Q. It's also true that if you tilted it
15 this way, that you're effectively creating a --

16 A. (Clearing throat.) Sorry.

17 Q. -- you're effectively creating a
18 blockage around the fluid inlet; is that
19 correct?

20 A. It could -- it could potentially
21 block it or it could just end up with a mixing
22 zone where you're -- you create a turbulent
23 flow and you're carrying that turbulent mixture
24 of gas, water, and sand all the way out to the
25 outlet down on this end.

1 Q. Okay. Would the pressure --
2 you're obviously -- if you cover the inlet with
3 liquid or sand or both, you've got to overcome
4 the -- let's just -- let me go back.

5 If you cover it with liquid, let's
6 assume, you've got to overcome at least the
7 increased pressure of the liquid head for the
8 gas -- for any gas to enter the vessel; is that
9 true?

10 A. Yes.

11 Q. Are you aware of anything, or can
12 you recall anything in Hemstock's written
13 description--not referring to its figures, but
14 the written portion of Hemstock--that says
15 where particulates will or will not accumulate?

16 A. I'd have to go back and review all
17 the text to say that for sure.

18 Q. You can't recall anything right now?

19 A. No. I mean, I'm just -- I think
20 it's -- I mean, the figures show that you've
21 got particulates accumulating along the bottom
22 of the vessel.

23 Q. Yeah. Let's leave the figures
24 aside. I'm talking about the written portion.
25 Can you recall anything right now?

1 A. I can't recall exactly right now to
2 point to.

3 Q. Let's look at this section of your
4 declaration. So section C starts at paragraph
5 94, goes to paragraph 99.

6 A. Sorry.

7 Q. See that?

8 A. Yes.

9 Q. I'd like to look at any portions of
10 Hemstock that you've cited here in this section
11 and whether those indicate to you where
12 particles will accumulate in the bottom of the
13 Hemstock vessel. So I don't see anywhere in
14 paragraph 94 where you've cited anything in
15 Hemstock. Do you -- is there anything there
16 I'm missing?

17 A. I don't -- I don't have a reference
18 to the patent in that paragraph.

19 Q. Yeah, and I'm just trying to get all
20 those, so -- and I think they're easy to find,
21 but I could miss them.

22 So paragraph 95, you cite to Simpson
23 deposition and you cite to the '256 patent, but
24 you do not cite to Hemstock; is that correct?

25 A. Yes.

1 Q. Okay. Paragraph 96, you do cite to
2 Hemstock. You cite to column 4, line 34 to 37.
3 And I'll read that into the record, and you
4 tell me if this is the part you're intending to
5 refer to.

6 Preferably, to avoid
7 impingement-type erosion, the length of the
8 vessel is sufficient to permit the particulates
9 to fall out of suspension before impinging
10 internals of the vessel 11.

11 Is that what you're intending to
12 refer to there?

13 A. It's 4, 40 through 42?

14 Q. 4, 34 to 37. There -- it's cited in
15 paragraph 96.

16 A. Oh, okay. And the part you started
17 with was the --

18 Q. Preferably.

19 A. -- the particulates?

20 Q. No. I started with, Preferably, to
21 avoid impingement-type erosion.

22 Do you see that?

23 A. Yes, I do.

24 Q. Is that what you intended to refer
25 to, this passage here?

1 A. Yes.

2 Q. Okay. So that doesn't teach where
3 particulates are going to accumulate in the
4 bottom of Hemstock, does it?

5 A. Well, it's -- it's -- if it would be
6 before impinging the internals of the vessel,
7 that means it's before the far end and possibly
8 before the downcomer.

9 Q. So let's be clear. So this is
10 talking about falling out of suspension where;
11 in the freeboard portion or the belly portion?

12 A. Well, it would be falling out of the
13 gas.

14 Q. Okay. So that's the freeboard
15 portion, right?

16 A. Yes.

17 Q. All right. So this doesn't say
18 anything about where particulates will
19 accumulate in the belly portion, does it?

20 A. I think that's -- you know, given
21 the drawings and the text, that's my assumption
22 that I understand where that's happening --

23 Q. Okay.

24 A. -- but I don't see that it -- it
25 didn't specifically state exactly what

1 particular point along the -- along the length
2 of the vessel, but it is giving you some
3 information about where they're -- they're
4 trying to have it fall out before you hit the
5 end of the vessel in the downcomer.

6 Q. Fall out of the freeboard portion?

7 A. Yes.

8 Q. Okay. So moving on from there. I
9 don't see that you've cited any -- any other
10 parts of Hemstock in the remaining paragraphs
11 of this section, 97, 98, or 99 other than, of
12 course, your references to Figure 3.

13 Do you see any other references to
14 written description of Hemstock excluding the
15 figures?

16 A. No.

17 Q. I'm going to hand you what's been
18 marked as Exhibit 2003.

19 (Exhibit 2003 introduced.)

20 BY MR. HALL:

21 Q. And let's look at page 20 of 20 at
22 the bottom there.

23 A. Yes, I see 20 of 20.

24 Q. So this says, Special application
25 slug catcher design, and then it has a

1 superscript referring to Footnote 13.

2 Do you see that?

3 A. Yes.

4 Q. And 13 refers to the Rhinesmith
5 article we previously discussed; is that right?

6 A. Yes.

7 Q. Okay. And that's Exhibit 2004.

8 A. You're asking if that's the --

9 Q. Yeah. Let me hand you -- go ahead
10 and hand that to you. Is that the same article
11 that is here in Exhibit 2004?

12 A. Yes.

13 Q. Okay. Now, here -- going back to
14 2003, the last sentence here says, Reference
15 13, which is Rhinesmith, Exhibit 2004, provides
16 design details in an example of slug catcher
17 design.

18 Is that your understanding of what
19 Rhinesmith does?

20 A. Yes.

21 Q. Let's look at Rhinesmith itself,
22 Exhibit 2004. This is titled "Proven methods
23 for design and operation of gas plant liquid
24 slug catching equipment." Is that right?

25 A. Yes.

1 Q. Is it your understanding that slug
2 catcher design is the same for gas plant inlet
3 service and other services?

4 A. I think the principles would -- many
5 of the principles would apply to different
6 applications.

7 Q. Okay. So is that yes or no?

8 A. I don't know that every single thing
9 in here is pertinent to all applications of
10 slug catchers, but I believe that some of the
11 information would be.

12 Q. Okay. So let's -- take the -- turn
13 to paragraph 110 in your declaration because
14 that's where I'm going to be asking you about.
15 Keep Rhinesmith handy. It's on page 67.

16 So on page 15 of Rhinesmith -- and
17 I've got to find it on the page myself. So
18 it's -- you see where it says "vessel" --

19 A. Yes.

20 Q. -- in the middle there? So go up a
21 couple of sentences from that. It says, The
22 slug catcher must be designed so that the
23 outlet gas flow is not impeded by the arriving
24 liquid flow.

25 You see that?

1 A. Yes.

2 Q. And what do you -- what does that
3 mean to you as a person of skill in the art?

4 A. Well, in the case of a slug catcher,
5 you would like the gas to move freely out of
6 the slug catcher, and for the slug catcher to
7 process the arriving slugs of liquid and have
8 those drain out of the slug catcher without
9 causing liquid to overflow into the outlet that
10 the gas is going out of.

11 Q. So when you say not have the liquid
12 overflow, is it your understanding the slug
13 catcher is intended to stop all liquids from
14 leaving the gas outlet?

15 A. Well, the -- I don't know that all
16 slug catchers are designed for that purpose,
17 but in general, the purpose of the slug catcher
18 is to catch the slug of fluid, allow you to
19 take that out of the slug catcher, and be able
20 to process that separately and then have the
21 gas go forward to the next part of the system.
22 And some parts of the system are more tolerant
23 of -- of having liquid go downstream than
24 others. It might depend on the application.
25 But in general, that's what you're trying to do

1 is just separate those two phases.

2 Q. So for a gas plant inlet, would you
3 expect there to be another gas liquid separator
4 downstream of a slug catcher?

5 A. Well, there might be if you had --
6 you also have water vapor in the gas and that
7 may precipitate out, so the -- the -- you can
8 have free water that's in the -- in a pipeline,
9 for example, but you could also have additional
10 water that you need to extract downstream of
11 the slug catcher. So there could be another
12 separator there.

13 If you thought there might be an
14 event where the slug catcher is overwhelmed,
15 you might want to have another device
16 downstream of that to try to catch any --
17 anything that escapes the slug catcher for some
18 reason it wasn't working properly.

19 Q. Okay. So just generally, though,
20 it's your understanding that a slug catcher is
21 usually designed to capture all of the liquid,
22 prevent it from continuing on with the gas
23 flow?

24 A. Yes.

25 Q. So if you look at paragraph 110, you

1 said in response to -- you explain what you
2 thought this meant to a POSITA, one of skill in
3 the art. You said, This teaching informs a
4 POSITA that when slugs of liquid enter the slug
5 catcher, the catcher must have enough volume in
6 it so that gas can continue to exit even during
7 a large liquid event such as a slug.

