

In the Matter of:

Arkema France
vs.
Honeywell International

Robert D. Lousenberg, Ph.D.

April 14, 2016



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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARKEMA FRANCE,

Petitioner

v.

HONEYWELL INTERNATIONAL, INC.,

Patent Owner

Trial No. IPR2015-00915
Trial No. IPR2015-00916
Trial No. IPR2015-00917
U.S. Patent No. 8,710,282

VIDEOTAPED DEPOSITION OF
ROBERT D. LOUSENBERG, Ph.D.
April 14, 2016

1 Videotaped Deposition taken of ROBERT D.
2 LOUSENBERG, Ph.D., before CINDY A. HAYDEN, RMR-CRR,
3 and Notary Public, pursuant to the Rules of the
4 United States Patent and Trademark Office, on the
5 14th of April, 2016, at the offices of Alston &
6 Bird, Bank of America Plaza, 101 South Tryon
7 Street, Suite 4000, Charlotte, North Carolina,
8 commencing at 12:04 p.m.

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Also Present: Ernie Magness, Videographer
Joshua Ney (Via telephone)

I N D E X

PAGE

EXAMINATION BY MR. BAUM

7

PREVIOUSLY MARKED EXHIBITS

NUMBER	DESCRIPTION	PAGE
EXHIBIT 1001	U.S. Patent Number 8,710,282	85
EXHIBIT 1002	Declaration of Leo E. Manzer, Ph.D.	38
EXHIBIT 1003	International Publication No. WO 2009/138764 A1	119
EXHIBIT 1005	English translation of Publication Number 2,940,968	
EXHIBIT 2029	Invention Disclosure: H0024680 - Integrated Continuous Process for dehydrofluorination of 236ea and 245eb	126

NEWLY MARKED EXHIBITS

NUMBER	DESCRIPTION	PAGE
EXHIBIT 1021	Document titled Fluoroolefins - Note 1. Cis and trans 1,2,3,3,3- pentafluoropripylene	156
EXHIBIT 1022	Original Italian version of document titled Fluoroolefins - Note 1. Cis and trans 1,2,3,3,3- pentafluoropripylene	156

1 EXHIBIT 1023 Certification of Translation 156

2
3 (All Exhibits were attached to the transcript
4 accept Exhibit 1002 which was referred to but
5 not attached to the transcript.)
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1 P R O C E E D I N G S

2 * * *

3 THE VIDEOGRAPHER: Okay. We're now on
4 the record. Today's date is April 14th, 2016. The
5 time is 12:04 p.m. This is the video deposition of
6 Mr. Robert Morris taken by counsel for the
7 petitioner --

8 MR. BAUM: That's the wrong -- wrong
9 deposition.

10 THE VIDEOGRAPHER: Off the record.
11 (Off-the-record conference.)

12 THE VIDEOGRAPHER: Okay. We're now
13 going back on the record. Today's date is
14 April 14th, 2016. The time is 12:05 p.m. This is
15 the video deposition of Mr. Robert D. Lousenberg,
16 Ph.D., taken by the counsel for the petitioner.
17 The location is Alston & Bird at Bank of America
18 Building, 101 South Tryon Street, Charlotte, North
19 Carolina.

20 My name is Ernie Magness, legal
21 videographer, representing Merrill Corp., Chicago,
22 Illinois. This is -- deposition is taken in the
23 matter of Arkema France, Petitioner, versus
24 Honeywell International, Incorporated, Trial Number
25 IPR2015-00915, 00916, and 00917, U.S. Patent Number

1 8,710,282. Case number is CH 080661 [sic].

2 Counsel, please introduce yourselves
3 for the record.

4 MR. BAUM: My name is Allen Baum. I'm
5 representing Petitioner Arkema. Along with me are
6 Jon Beaupre, Allyn Elliott, and we have Joshua Ney
7 on the phone.

8 MR. ROSE: Good afternoon. My name is
9 Bruce Rose with Alston & Bird on behalf of the
10 patent owner, and with me is my colleague,
11 Christopher Douglas.

12 THE VIDEOGRAPHER: And would the court
13 reporter please swear in the witness.

14 * * *

15 ROBERT D. LOUSENBERG, Ph.D.
16 being first duly sworn, testified as follows:

17 * * *

18 EXAMINATION

19 BY MR. BAUM:

20 Q. Okay. We're back on the record. Good
21 morning, Dr. Lousenberg.

22 A. Good morning.

23 Q. Good afternoon. Am I pronouncing your
24 name correctly?

25 A. Lousenberg.

1 Q. Okay. Dr. Lousenberg, would you please
2 state your full name for the record.

3 A. My full name is Robert Daniel
4 Lousenberg.

5 Q. And what is your address?

6 A. My address is 2103 Anson Road,
7 Wilmington, Delaware.

8 Q. Is there any reason that you cannot
9 give complete and accurate testimony this
10 afternoon?

11 A. No.

12 Q. Are you under the influence of any
13 alcohol or drugs of any kind that would influence
14 your testimony in any way?