8 Which I think that's consistent with
9 what you just testified here; is that fair?

10 A. Yes.

11 Q. Okay. So then you say, This, in
12 turn, informs a POSITA that the level of liquid
13 must be well below the gas outlet to avoid
14 having excessive entrained liquid exit the slug
15 catcher and continue downstream with the gas.

16 What is -- what is excessive
17 entrained liquid in this context?

18 A. Well, in the case of -- in the
19 context of going into a gas plant, for example,
20 the liquid's incompressible, and if you pull
21 that into your compressor, you could basically
22 bend the rods and damage the compressor. So
23 you really don't want any of that kind of
24 liquid going downstream. Your plant might be
25 sensitive to erosion through a JT, a

1 Joule-Thompson orifice, by having excessive
2 liquids in the gas. So there's -- you know,
3 basically, I guess the definition then would
4 be -- depending on the application, you would
5 want to reduce the liquid level to below that
6 which would cause any damage or difficulties
7 downstream.

8 Q. Okay. So if you look back at
9 Rhinesmith, page 15. So it's a little bit
10 further up the page in the same paragraph.
11 It's the first full paragraph on the page.
12 Looks like it is the -- starting with the third
13 sentence. Do you see where it says, While many
14 primary separation applications?

15 Do you see that?

16 A. Yes.

17 Q. Okay. I'll just read that into the
18 record. While many primary separation
19 applications are designed to allow the
20 carryover of a droplet not bigger than 100 to
21 150 micron diameter particles and secondary
22 devices such as mesh pads or mist eliminators
23 may be used to reduce droplet size to
24 approximately 10 to 50 microns, slug catcher
25 design often sets a much less demanding goal of

1 establishing stratified flow to separate the
2 gas and liquid phases particularly if
3 additional downstream separation is adequate.

4 So I want to kind of parse this out,
5 this sentence. So the very first part, it
6 talks about primary separation applications.
7 It's not talking about slug catchers there,
8 correct? It's talking about...

9 A. I'm sorry. Where are we talking
10 about in that sentence?

11 Q. The very beginning. While many
12 primary separation applications.

13 A. Yes.

14 Q. So that's not -- it's not talking
15 about slug catcher design there, right?

16 A. Correct.

17 Q. And then it moves on and talks about
18 secondary devices such as mesh pads or mist
19 eliminators. Those are devices installed
20 inside other separators, correct?

21 A. Yes.

22 Q. So then it distinguishes those --
23 that application or the primary separation
24 applications and the secondary devices from
25 slug catcher design, and it says, There's often

1 a much less demanding goal of establishing
2 stratified flow.

3 What is stratified flow? What's
4 your understanding of that?

5 A. Well, you're basically trying to
6 have, I guess you could say, a bulk phase of
7 liquid that you're pulling out of the slug
8 catcher and then you've got a relatively dry
9 gas that's leaving the slug catcher.

10 Q. Oh, let me -- let me stop you. So I
11 asked you what was stratified flow.

12 A. That's what I'm explaining.

13 Q. No. You're telling me about slug
14 catchers. I just want to know what stratified
15 flow is.

16 A. Well, stratification would be
17 separating it into two separate strata.

18 Q. So if you're flowing in a pipe, what
19 does that look like?

20 A. Well, you could have gas in the pipe
21 and you could have water in the pipe.

22 Q. Okay. So you have gas flowing --
23 let's say you have a horizontal pipe. Gas
24 flowing at the top, and then you have liquid
25 flowing in a separate phase at the bottom?

1 A. Yes.

2 Q. That's stratified flow?

3 A. Could be, yes.

4 Q. Okay. So this is saying slug
5 catcher design often sets a much less demanding
6 goal of establishing stratified flow to
7 separate the gas and liquid phases.

8 A. It doesn't really tell you where
9 that stratified flow is occurring. Is that
10 occurring in the slug catcher, or are you
11 saying that's it okay to allow free water to go
12 downstream of the slug catcher?

13 Q. Okay. So you're saying that it's
14 one of those two or both or...

15 A. Well, if you have a large volume of
16 water and you suck that into your compressor,
17 you're going to destroy your compressor.

18 Q. Sure. So I think --

19 A. So you would want to have the
20 stratified flow occur inside that slug catcher
21 and pull that raw liquid out. Now, the
22 separator can handle water vapor in small
23 micron size droplets, but it's not going to
24 handle incompressible water.

25 Q. You're talking about the compressor?

1 A. Yeah, just as an example of a piece
2 of equipment --

3 Q. Sure.

4 A. -- that you're trying to protect.

5 Q. So the rest of this sentence goes on
6 and it ends, Particularly, if additional
7 downstream separation is adequate. Right.

8 So I think -- let's assume that
9 there is a downstream gas/liquid separator as
10 well. And let's put aside the compressor
11 inlet. It seems to me the context of the
12 sentence is saying the goal is not to have a
13 dry -- or dry gas leaving the slug catcher so
14 there's no liquid. It's simply to make sure
15 that you don't have slug flow leaving the slug
16 catcher. You have stratified flow. Is
17 there -- am I interpreting that wrong?

18 A. Well --

19 Q. Is my interpretation wrong?

20 A. From my point of view, I would
21 design the system to get all of the free liquid
22 out that I possibly could in the slug catcher.
23 I would then use my typical separation
24 mechanisms downstream of that to get out the
25 other particles of liquid. But I wouldn't want

1 in any case, to have a large blob of fluid
2 running down the pipe into my other separation
3 equipment which is not designed to handle
4 slugs. It could overwhelm those -- that
5 equipment.

6 So I think a POSITA would design
7 this so that he's separating out as much fluid
8 as you can in that slug catcher and that you
9 don't have any large, you know, blobs of fluid
10 that the downstream equipment can't handle
11 leaving that slug catcher.

12 Q. So when you say "blobs of fluid,"
13 you mean slugs?

14 A. A slug, a single phase of fluid
15 moving down the pipe.

16 Q. Okay. So you disagree with
17 Rhinesmith's statement here that slug catcher
18 design often sets a much less demanding goal of
19 establishing stratified flow?

20 MR. KESACK: Objection, form.

21 A. I don't think it's -- I think it's a
22 little bit vague in that respect. I don't know
23 that I'm disagreeing. I'm just stating how I
24 would design a system and how I think a POSITA
25 would view it.

1 BY MR. HALL:

2 Q. Okay. So what I'm trying to
3 understand is, is it incorrect to interpret --
4 I -- given -- I understand how you would do it
5 and how -- what might be the best way to do it,
6 but I want to focus on what Rhinesmith is
7 saying what a -- one of the goals might be.

8 And you can imagine situations
9 where, for whatever reason, equipment
10 constraints, you might have less demanding
11 goals, right?

12 A. Yes, you could if you have designed
13 the system to handle that.

14 Q. So if you -- in this situation what
15 Rhinesmith is discussing where you have this
16 much less demanding goal, this is stating that
17 you're going to have stratified flow leaving
18 the slug catcher; is it not?

19 MR. KESACK: Objection, form.

20 A. I don't believe that what he's
21 saying is that's the steady state operation of
22 the slug catcher. I think that he's saying
23 that you could live with a little bit of liquid
24 spilling over, but I don't believe that he's
25 saying that he's designing it to have liquid

1 flow over.

2 BY MR. HALL:

3 Q. Well, it says it's the goal. It's
4 the -- it is the goal to establish stratified
5 flow.

6 A. Again, I don't know why anybody
7 would build a slug catcher that doesn't work
8 properly. So if --

9 Q. Based on your understanding of how
10 slug catchers are supposed to work?

11 A. He's setting the bar relatively low
12 if he's saying he can have overflow
13 occasionally. But I don't think you're
14 designing your slug catcher in steady state to
15 have a constant flow of fluid leaving the slug
16 catcher. I think you're trying to design the
17 slug catcher such that you catch as much liquid
18 as you can and don't pass liquid downstream.

19 Q. And, again, you've never designed a
20 slug catcher yourself, right?

21 A. No.

22 Q. Okay. Take a look at page 18 of
23 Rhinesmith. Apologize. Okay. So on page 18,
24 you see the section--it's in bold--Mist
25 Eliminators/Secondary Gas Separation?

1 A. Yes.

2 Q. So right above that, we have the
3 sentence that says, In the case of larger slug
4 catcher designs (in excess of 100 barrels), it
5 may be advantageous to use a harp-type design
6 with a series of vessels rather than or in
7 combination with pipe.

8 What's your understanding of that
9 sentence?

10 A. He's -- I believe what he's trying
11 to describe there is that if you have very
12 large slugs coming into the system, that you
13 need to be able to drain those out of the
14 vessel rapidly. So by using a harp design, you
15 add additional cross-sectional area by having
16 multiple pipes attached to the vessel to drain
17 the fluid out as rapidly as possible.

18 Q. What does he mean -- I want to call
19 your attention specifically to a -- use a
20 harp-type design with a series of vessels
21 rather than or in combination with pipe.

22 So is this not suggesting that if
23 you have a larger slug catcher design in excess
24 of a hundred barrels, you would want to use the
25 harp-type slug catcher design that we -- you

1 opined about or the petitioners proposed from
2 the GPSA you -- let me scratch all that. Back
3 up.

4 So we've been talking -- or you
5 opined about the multiple pipe or harp-style
6 slug catcher in your declaration. Do you
7 recall that?

8 A. I'm sorry. Say that again.

9 Q. Do you remember testifying, and the
10 petitioners proposed, that the GPSA data book
11 discloses a harp-style inclined pipe slug
12 catcher. Do you recall that?

13 A. Yes.

14 Q. Okay. So harp-type design, what
15 does that mean to you?

16 A. That you've got multiple pipes
17 coming off the inlet so that you have multiple
18 essentially drains that allow the fluid to
19 escape down those different -- like fingers, if
20 you will, is one of the ways to describe them.

21 Q. The strings of a harp?

22 A. Correct. Yes.

23 Q. So this is saying it might be
24 advantageous, depending on the volume
25 requirements, to use a harp design with vessels

1 instead of pipes; is that accurate?

2 A. I don't know that they're talking
3 about tilting vessels. I think they're talking
4 about having -- you could have a vessel with a
5 series of harps that goes to another vessel
6 with a series of harps or you could use other
7 types of conventional vessels, you know,
8 downstream or upstream. So I'm not sure that
9 that's what he's getting at there is that
10 you're going to tilt the vessel.

11 Q. Sure. And my question didn't
12 actually have anything -- didn't presuppose
13 tilting.

14 Harp-type design means multiple
15 vessels in parallel, almost piece of pipe in
16 parallel, right, where you're adding a finger
17 or a string to increase your capacity?

18 A. Well, I guess those could be -- I
19 guess this gets down to the -- to try to define
20 the difference between a vessel and a pipe,
21 because you -- you're saying it's a vessel
22 because it's just a very thick-walled pipe.

23 Q. I'm just going off of what he's
24 saying here. In Rhinesmith, he's saying -- I
25 mean, this discussion is about multiple pipe

1 slug catchers. That's, what, page 17 of 33.

2 A. Right.

3 Q. It's talking about multiple pipe
4 slug catchers.

5 A. I can't tell from that one sentence
6 exactly how this system is designed, I guess is
7 what I'm saying.

8 Q. Sure. But you've reviewed this
9 document before, right?

10 A. Yes.

11 Q. So let's take a look at page 17 of
12 33 where this section starts. Multiple pipe.
13 At the increased operating pressures.

14 Do you see where I'm reading from?

15 A. Yes.

16 Q. Slug catcher price optimization
17 tends to favor smaller diameter slug catchers
18 of longer length. This type of slug catcher is
19 known as a multiple pipe or harp-style --
20 harp-type slug catcher.

21 That's your understanding, correct?

22 A. Correct.

23 Q. And then it says in the next
24 paragraph, The multiple pipe slug catcher is
25 usually designed with the multiple pipe

1 sections sloping gently downward and a diameter
2 selected for stratified multiphase flow.

3 Do you see that?

4 A. Yes.

5 Q. Okay. So then at the very end of
6 this section, he starts -- he says, In case of
7 larger slug catcher designs in excess of
8 100 barrels, it may be advantageous to use a
9 harp-type design with a series of vessels
10 rather than or in combination with pipe.

11 So to you, that's not suggesting
12 depending on if you have a high volume, you may
13 want to use vessels instead of pipe?

14 A. Well -- okay. So pipe is a certain
15 definition under the ASME and, you know,
16 API-type standards --

17 Q. Uh-huh.

18 A. -- you're buying standard pipe, and
19 because it's smaller diameter, it can have a
20 very high pressure rating.

21 And then a vessel would be another
22 standard, but it's a larger diameter with --
23 but it's going to need very thick walls, but it
24 may not -- you know, to get to the same
25 pressure rating, the wall thickness would have

1 to be very high relative to the smaller
2 diameter pipe.

3 So I'm not quite sure what he's
4 getting at in that particular sentence. If
5 he's -- if what we're talking about is just
6 having a very thick-walled string on a harp as
7 opposed to just using -- you know, thick enough
8 and constructed with the same standards as you
9 would a pressure vessel relative to just using
10 pipe that has another set of standards that's
11 off-the-shelf pipe that I'm just attaching to
12 my -- as the fingers of my harp, I think that's
13 what he's talking about.

14 Q. Well, he doesn't say use something
15 that's like a vessel. He says use a series of
16 vessels. Does that not have a meaning to you?

17 A. Well, again, I can visualize many
18 different ways you could do that. One thing
19 he's saying is a series of vessels.

20 Q. Uh-huh.

21 A. Well, the harp-type design
22 technically is in parallel. So the fingers are
23 in parallel. So is he talking about vessels
24 that are downstream, or is he talking about
25 replacing the fingers of the harp with vessels

1 in which case they're no longer in series,
2 they're in parallel? So...

3 Q. So you don't understand this last
4 sentence here? It's ambiguous to you?

5 A. Well, this -- you're taking one
6 sentence out of context with this whole
7 document and asking me to decide what the
8 design of the system looks like, so that's kind
9 of difficult to do.

10 Q. Okay. Look at page 19. See where
11 it says Solids Handling?

12 A. Yes.

13 Q. It says, Solid particles often build
14 up and settle out in a slug catcher. These
15 particles can include sand, iron sulfide, coal
16 fines, and carbonate scales.

17 Do you agree with that?

18 A. Yes.

19 Q. And it says, If a vessel-type slug
20 catcher is utilized -- then let's skip that
21 sentence and go to the next one.

22 For pipeline and multi-pipe slug
23 catchers, it is advisable to include clean-out
24 connections.

25 Do you agree with that?

1 A. Yes.

2 Q. Look back at your declaration,
3 paragraph 110. So you see the very end of
4 this -- the very bottom of page 67, you cite to
5 Rhinesmith at page 20.

6 A. Yes.

7 Q. Where you say, The goal of a level
8 control system for a slug catcher is to keep
9 the normal liquid level in the vessel as low as
10 possible so that more volume is available for
11 liquid slug handling.

12 Do you see that?

13 A. Yes.

14 Q. So I wanted to look at page 20
15 itself in Rhinesmith, what you're citing to,
16 and this is under a section called
17 Instrumentation, correct?

18 A. Yes.

19 Q. And then it says, Level control?

20 A. Yes.

21 Q. The second sentence of the section
22 after the one that you cited says, Level
23 control on a slug catcher is best performed
24 with a snap-acting controller and valve.

25 What does that mean to you?

1 A. I'm not really familiar with the
2 term "snap acting," but I'm assuming that
3 they're talking about a valve that opens and
4 closes based on some input from a level
5 control.

6 Q. So that's a -- that's a -- a level
7 control is a device used to detect the level of
8 liquid in the -- a pipe or a vessel?

9 A. Correct. And as opposed to a
10 slow-closing valve, I think they're referring
11 to a rapidly closing or opening or closing
12 valve.

13 Q. Okay. So this is discussing a
14 system where there is an automatic level
15 control that sends a signal to the valve to
16 open or shut based on the level it's detecting
17 in the vessel; is that fair?

18 A. Yes.

19 Q. So if the liquid level gets too
20 high, it opens the valve and it drains liquid
21 out?

22 A. Correct.

23 Q. Do you agree that pipe-type slug
24 catchers are frequently less expensive than
25 vessel-type slug catchers of the same capacity?

1 Let me give you the full quote. So
2 this is from the GPSA, the data book, and it
3 says that pipe-type slug catchers are
4 frequently less expensive than vessel-type slug
5 catchers of the same capacity due to thinner
6 wall requirements of smaller diameter pipe.

7 Do you agree with that?

8 A. In that application --

9 Q. Right.

10 A. -- that would be true.

11 Q. And that's because you were
12 previously discussing the differences between
13 pipe and the vessel just a moment ago?

14 A. Well, the difference in the
15 application is, is in a hydraulic fracturing
16 application, you may not have the luxury of
17 having hundreds of feet -- you know, a hundred
18 feet or so to put this large slug catcher in
19 place. So I'm not -- I think you'd have to
20 look at the situation and decide if the --

21 Q. Sure.

22 A. -- in a pipeline application, I
23 believe they're doing that because they don't
24 have to have thick-walled vessels, they can
25 just use pipe.

1 Q. Right. And that's because the
2 requirements for -- and this is somewhere --
3 I'm out of my depth.

4 So the requirements for complying
5 with vessel code would require a -- versus a
6 pipe code, it's more expensive to make a vessel
7 that would withstand the same pressure rating
8 as a piece of pipe; is that fair?

9 A. That's fair. And it's probably
10 because the diameter of a vessel is typically
11 larger than a pipe. So as the diameter
12 increases, the pressure rating goes down. So
13 if you have a small diameter tube, then you can
14 have a high pressure rating on that small
15 diameter tube.

16 Q. Is it also -- is it also -- and I
17 understand your distinction between the
18 fracturing application versus a slag catching
19 on the pipeline. So that's fair enough.