15 A. No.

16 Q. The deposition is essentially a
17 question-and-answer session. I'll ask you
18 questions, and you'll need to give me verbal
19 answers; do you understand that?

20 A. Yes.

21 Q. If there's a question that you don't
22 understand, will you ask me to clarify or rephrase
23 it if you need me to do so?

24 A. Yes.

25 Q. Also, if you let me complete my

1 question before you answer, that will result in a
2 cleaner record; do you understand that?

3 A. Yes.

4 Q. And also it's important that you speak
5 clearly and audibly so that the court reporter can
6 pick up on your testimony; do you understand that?

7 A. Yes, I do.

8 Q. If you answer a question and you cannot
9 understand it, please ask if you need to have the
10 question clarified, okay?

11 A. Okay.

12 Q. If you do answer a question and it can
13 be understood -- excuse me. Let me rephrase.

14 If you answer a question, can it be
15 understood that you heard and understood the
16 question that you're answering and that you're
17 answering it to the best of your recollection?

18 A. Sorry. Could you repeat that?

19 Q. If you answer a question, can it be
20 understood that you heard and understood the
21 question and that you answered it to the best of
22 your recollection?

23 A. Yes.

24 Q. Do you understand that you're appearing
25 here pursuant to some deposition notices?

1 MR. BAUM: I'm going to place before
2 the witness deposition notices for the deposition
3 of Robert Lousenberg in IPR2015-915, 2015-916 and
4 2015-917.

5 BY MR. BAUM:

6 Q. Do you -- do you understand that you're
7 here responsive to these notices of deposition?

8 A. Yes, I do.

9 Q. Have you ever been -- have you ever
10 been deposed before?

11 A. No.

12 Q. Have you ever given trial testimony
13 before?

14 A. No.

15 Q. Okay. I'm going to go through some
16 nomenclature, and we'll do this slowly for the
17 court reporter. So please bear with me.

18 So you understand that 236 is or refers
19 to 1,1,1,2,3,3-hexafluoropropane, and when I
20 mention 236, you will understand that to mean
21 236ea?

22 A. Yes.

23 Q. You understand that 245eb is
24 1,1,1,2,3-pentafluoropropane, and when I mention
25 245, you'll understand that to mean 245eb?

1 A. Yes.

2 Q. You understand that 1225ye is
3 1,1,1,2,3-pentafluoropropene, and when I mention
4 1225, you will understand that to mean 1225ye?

5 A. I understand that, but the nomenclature
6 is wrong.

7 Q. Okay. Would you --

8 A. Yes. It should be numbered from --
9 from the double bond. The lowest number should be
10 from the double bond.

11 Q. Okay. So then what do you understand
12 1225ye refers to?

13 A. That would be
14 1,2,3,3,3-pentafluoropropene.

15 Q. You understand that 1234yf is
16 1,1,1,2-tetrafluoropropene, and when I mention
17 1234, you'll understand that to mean 1234yf?

18 A. I do, and again it's numbered
19 incorrectly.

20 Q. So please tell us the correct
21 numbering.

22 A. 2,3,3,3-tetrafluoropropene.

23 Q. And you understand that KF refers to
24 potassium fluoride?

25 A. Yes.

1 Q. You understand that KOH refers to
2 potassium hydroxide?

3 A. Yes.

4 Q. You understand that lime is calcium
5 hydroxide?

6 A. Yes.

7 Q. You understand that slaked lime is also
8 calcium hydroxide?

9 A. Yes.

10 Q. You understand that DHF stands for
11 dehydrofluorination?

12 A. Sorry?

13 Q. You understand that DHF stands for
14 dehydrofluorination?

15 A. I do now.

16 Q. You understand that DHA is
17 dehydrohalogenating agent?

18 A. Yes.

19 Q. You understand that CSTR stands for a
20 continuously stirred tank reactor?

21 A. Yes, I do.

22 Q. You understand that HFO refers to
23 hydrofluoroolefin?

24 A. Yes.

25 Q. And you understand that HFC refers to

1 hydrofluorocarbon?

2 A. Yes.

3 Q. Okay. Great. So when were you first
4 hired to work on this matter?

5 A. I was hired, I believe, in early
6 November.

7 Q. And how many hours have you devoted to
8 working on this matter so far?

9 A. I am going from memory, and I would
10 have to say it would -- it's somewhere between 60
11 and 80 so far, not including this week.