20 So is it also a reason that
21 pipe-style slug catchers might be less
22 expensive because they come in standard sizes,
23 pipe itself comes in standard sizes?

24 A. The pipe itself is, yeah,
25 mass-produced.

1 Q. Okay. If you used a pipe as a
2 vessel or in a vessel service or let's just
3 say -- scratch that.

4 If you used a pipe as a slug
5 catcher, would you still refer to it as a piece
6 of pipe? Would you still -- is it still --
7 well, let me strike that.

8 I'm going to hand you page 45 of
9 Exhibit 1008. I didn't bring the whole thing.
10 So this is from the Pipe section of the GPSA
11 data book. And so I pulled this out because I
12 wanted to ask you about the -- how you describe
13 pipe itself.

14 So you said that pipe comes in
15 standard thicknesses. Is that the schedule
16 number, the second column here of this diagram?

17 A. Yes. That's one way to designate
18 this type of pipe.

19 Q. Okay.

20 A. Right.

21 Q. So this says -- so this -- the
22 first -- the one-half nominal pipe size inches
23 says one-half and has schedule number S40,
24 correct? That's schedule 40 pipe, right?

25 A. Yes.

1 Q. And then -- so if you have one-half
2 inch schedule 40 pipe, wherever you get that
3 from, it's supposed to comply with these
4 physical requirements, right?

5 A. Correct.

6 Q. I'm trying to move down to one that
7 has all of them. So the one-inch has schedule
8 40 and has X80. What does X80 mean? Do you
9 know what that means?

10 A. It's just a different -- different
11 type of base material. So you're getting a
12 higher strength material, so you get higher
13 pressure ratings.

14 Q. Okay. And then so it has 160.
15 That's schedule 160?

16 A. I believe so. I notice it doesn't
17 have an S in front of it, but it's -- the
18 designation is the schedule number, so...

19 Q. Okay. And then XX is -- you know
20 what that is?

21 A. Where is that at?

22 Q. Right below 160.

23 A. I just believe that's another
24 designation for -- you've got a different
25 weight of that pipe and you've got a different

1 pressure rating for that pipe.

2 Q. Well, I guess the point is for -- if
3 you wanted to specify a pipe, you would give
4 the nominal pipe size and your schedule number
5 and that's going to determine the
6 characteristics of the pipe, correct?

7 A. Yes.

8 Q. Okay.

9 A. You would want the well, the
10 schedule number, and the weight.

11 Q. The weight is the third column
12 there?

13 A. Correct.

14 Q. Is that determined by the schedule
15 number or is that an independent variable?

16 A. I believe that's independent.

17 Q. Seems like that would depend on the
18 material used whether it was steel or another
19 type of material?

20 A. Correct, and the heat treat and so
21 forth.

22 Q. Okay. So you had earlier drawn a
23 distinction between the desanding
24 application -- the fracturing application
25 versus the pipeline, the slug catcher. So I

1 wanted to ask you if you think someone wanting
2 to save money would want to use pipe in a
3 desanding application instead of a pressure
4 vessel?

5 A. I think the difference is when you
6 start cutting holes in the pipe that presents a
7 whole new set of problems. So that's why they
8 have all these standards for vessels and
9 pressure ratings for vessels and how you weld
10 and test and that type of thing. So I don't
11 think it's just -- I mean, you might get --
12 might be able to make a piece of pipe into a
13 vessel, but you would have to do it to the
14 vessel standards and the way that you did a
15 fabrication.

16 Q. Okay. Do you -- for the pipe's
17 schedule numbers, that's something that's
18 limited to pipe, right? You don't have
19 schedule number for vessels?

20 A. I would typically -- in the upstream
21 industry, we would normally have pressure
22 ratings for vessels as opposed to schedule
23 numbers.

24 Q. Okay. Have you ever seen someone
25 use a schedule number to describe a vessel?

1 A. I have not.

2 Q. Almost done. Go back to your
3 declaration, paragraph 78. See here you say,
4 There is -- and you're talking about the Davis
5 reference, which is -- let me give you that
6 real quick. Exhibit 1005.

7 (Exhibit 1005 introduced.)

8 BY MR. HALL:

9 Q. So this is a paragraph referring to
10 the Davis reference. So here you say, There is
11 no flow through the vertical channel from one
12 end to the other.

13 You say, Davis deals with the
14 situation with a fluid flow and the vertical
15 channel is static.

16 What's the basis for your statement
17 there that the -- there's no flow in the
18 vertical channel?

19 A. Well, as I recall, the figure just
20 shows a vertical vessel, and I believe they
21 discuss that the fluid is in laminar flow.

22 Where is the picture?

23 Q. It's on page 17, if you're referring
24 to Figure 4.

25 A. Correct.

1 Q. Okay.

2 A. So -- and they mention that this is
3 a -- basically a -- similar to a super settler
4 or a lamella settler, and they're depending on
5 retention time.

6 So if you're depending on retention
7 time, that would be dealing with a static
8 situation where you basically stop the fluid
9 movement and allow the particles to settle.

10 Q. So the paragraph -- the first
11 paragraph here talks about super settlers and
12 lamella settlers. That's what you're referring
13 to?

14 A. Yes.

15 Q. So Figure 4 itself says it's a
16 tilted channel. So --

17 A. Correct.

18 Q. That's at the very bottom of the
19 page there?

20 A. Yes, that's right.

21 Q. So to you, those are the same thing?

22 A. Well, they're describing in general
23 a -- the situation where they've -- created a
24 situation where they have a fluid with some
25 type of solid particles that are settling. And

1 from my reading of this, there's -- they're not
2 talking about a dynamic fluid flow.

3 Q. Okay. But there is laminar flow,
4 correct?

5 A. I think the only laminar flow is the
6 flow that's created by the actual movement of
7 the particles themselves and they fall through
8 the liquid and create currents.

9 Q. Okay. So paragraph 79 of your
10 declaration you state, Davis clearly teaches
11 that equation 4-1 is only valid for laminar
12 flow.

13 So that's a different -- that's the
14 laminar flow you're referring to there?

15 A. Yes.

16 Q. Oh, it's not flow through the
17 channel?

18 A. In the example they're giving here
19 that there's -- there's no -- it's not an
20 open-ended channel so that -- there can't be
21 any flow through the channel. So it's -- they
22 can put fluid in the top of the channel.

23 Q. Okay. But then you say, The
24 enhancement in the settling rate predicted by
25 equation 4.1 holds true only so long as the

1 flow in the channel remains laminar.

2 So it's -- as long as the flow in
3 the channel remained laminar, you would expect
4 equation 4.1 to hold?

5 A. Well, let me think about that a
6 minute. I guess I'd have to kind of see the
7 exact situation we're talking about. But in
8 general, they were deriving this analysis based
9 on a static fluid in a channel that's inclined
10 and the -- and these particles are settling.

11 If you add another component of also
12 moving the fluids through the channel in
13 laminar flow, this may also apply, but
14 that's -- I don't believe that Davis actually
15 is speaking to that.

16 Q. Okay. So you're not sure whether
17 that equation would still apply?

18 A. I think that it might still apply,
19 but, again, you've added another force factor
20 to the particle, so it's moving. I would
21 assume that having additional area would be
22 beneficial just based on, you know, my
23 understanding of how these things work.

24 Q. Okay. Take a look at Davis equation
25 4.1. It's on page 19 of Davis.

1 A. At the top?

2 Q. Yeah. You see that?

3 A. Yes.

4 Q. I just want to run through the
5 variables here, the -- what they mean.

6 So the equation is $S \star T$ equals V
7 sub 0 times $B (\cos \theta + L)$ divided
8 by $B \sin \theta$.

9 So $S \star T$ says, right below the
10 equation here, is the volumetric rate of
11 production of clarified fluid per unit depth in
12 the third dimension of the vessel hereafter
13 referred to as the settling rate.

14 Do you see that?

15 A. Yes.

16 Q. If you look at your declaration in
17 paragraph 47, it's on page 28. See that?

18 A. Page 28?

19 Q. Yes, sir. Paragraph 47.

20 A. Yes. Yes.

21 Q. You call this the settling
22 efficiency.

23 A. Yes.

24 Q. Not the settling rate, that's
25 correct?

1 A. That's correct.

2 Q. What are the units of this -- of S
3 star T?

4 A. I believe it's going to be a ratio,
5 I believe, but I'd have to -- I haven't
6 actually sat down and calculated that recently,
7 so I don't really remember if that's the case,
8 but --

9 Q. Okay. Well, I can -- we'll try to
10 work through it with you. So it says it's the
11 volumetric rate of production of clarified
12 fluid.

13 So what's the volumetric rate of
14 production? Is that a unit of volume per unit
15 time?

16 A. Well, you know, time is in the
17 function. So at some time T you'll have a
18 different -- a different clarified fluid per
19 unit depth than you would at another time T.

20 Q. Well, I'm just wanting to understand
21 what volumetric rate of production of fluid
22 means at this point.

23 I mean, volumetric rate of
24 production to me indicates a volume divided by
25 time, a rate of production. Is that accurate

1 or not?