12 Q. And then how many hours do you think
13 you've spent on this matter this week?

14 A. More than 20.

15 Q. What are you being paid for your work
16 per hour in this case?

17 MR. ROSE: You can answer.

18 THE WITNESS: \$250 per hour.

19 BY MR. BAUM:

20 Q. Okay. Is that your normal rate?

21 A. Yes.

22 Q. What's the total amount that you've
23 billed so far in this matter?

24 A. Approximately 25,000.

25 Q. Have you served as a consultant for

1 Honeywell before?

2 A. No.

3 Q. How about for Alston & Bird?

4 A. No.

5 Q. For any other law firms?

6 A. No.

7 Q. When did you first become engaged --
8 you've already answered that. New question.

9 So you said you started, you believe,
10 in November. How did they hire you? Did they give
11 you a phone call?

12 A. I was hired through Intelligent
13 Management Services, and Alston & Bird retained
14 Intelligent Management Services. So I actually
15 invoice them, and they invoice Alston & Bird.

16 Q. Okay. And what were you asked in the
17 first discussion that you had with Alston & Bird?

18 A. If I was aware of the '282 patent.

19 Q. What did you tell them?

20 A. Yes, I had.

21 Q. And what was your -- the source of your
22 prior knowledge of the '282 patent?

23 A. I had heard that there -- from a
24 colleague at Dupont that they were looking for an
25 expert witness in what he believed was litigation

1 between Arkema and Honeywell, and I had also
2 received an e-mail from IMS, which, I believe, they
3 were able to contact me through my LinkedIn
4 information.

5 Q. And who --

6 A. And based on that -- and I -- I knew --
7 I knew some -- I knew some -- I was aware of some
8 of Honeywell's patents from being in Dupont. So
9 I -- I surmised that it was the '282 patent.

10 Q. Okay. So you had enough familiarity
11 with the subject matter that you knew -- you were
12 able to identify the patent before someone -- that
13 was the subject of this case before somebody told
14 you what the patent --

15 A. Right.

16 Q. -- number was?

17 A. Right.

18 Q. Okay. And who was the colleague that
19 referred -- the former colleague at Dupont that
20 referred you?

21 A. I can't remember his name offhand.

22 Q. Okay. Do you remember having any
23 impressions when you first saw the '282 patent
24 while you were at Dupont of the patent?

25 A. Well, not really strong impressions. I

1 knew that they had filed an integrated process
2 patent, and without being familiar with patent law,
3 I -- I didn't really see what the initial invention
4 was, so that -- that was my initial thing, well,
5 what is the invention here.

6 Until I started to go through it and
7 understand a little bit about patent law, how
8 claims are formulated in terms of independent or
9 dependent and independent claims, I didn't -- I
10 wasn't -- I wasn't sure how -- how it was a patent,
11 but as I got more into it, I can -- I -- I could
12 see how it would have been issued.

13 Q. So you took a look at the patent while
14 you were at Dupont, and your first impression was
15 that -- how could this be patentable; is that --

16 A. Right.

17 Q. -- right?

18 MR. ROSE: Objection to form.
19 Mischaracterizes.

20 BY MR. BAUM:

21 Q. Excuse me. Answer the question,
22 please.

23 A. Could you restate?

24 Q. So you took a look at the patent while
25 you were at Dupont, and your first impression was

1 how could this be patentable; is that right?

2 MR. ROSE: Objection to form.

3 You may answer if you can.

4 THE WITNESS: Okay. Yes. Yes. I
5 didn't understand enough about it to -- to see that
6 and -- and I know that Dupont had started to do
7 that, too, so it -- it -- it really -- it was a new
8 area that I wasn't familiar with how these were now
9 patents.

10 BY MR. BAUM:

11 Q. Okay. So when you say Dupont had
12 started to do that, too, are you referring to the
13 process that's described in the --

14 A. Yeah.

15 Q. -- '282 patent?

16 A. Filing integrated process patents.

17 Q. Okay. And patents on integrated
18 process patents, it was surprising for you to see
19 companies filing on these --

20 A. Well --

21 Q. -- processes?

22 A. Well, I didn't realize that in order to
23 be obvious all of the limitations in a claim had to
24 be disclosed in prior art. And when you read the
25 '282 patent, it's not obvious that all of the

1 limitations in the claims are disclosed in the
2 prior art.

3 Q. So it was really through your
4 involvement with counsel in this case that you came
5 to the understanding that -- or your belief that
6 the subject matter claimed in the '282 patent is
7 patentable?