2 A. Well, given that there's not a --
3 they're not dividing this by T, so is there
4 a -- is -- let's see. What was --

5 Q. Well, S star T is a function, right?

6 A. Right.

7 Q. So, I mean --

8 A. So it's going to give a --

9 Q. -- by definition, it's divided by T,
10 right?

11 A. Well, you asked about units, so --

12 Q. Right.

13 A. -- if you don't have a unit in the
14 equation of time, then --

15 Q. Right.

16 A. -- there's not a time unit in the
17 output.

18 Q. Well, I'm just --

19 A. It's at some time T, you would have
20 a value, and at some other time T, you would
21 have another value.

22 Q. Got it. So then you would -- you
23 need to plug your time T into this to figure
24 out what your volumetric rate of production is,
25 right, at that point in time?

1 A. Well, in this particular equation,
2 the way he's got it styled, there's no T in the
3 equation.

4 Q. Sure. Okay. So the entire
5 equation, though, is giving you the volumetric
6 rate of production of clarified fluid per unit
7 depth?

8 A. Right. And I was taking this as
9 he -- basically, he's trying to create -- it
10 may add dimensions, but it's sort of like a
11 dimensionless factor that's an expression of
12 how -- how rapidly the fluid is being
13 clarified.

14 Q. Okay. So you were taking it to be
15 dimensionless, but it may have dimensions?

16 A. I mean, it may have dimensions, but
17 it's like a dimensionless -- you know, it's a
18 relative term. But there's not a time T as
19 part of the equation, so I don't see how time
20 is -- would be in the units.

21 Q. It may not be in the units. That's
22 what I'm trying to ask you, I'm trying to get
23 at.

24 A. I don't believe that it is. I think
25 he's saying that at some -- that at a

1 particular time T, you'll have one value, and
2 another time T, you'll have another value.

3 Q. Okay. And that --

4 A. And over time, you would see more
5 settling or the -- you know, you'd see the
6 fluid clarifying over time --

7 Q. You would see --

8 A. -- as it settles.

9 Q. -- more production of clarified
10 fluid?

11 A. Correct.

12 Q. Okay. So there -- that's where your
13 volumetric rate of production comes in?

14 A. Right.

15 Q. Okay.

16 A. But he's saying per unit depth as
17 opposed to per unit time.

18 Q. Right. So then you would need to
19 take your rate of production and divide it by a
20 unit of depth, right?

21 A. Right. So if you were to -- you
22 know, another way to approach this would have
23 been to talk about at time zero, I have this
24 much volume. At time -- of clear fluid. At
25 time, you know, T plus 1 hour, I have another

1 volume of fluid and therefore I've produced
2 this volume of fluid per that amount of seconds
3 or minutes.

4 Q. And you've got to look at the
5 difference between the two times to give you
6 the rate of production, right?

7 A. Right.

8 Q. Okay. Fair enough. I'm just trying
9 to get to the bottom of -- you called this an
10 efficiency and he called it a settling rate, so
11 it seemed to be a difference, and I wanted to
12 try to understand what was going on there.

13 A. Well, in petroleum engineering, you
14 normally look at volume as a -- production as a
15 function of time. So when I look at this and I
16 don't see time in the equation, I think of it
17 as more of a factor that I'm using to examine
18 in general the efficiency of the settling.
19 That's kind of why I used that term.

20 Q. This is a function of time, right?

21 A. It is a function of time, but
22 there's no time in the equation. So --

23 Q. Sure.

24 A. -- if this was in gallons per -- of
25 clarified fluid per minute, I would call that a

1 production rate in terms of -- the terms I
2 would normally understand.

3 Q. So you don't recall going through
4 and figuring out what the units of the
5 expression are?

6 A. No. I mean, I may have in my
7 calculation table over here. Let's see.

8 Q. Okay. I think you just called it --

9 A. I think I was just looking at the
10 ratio --

11 Q. Yeah --

12 A. -- basically.

13 Q. -- that's right. Okay. You can
14 leave that aside. It's not critically
15 important.

16 Let's go to the rest of the
17 figures -- or rest of the components of the
18 expression. V subzero is the vertical settling
19 velocity?

20 A. Well, there would be -- there could
21 be time in that equation or that, you know,
22 expression.

23 Q. Okay. So that's going to be a unit
24 of length per unit time?

25 A. Right.

1 Q. So like feet per second?

2 A. Yes.

3 Q. B is what it says on -- again, going
4 back to page 19. B is the spacing between the
5 plates?

6 A. Yeah, B is this -- well, if you go
7 back to the figure, they show you what B is on
8 the figure.

9 Q. Right. So if it's imagining this as
10 two plates --

11 A. It's the width of the -- of the --
12 of the -- of the structure, I guess you could
13 say.

14 Q. Right. So if you have flow -- let's
15 say your direction of flow is along the length.
16 So parallel to the arrow that says L. Do you
17 see that?

18 A. I do see that, that there's a
19 direction L, but --

20 Q. Or dimension L?

21 A. -- that the vessel appears to be or
22 the channel or the structure, it looks to be
23 closed on one end, so I don't know how I have
24 flow.

25 Q. Yeah. And I'm just trying to --

1 A. Right.

2 Q. -- I'm trying to get a common frame
3 of reference.

4 So B is the spacing -- in the
5 equation, B is the space between the plates and
6 it's also the spacing -- well, we have settling
7 in this figure from top to bottom, right?

8 A. Correct.

9 Q. So there is flow at least vertically
10 downwards. It's not parallel L, correct?

11 A. Well, there's movement of
12 particles --

13 Q. Right. Movement --

14 A. -- but I don't --

15 Q. -- flow of particles.

16 And there's flow of clarified fluids
17 upwards, right?

18 A. There could be some currents that
19 are set up in the -- in the fluid because of
20 the movement of the particles.

21 Q. Let me just leave that off. I can't
22 think of a way to phrase that so that it'll --
23 we can use it.

24 So B is the spacing between the
25 plates?

1 A. It's defining -- to me, it's
2 defining the geometry of this structure.

3 Q. Okay.

4 A. So whatever that structure is.

5 Q. So L is the length of the vessel?

6 A. Correct.

7 Q. If this were, in fact, a pipe, B
8 would be the same as the diameter?

9 A. Correct.

10 Q. Theta is the angle of inclination of
11 the plates from the vertical?

12 A. Correct.

13 Q. So if you're completely vertical,
14 your angle is what, zero?

15 A. I believe that's right. Yeah, zero.
16 But let me look at my table.

17 Q. Okay.

18 A. Depending where you want to measure
19 the angle from.

20 Q. Well, I'm trying to -- I want to --
21 I want to focus on the way it's used in Davis
22 at this point.

23 A. Yes, if it's just vertical, it's
24 zero.

25 Q. Okay. So are you -- so you're

1 looking at page 33 of your declaration?

2 A. Yes.

3 Q. So vertical there, your inclination
4 of theta degrees, that is zero?

5 A. Yes.

6 Q. And then 90 is completely
7 horizontal?

8 A. Yes.

9 Q. Okay. All right.

10 MR. KESACK: If you can find a time
11 to take a quick break, I'd appreciate it.

12 MR. HALL: Okay. I'm almost done,
13 actually, so -- I think.

14 BY MR. HALL:

15 Q. So looking back at Davis, page 18 --
16 bottom of page 18, it's -- this is Davis
17 setting up before it introduces equation 4.1.
18 See this last paragraph where it's talking
19 about the --

20 A. Yeah.

21 Q. -- so-called PNK theory?

22 A. Yes.

23 Q. Okay. It says, This theory states
24 that the rate of production of clarified fluid
25 is equal to the vertical settling velocity of

1 the particles multiplied by the horizontal
2 projection of the channel area available for
3 settling.

4 And then it says, For the parallel
5 plate geometry of Figure 4, which is on page
6 17, the expression is, and then it gives
7 equation 4.1.

8 A. Correct.

9 Q. So is it your understanding that
10 Figure 4 or the -- I'm sorry, the equation 4.1
11 is limited to the parallel plate geometry of
12 Figure 4?

13 A. Or a similar construct.

14 Q. Okay.

15 A. I guess just to clarify, the -- I
16 believe the velocity of V subnaught would be
17 impacted by the viscosity of the fluid. And
18 the thing I was focused on in my table was the
19 rest of the term. So -- and they talk -- he
20 talks about the --

21 Q. You mean the rest of the term in
22 4.1?

23 A. In 4.1, right. So, yeah.

24 Q. Okay.

25 A. So it was equal to the vertical

1 settling velocity --

2 (Interruption by the reporter.)

3 A. Well, basically, I'm not including
4 the velocity in my table, right? The velocity
5 would be dependent upon the viscosity of the
6 fluid. I was focused on the remaining term
7 which is -- relates to the geometry.

8 BY MR. HALL:

9 Q. Understood. Understood. So you
10 just left V subzero out to get a relative
11 change of settling efficiency based on the
12 geometry of the vessel?

13 A. Exactly.

14 Q. Okay.

15 MR. KESACK: So would you mind if I
16 took a bathroom break?

17 MR. HALL: I don't mind. I've just
18 got about five minutes left.

19 (Recess held.)

20 BY MR. HALL:

21 Q. So paragraph 53 of your declaration.
22 So you --

23 A. I'm sorry. I'm --

24 Q. It's on page 31.

25 A. Yes.

1 Q. So paragraph 53, you begin to
2 discuss using equation 4.1 with dimensions of
3 prior art vessels described in the '256 patent;
4 is that correct?

5 A. Yes.

6 Q. In paragraph 55, you state -- I
7 think this is in the bottom of page 33,
8 actually. You state that, The inclined vessel
9 offers an increase in settling efficiency of
10 0.5 percent or less.

11 And the inclined vessel here is
12 the -- is a vessel inclined from the
13 horizontal, correct?

14 A. Correct.

15 Q. Back on page 31, you have a Footnote
16 2, and in this footnote you explain how to find
17 the maximum angle where a settling surface
18 increase occurs; is that correct?

19 A. Correct.

20 Q. And your diagram on page 32 says,
21 The maximum benefit angle is 11.31 degrees.

22 Is that correct?

23 A. For that particular geometry.

24 Q. Right. The one that's in Table 1?

25 A. Yes.

1 Q. So looking at the chart on page 33
2 of your declaration. So it appears there's a
3 change in what you're calling the settling
4 efficiency, and based on an incline from the
5 horizontal.

6 So percent increase in SA, that's
7 settling area?

8 A. Yes.

9 Q. Percent increase in SA relative to
10 horizontal. So zero degrees, zero percent.

11 And then it goes up, and then we get
12 to 11. It's at .07 percent, and then at 12,
13 it's negative.

14 So you calculated that at
15 11.31 degrees is the maximum benefit angle.
16 Can you -- so is that the point where it goes
17 back to zero or right before it goes back to
18 zero, the increase in settling efficiency?

19 A. Yes. And if you just look at the
20 figure on page 32, there's a -- based on the
21 geometry, there'll be a point at which there's
22 just -- there's no additional surface area that
23 you're -- or you're -- actually in this case,
24 you're reducing the surface area available for
25 settling.

1 Q. And so you're saying if you tilt it
2 beyond, in this case, 11.31 degrees, you're
3 back at the same surface area or worse that you
4 had when it was a horizontal vessel?

5 A. Yes.

6 Q. Okay. And so it appears that the
7 maximum increase is around -- at least in your
8 table here, is at 6 degrees where it says
9 .5 percent?

10 A. Yes.

11 Q. Okay. Paragraph 57, you do the same
12 calculation for a different size vessel, right?
13 The B is 20 feet and the L is one foot?

14 A. Yes.

15 Q. And here you state that the maximum
16 benefit angle, although you don't call it that,
17 is 5.7 degrees; is that correct?

18 A. Yes.

19 Q. So between zero and 5.7 degrees of
20 inclination from the horizontal, you will have
21 an increased settling rate?

22 A. Well, you've got increased area.
23 You know, if you've just got a -- you know, if
24 it's a still fluid and you've just got
25 particles settling, you've got this increased

1 area for the particles to settle on.

2 Q. And you -- but you call that the
3 settling efficiency?

4 A. Yes.

5 Q. Right. So for both the vessels,
6 there is an increase settling efficiency when
7 you tilt them from the horizontal?

8 A. In that particular situation of
9 just -- assuming you just got a still fluid and
10 all you've done is just tilt the structure so
11 that you -- you've changed the geometry.

12 Q. Right. So just --

13 A. But you're ignoring any other
14 factors.

15 Q. Exactly. So you're applying
16 equation 4.1, in other words?

17 A. Correct.

18 Q. So yeah. In that situation with
19 these size vessels, you're calculating there is
20 an increase in settling efficiency between --
21 if you start out with a horizontal vessel and
22 then you tilt it and you incline it, there is
23 an increase in settling efficiency?

24 A. Unless you take other factors into
25 account.

1 Q. Right. And I'm -- but you didn't do
2 that, right? You're just --

3 A. I'm just saying that, yeah, for
4 this -- you know, for this geometry under that
5 situation, this is --

6 Q. Right.

7 A. -- the result of the calculation.

8 Q. Fair enough. That's all I'm asking
9 is there is an increase in settling efficiency
10 applying this equation to these size vessels if
11 you incline a horizontal vessel?

12 A. Negligible, but yes.

13 Q. Okay. One more thing. Take a look
14 at Davis's title. It's on page 3 of 30. See
15 it?

16 A. Yes.

17 Q. It says, Sedimentation of
18 noncolloidal particles at low Reynolds numbers.

19 What does -- what does noncolloidal
20 mean? Do you know what a colloid is?

21 A. It's a very small particle.

22 Q. A colloid is a very small particle?

23 A. Hold on just a sec.

24 Q. Okay.

25 A. Yes, I'm saying a colloid is a small

1 particle.

2 Q. Okay. And so is it true that
3 particles of a colloid will not settle?

4 A. No.

5 Q. Not true?

6 A. Well, I mean, I think eventually
7 they will settle, but they may settle very
8 slowly.

9 Q. We talked about sedimentation of
10 noncolloidal particle at low Reynolds numbers.
11 So what is a noncolloidal particle?

12 A. I'm trying to remember the
13 definition.

14 Q. Well, I'm not sure there is one in
15 this, actually. I just want to know what it
16 means to you when you read it.

17 A. Well, when you get particles small
18 enough, you start having forces that act on the
19 particles other than just gravity. So I don't
20 think I can give you a great lexical
21 definition. But I think he's dealing with
22 particles that are very small particles, but I
23 don't have a good lexical definition of
24 "noncolloidal" for you.

25 Q. Okay. So would colloidal particles

1 be smaller than what he's discussing in this
2 paper?

3 A. Would colloidal particles?

4 Q. Colloidal particles. I'm trying to
5 get at -- what I'm trying to get at is he's not
6 looking at particles that are so small that
7 they could be called colloids. He's looking at
8 particles that are larger than that; is that
9 fair?

10 A. I think so, yeah.

11 Q. Okay.

12 MR. HALL: Pass the witness.

13 MR. KESACK: Okay.

14 EXAMINATION

15 BY MR. KESACK:

16 Q. Can you turn that to paragraph 5 of
17 your declaration? Are you there?

18 A. Paragraph 5.

19 Q. It's on page 2.

20 A. I keep turning the page. Yes.

21 Q. Do you remember testifying about
22 your experience with desanders in relation to
23 this paragraph?

24 A. Yes.

25 Q. Do you remember testifying about

1 horizontal and vertical desanders?

2 A. Yes.

3 Q. Have you ever worked with a desander
4 that was neither horizontal nor vertical?

5 A. No.

6 Q. Let's turn to paragraph 26 of your
7 declaration. Sorry. I'll come back to this.

8 Paragraph 23.

9 A. Paragraph 23.

10 Q. All right. Specifically at the
11 bottom of page 10.

12 A. I'm there.

13 Q. See the sentence that starts with,
14 Specifically for the desander?

15 A. Yes.

16 Q. Do you remember testifying about
17 this sentence?

18 MR. HALL: Objection, outside the
19 scope.

20 A. Well, we've -- I've testified about
21 a lot in the last few hours. I remember a
22 discussion of the cross-sectional area.

23 BY MR. KESACK:

24 Q. And what is that cross-sectional
25 area?

1 A. The -- if you take a slice through
2 the vessel perpendicular to its axes or off the
3 vertical through the -- its long axes, you
4 would have a cross-sectional area of the
5 vessel.

6 Q. And you say, Volume is the
7 cross-sectional area of the freeboard portion
8 of the vessel.

9 Right?

10 MR. HALL: Objection, outside the
11 scope.

12 BY MR. KESACK:

13 Q. Still on page 10.

14 A. Yes. I'm sorry. Could you repeat
15 the question?

16 Q. I said your sentence says, The
17 volume is the cross-sectional area of the
18 freeboard portion of the vessel.

19 Do you see that?

20 A. Yes.

21 MR. HALL: Same objection.

22 BY MR. KESACK:

23 Q. What is cross-sectional area of the
24 freeboard portion of the vessel?

25 MR. HALL: Same objection.

1 A. Well, I have a -- I have a diagram
2 on Figure 1 that shows the cross-sectional area
3 of the freeboard and it's labeled as such.

4 BY MR. KESACK:

5 Q. Sure. Can you explain what it is,
6 explain the figure?

7 A. It's the --

8 MR. HALL: Objection, outside the
9 scope.

10 A. It's the area between the liquid
11 interface and the free gas, so it's above the
12 -- above the liquid interface.

13 BY MR. KESACK:

14 Q. Okay. So the next part is -- says,
15 Does not include the belly portion of the
16 vessel because fluid in the special gas cannot
17 flow in the belly portion of the vessel.

18 A. Correct.

19 Q. What are you saying can't flow in
20 the belly portion of the vessel?

21 A. Well, the -- there's not a path for
22 free movement to the outlet in the belly
23 portion of the vessel like there is in the
24 freeboard section of the vessel, and so that
25 portion would be full of fluid and the -- you

1 would have movement of gas and -- along the
2 interface to the -- to the outlet.

3 Q. So what is it you're saying cannot
4 flow in the belly portion of the vessel?

5 MR. HALL: Objection, asked and
6 answered.

7 A. The liquid and the solids.

8 BY MR. KESACK:

9 Q. Sorry. The liquids and the solids
10 cannot flow in the belly portion? Is that what
11 you're saying?

12 A. Correct.

13 Q. That's what the cross-sectional area
14 of the freeboard portion of the vessel refers
15 to?

16 A. Well, the -- okay. The
17 cross-sectional area of the freeboard is the
18 area above the liquid interface.

19 Q. Okay.

20 A. So that's what I'm referring to is
21 the cross-sectional area. It's above -- above
22 the liquid interface.

23 Q. And that doesn't include the belly
24 portion. That's why you're saying that,
25 correct?

1 A. It does not include the belly
2 portion.

3 Q. So what's flowing in the freeboard
4 portion?

5 A. The gas and possibly the -- whatever
6 particles are still in the gas is in that upper
7 portion.

8 Q. So in this sentence, you're talking
9 about the flow of the gas in the freeboard
10 portion; is that right?

11 A. Correct.

12 Q. And is it fair to say, then, that
13 that's what cannot flow in the belly portion of
14 the vessel?

15 A. Correct, the gas is not flowing in
16 the belly portion.

17 Q. So you're not trying to say that
18 liquid can't flow in the belly portion; is that
19 right?

20 A. It's not going to flow freely. It's
21 just -- it could -- it can have some movement,
22 but the flow is occurring in that -- in
23 that freeboard of the gas is occurring in the
24 freeboard section.

25 Q. Can you go to paragraph 98? It's on

1 page 57.

2 A. Yes.

3 Q. Do you remember testifying about
4 paragraphs 97 through 99 about whether sand --
5 where sand accumulates in the Hemstock vessel?
6 Do you remember that testimony?

7 A. Yes.

8 Q. Counsel asked you for testimony
9 regarding the written description, but asked
10 you to exclude Figure 3 from your testimony.
11 Do you remember that?

12 A. I don't remember. I remember there
13 was discussion about Figure 3.

14 Q. Does Figure 3 show you where sand
15 settles in the Hemstock vessel?

16 A. Yes.

17 Q. What does it tell you?

18 A. Well, Figure 3 shows that the -- the
19 fluid stream is coming in at the inlet, but
20 there's a -- some arc of the movement of the
21 particulates and that they're settling -- it
22 shows that they're settling basically
23 concentrated in the middle of the vessel and
24 then before you get to the downcomer.

25 Q. Can you flip back to paragraph 26,

1 specifically on page 13? See the first full
2 sentence that starts with, On the other hand?

3 A. This is paragraph 26?

4 Q. Yeah, on page 13.

5 A. Yes.

6 Q. This says, In the Hemstock vessel,
7 particulates collect substantially along the
8 entire length of the vessel.

9 Do you see that?

10 A. Yes.

11 Q. Do you agree with that statement?

12 A. Yes.

13 Q. Are you citing anything in support
14 of this statement?

15 A. Well, there's the figure and then
16 there's also this reference to the discussion
17 about the scraper rods from the -- from the
18 '256 patent.

19 Q. Can we go to the '256 patent? It's
20 Exhibit 1001. Let's look at 218 to 21.

21 A. Yes.

22 Q. What does it say?

23 A. The accumulation of particulates is
24 along a substantial length of the elongate
25 vessel increasing the difficulty of periodic

1 manual removal of such accumulating --

2 (Interruption by the reporter.)

3 A. The accumulation of particulates is
4 along a substantial length of the elongate
5 vessel increasing the difficulty of periodic
6 manual removal of such accumulating using
7 scraper rods and the like.

8 BY MR. KESACK:

9 Q. Do you agree with that statement?

10 A. Yes.

11 Q. Is that consistent with your
12 testimony about where sand settles in the
13 Hemstock vessel?

14 A. Yes.

15 Q. Let's go to paragraph 108 -- sorry,
16 109. It's on page 66. Do you remember
17 testifying about slug catchers in the data
18 book?

19 A. Yes.

20 Q. Do you remember testimony about
21 whether any liquid could come out of a slug
22 catcher and still be a slug catcher?

23 MR. HALL: Objection, form.

24 A. Yes.

25 BY MR. KESACK:

1 Q. Can you look at the -- if you go up
2 the page, we have the nomenclature of the data
3 book which explains what a slug catcher is. Do
4 you see that?

5 A. Where is -- is this on the page?
6 What page?

7 Q. About four lines down.

8 A. Page 66?

9 Q. Yeah. Four lines from the top.

10 MR. HALL: This is paragraph 108?

11 MR. KESACK: Yes.

12 A. Yes, I see that reference.

13 BY MR. KESACK:

14 Q. And what do you say the nomenclature
15 of the data book is for a separator?

16 A. You mean for a slug catcher?

17 Q. Yeah. Let's start there. What is
18 it for a slug catcher?

19 A. This is the one, two -- let's see.
20 One, two, three, four. This would be the
21 fourth sentence. Starting with the fourth
22 sentence where it starts, This is.

23 Q. Sure.

24 A. This is consistent with the
25 nomenclature of the data book which explains

1 that a slug catcher is a particular separator
2 design and that a separator is a vessel which
3 is used to separate a mixed base stream into
4 gas and liquid phases that are relatively free
5 of each other.

6 Q. Let's turn to Rhinehart [sic] page
7 15, Exhibit --

8 MR. HALL: 2004.

9 MR. KESACK: 2004. Thank you.

10 BY MR. KESACK:

11 Q. Page 15. Do you remember testifying
12 about the top paragraph on this page?

13 A. Yes.

14 Q. Here we have -- the first part was a
15 droplet not bigger than a hundred to 150 micron
16 diameter. Do you see that?

17 A. Yes.

18 Q. Would a gas with droplets not bigger
19 than a hundred to 150 micron diameter still be
20 relatively free of liquid?

21 A. Yes.

22 Q. See where we get to droplet size of
23 approximately 10 to 15 microns?

24 A. Yes, I see that.

25 Q. Would a gas flow that had droplet

1 size of about 10 to 50 microns still be
2 relatively free of liquid?

3 A. Yes.

4 Q. And when we get to the bottom, we're
5 talking about stratified flow. Do you remember
6 that?

7 A. Yes.

8 Q. Would a gas that was stratified flow
9 of both gas and liquid be relatively free of
10 liquid?

11 MR. HALL: Objection, form.

12 A. Well, that depends on how much
13 liquid we're talking about. But I would say --
14 again, I'm thinking, you know, in the -- in the
15 situation where you've got equipment
16 downstream, I think it's relative to the damage
17 you're going to do with the amount of liquid
18 that spills over.

19 You can ask the question again.

20 BY MR. KESACK:

21 Q. Sure. So we talked about a hundred
22 to 150 micron diameter droplets. We said if
23 those droplets were coming out of the slug
24 catcher, that gas would still be relatively
25 free of liquid?

1 MR. HALL: Objection, form.

2 A. Correct.

3 BY MR. KESACK:

4 Q. And we talked about 10 to 50 micron
5 verticals, correct?

6 MR. HALL: Objection, form.

7 (Interruption by the reporter.)

8 BY MR. HALL:

9 Q. So now I'm asking you about flow
10 which would be stratified flow of gas and
11 liquid coming out the fluid outlet or the vapor
12 outlet. Would that vapor be relatively liquid
13 free?

14 MR. HALL: Objection, form.

15 A. I don't think so. It just depends
16 on how much liquid we're talking about.

17 BY MR. KESACK:

18 Q. Can you turn to Table 1 on page 33
19 of your declaration? Are you there?

20 A. Yes.

21 Q. Do you remember testifying about
22 this table?

23 A. Yes.

24 Q. I think you testified that the
25 inclination of zero degrees would be a vertical

1 vessel?

2 A. Yes.

3 Q. Is that your understanding of this
4 table, that at zero degrees, you would be at
5 vertical? And take your time to review it.

6 A. Let me make sure I'm referring to
7 the right table. I think I may have it
8 backwards. It's a horizontal vessel.

9 Q. So what does zero degrees mean in
10 this table?

11 A. It means that it's horizontal.

12 Q. Then you were talking about the
13 figure on the page before. It was page 32.

14 A. Yes.

15 Q. There's a part of this figure that
16 says, Cosign theta is adjacent over hypotenuse.
17 Do you see that?

18 A. Yes.

19 Q. And that B prime equals cosign theta
20 times V?

21 A. Yes.

22 Q. What is B prime?

23 A. B prime is this bottom dimension of
24 this triangle at the -- in the figure.

25 Q. And what does that represent?

1 MR. HALL: Objection, form.

2 A. That represents the component
3 that's -- of that -- that vessel that's
4 horizontal in the horizontal plane, or the
5 areas in the horizontal plane.

6 BY MR. KESACK:

7 Q. And why is that important?

8 A. Because that's the area that's
9 available for settling or part of the area
10 that's available for settling.

11 Q. And in Davis and in this figure
12 specifically, what do you mean when you say
13 "area available for settling"?

14 A. I mean the bottom of the vessel or
15 the structure.

16 Q. So if there were no wall on this
17 tube, would there be an area available for
18 settling on B prime?

19 A. No.

20 MR. HALL: Objection, form.

21 BY MR. KESACK:

22 Q. All right. And let's go to page 19
23 of your declaration. One more question about
24 that figure.

25 B prime is part of the equation of

1 the equation 4.1, right?

2 A. Well, it's one of the components of
3 that equation.

4 Q. Okay.

5 A. There's a cosign of the angle in the
6 4. -- 4-1 equation, just broken it into two
7 separate components just for the ease of
8 explanation.

9 Q. So in your opinion, is equation 4-1
10 relying on B prime as part of the settling
11 efficiency?

12 MR. HALL: Objection, scope.

13 A. Yes.

14 BY MR. KESACK:

15 Q. And let's go to paragraph 33,
16 specifically on page 19. So the first sentence
17 on this page talks about what's required in
18 order for the vessel to operate properly.

19 Do you remember testifying about
20 this?

21 A. The first -- I'm sorry.

22 Q. The first sentence on page 19 --

23 A. Yes.

24 Q. -- talks about what's required for
25 the '256 patent to operate properly?

1 A. Yes.

2 Q. And you testified that in order for
3 it to operate properly, there would need to be
4 both sand removal and gas and liquid being
5 removed.

6 Do you remember that?

7 MR. HALL: Objection, form.

8 A. Yes.

9 BY MR. KESACK:

10 Q. Would the vessel be operating
11 properly if it was only achieving one of those
12 two purposes?

13 A. No.

14 Q. Let's go to the '256 patent, column
15 7, Claim 1.

16 A. Column 7?

17 Q. Uh-huh. Can you see Claim 1?

18 A. Yes.

19 Q. Is it your understanding that Claim
20 1 requires each of the limitations of Claim 1
21 in order to meet the claim itself?

22 A. Yes.

23 Q. And is the gas/liquid interface
24 being at the outlet a requirement of Claim 1?

25 MR. HALL: Objection, scope.

1 A. Yes.

2 BY MR. KESACK:

3 Q. Where is that?

4 A. It talks about that on line 50 --
5 let's see, I guess 58. A gas/liquid interface
6 formed at the fluid outlet.

7 Q. So is it your opinion that a
8 gas/liquid interface formed at the fluid outlet
9 is a requirement of Claim 1?

10 MR. HALL: Objection, form.

11 A. Yes.

12 MR. KESACK: That's all.

13 FURTHER EXAMINATION

14 BY MR. HALL:

15 Q. Redirect or cross. Sorry. If you
16 look at paragraph 23 in which your counsel
17 asked you about, this is paragraph 23 of your
18 declaration, page 9 -- actually, page 9 to 10.
19 Actually, page 10 to 11. Go to page 10.

20 So Mr. Kesack asked you about this
21 last sentence just now. You said that there
22 would be -- and I'm -- I don't remember exactly
23 what you -- how you phrased it, but you said
24 that this -- referring to the '256 patent
25 desander, there would be some liquid movement

1 in the belly portion of the vessel.

2 Do you recall that?

3 A. Yes.

4 Q. Is that -- is that accurate what

5 I -- the way I just phrased that?

6 A. Well, what I'm trying to describe
7 here is that at the inlet, you would have
8 liquid below and you would have a freeboard
9 with gas and that's got a cross-sectional area.
10 The liquid is an incompressible fluid, for all
11 practical purposes, and so the expansion volume
12 available is that cross-sectional area above
13 the fluid. But I'm not saying that that fluid
14 is completely quiescent, but neither am I
15 saying it's flowing in the same way that the
16 fluid is moving in that freeboard area.

17 Q. Understood. So previously you and
18 I -- or I had asked you some questions about
19 the horizontal velocity in the belly portion,
20 right?

21 A. Correct.

22 Q. I'm just wanting to understand.
23 You're not changing your testimony. You're
24 still -- it's still your testimony that there
25 is a liquid velocity in the belly portion of

1 the vessel?

2 A. Well, again, it depends on where
3 you're at in the belly portion --

4 Q. Understood.

5 A. -- both vertically and horizontally.

6 Q. And that's the velocity profile
7 we've talked about?

8 A. Correct. And the majority of that I
9 would assume would be at -- close to the outlet
10 and it -- just at the interface.

11 Q. So below that and away from the
12 outlet, there's little or zero horizontal
13 velocity in the belly portion?

14 A. I would assume that there's some
15 movement of fluid. You got several different
16 things going on, so you've got the fluid stream
17 coming in from the inlet. It's -- and you've
18 got particles arcing down and hitting the
19 fluid. So there's going to be movement there.
20 So I don't know if that's quote, unquote float,
21 but it's going to be movement of fluid.

22 Q. Okay.

23 A. And then you've got fluid that's
24 actually moving out of the vessel, which is
25 being pulled off at the -- at the outlet,

1 but -- so you don't have a completely
2 homogenous velocity profile vertically or
3 horizontally along the vessel, but you do have
4 some parts of the fluid that's moving and some
5 parts of the fluid that's not moving.

6 Q. Does that same discussion apply to
7 the Hemstock desander?

8 A. Yes.

9 Q. So it's fair to say that in the
10 belly portion of the vessel, there are some
11 portions of it which are turbulent flow regime
12 and some portions of it which are laminar flow
13 regime and some portions of it which are
14 quiescent?

15 MR. KESACK: Objection, scope.

16 A. Correct. But I would say that where
17 you've got an impact of fluid and particulates
18 impacting the interface that you're going to
19 have turbulent flow in that area.

20 BY MR. HALL:

21 Q. Okay. Go to paragraph 98. This is
22 the -- on page 57. You see Figure 3 there?

23 A. Yes.

24 Q. And you just testified when
25 Mr. Kesack was questioning you that this figure

1 informs you as to where sand is going to be
2 settling in the Hemstock vessel; is that
3 accurate?

4 A. Yes.

5 Q. Would you expect the sand to settle
6 in the same place every time the Hemstock
7 desander is operated?

8 MR. KESACK: Objection, form.

9 A. Well, generally speaking, I would
10 expect it to be in this -- in this region
11 that's being shown here. I can't say whether
12 it would be exactly at that spot.

13 BY MR. HALL:

14 Q. Isn't that dependent on operating
15 variables like the particulate size, the fluid
16 composition, viscosity?

17 A. Well, it might -- I don't really see
18 a scenario where it's going to vary
19 appreciably. It's -- the fluid stream is
20 entering on the inlet and it's coming out of
21 the nozzle or the -- into the vessel. It's
22 going to have some trajectory where the liquid
23 and the particles are falling down, so -- and
24 then over -- as the -- as it fills up,
25 that's -- this cross-sectional area is

1 changing, so the velocity might be changing in
2 that upper section. But I still think it would
3 be relatively, you know, close to this -- this
4 simple diagram in most situations.

5 Q. But not all?

6 A. I can't say for sure.

7 Q. Okay.

8 MR. HALL: No further questions.

9 MR. KESACK: Thank you very much.

10 (Deposition concluded at 2:44 p.m.)

1 CORRECTIONS AND SIGNATURE

2 PAGE LINE CORRECTION REASON FOR CHANGE

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12 I, HAROLD E. McGOWEN III, have read
13 the foregoing deposition and hereby affix my
14 signature that same is true and correct, except
15 as noted herein.

16
17 _____
18 HAROLD E. McGOWEN III
19 SUBSCRIBED AND SWORN to before me this the
20 _____ day of _____, 2019.

21
22 _____
23 NOTARY PUBLIC IN AND FOR THE
STATE OF TEXAS

24 My commission expires: _____
25 Job No. 25693

1 COUNTY OF DALLAS)

2 STATE OF TEXAS)

3 I, Daniel J. Skur, Certified
4 Shorthand Reporter and Notary Public in and for
5 the State of Texas, do hereby certify that the
6 facts as stated by me in the caption hereto are
7 true; that there came before me the
8 aforementioned named person, who was by me duly
9 sworn to testify the truth concerning the
10 matters in controversy in this cause; and that
11 the examination was reduced to writing by
12 computer transcription under my supervision;
13 that the deposition is a true record of the
14 testimony given by the witness.

15 I further certify that I am neither
16 attorney or counsel for, nor related to or
17 employed by, any of the parties to the action
18 in which this deposition is taken, and further
19 that I am not a relative or employee of any
20 attorney or counsel employed by the parties
21 hereto, or financially interested in the
22 action.

23 I further certify that pursuant to
24 Rule 30 of the Federal Rules of Civil
25 Procedure, signature of the witness was not
reserved by the witness or other party before
the conclusion of the deposition;

Given under my hand and seal of
office on this, the _____ day of August, A.D.,
2019.

22 Daniel J. Skur
23 Notary Public, State of Texas
24 My Commission Expires 7/7/2022
25

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