8 A. Definitely.

9 MR. ROSE: Objection to form.

10 BY MR. BAUM:

11 Q. Okay. But when you were at Dupont you
12 felt that -- you were --

13 A. Well, I didn't -- I didn't have an
14 opinion one way or the other. I just didn't know.

15 Q. But your initial reaction, as a
16 scientist, was how can this be patentable? That's
17 what you testified to before?

18 A. Yes. Yes. I didn't know.

19 Q. Okay. So you said this week you've
20 worked about 20 hours on this case. Has that been
21 time spent with your attorneys getting ready for
22 this --

23 A. I --

24 Q. -- deposition?

25 MR. ROSE: Objection. We're not his

1 attorneys. We are Honeywell's attorney.

2 BY MR. BAUM:

3 Q. Let me rephrase, so --

4 A. Let -- let me --

5 Q. Yeah.

6 A. I've worked -- I've -- I had two days
7 of deposition preposition -- preparation this week,
8 Tuesday and Wednesday, and that was between eight
9 and nine hours a day, so there's maybe 20 hours
10 there, and now there's today.

11 Q. Okay. All right. So you provided a CV
12 along with your expert report?

13 A. Yes.

14 Q. Is it correct that you don't have a
15 degree in chemical engineering?

16 A. That's correct.

17 Q. But you have a fair amount of
18 experience with designing chemical processes?

19 A. That is correct.

20 Q. Did you take any chemical engineering
21 courses in college or graduate school?

22 A. Yes, actually. In graduate school my
23 supervisor was cross-appointed in both chemistry
24 and in chemical engineering, so some of my graduate
25 polymer courses were taught in chemical

1 engineering.

2 Q. Okay. So these are polymer courses
3 that you took that were offered through the school
4 of engineering --

5 A. Yes.

6 Q. -- is that correct?

7 Okay. And did you have any courses,
8 other than those courses in polymers, that were
9 offered through the chemical engineering school?

10 A. Not that I recall.

11 Q. Did you take any classes that taught
12 you how to perform separations in -- in chemical
13 processes?

14 A. No. All -- all of -- all of my
15 experience in that has come from working at Dupont.

16 Q. Okay. And your CV says that your title
17 at both Dupont and Chemours was principal
18 investigator.

19 Can you describe what years you had
20 that title?

21 A. I was promoted to principal
22 investigator, I believe, in 2010.

23 Q. And can you describe your
24 responsibilities as a principal investigator?

25 A. I was overseeing, and also conducting,

1 the research in a research lab. So I was
2 overseeing the research of a technician that
3 reported to me.

4 Q. Okay. And what did that technician do?

5 A. He did a lot of the hands-on
6 experimentation and maintenance and -- and keeping
7 the lab functional.

8 Q. Okay. So can you describe what was in
9 that lab that he was responsible for?

10 A. Running our CSTR, running our
11 continuous distillation columns, doing analysis of
12 materials by gas chromatography and other methods
13 such as Karl Fischer. I don't think we had an
14 FTIR, but -- yeah.

15 Q. Okay. All right. So your technician
16 that you're responsible for overseeing is -- is
17 running a CSTR along with a continuous distillation
18 column. As I have understood your testimony, then,
19 there was analysis of the material that was
20 generated in the CSTR?

21 A. Right.

22 Q. That analysis could include GC
23 analysis?

24 A. Right.

25 Q. Karl Fischer?

1 A. Right.

2 Q. Tropes analysis?

3 A. Other -- other wet chemical techniques,
4 analytical -- analytical techniques that were
5 gravimetric in nature.

6 Q. Did you, during your tenure as
7 principal investigator at either Chemours or
8 Dupont, have any separations occurring in your lab?

9 A. Can you be more specific? Separations?

10 Q. Well, let's -- let's begin again.

11 So you had indicated before that you
12 were running a CSTR?

13 A. Right.

14 Q. You were analyzing --

15 A. Okay.

16 Q. -- what was coming off the distillation
17 column. So --

18 A. I think I understand. In conjunction
19 with our CSTR we also ran continuous decanters
20 where we would get phase separation of organic and
21 aqueous phases.

22 Q. Any other type of separators?

23 A. Just distillation, if you include it in
24 that.

25 Q. Okay. So during your time at Dupont,

1 the only types of separators that you were working
2 on in your lab included continuous decanters and
3 continuous distillation columns; is that correct?

4 A. That was the major types of separations
5 that we did. Did we do any separations like by say
6 crystallization? Maybe, but it wasn't a focus of
7 what we did on a -- on the day-to-day basis.

8 Q. Okay. When was your first experience
9 in manufacturing HFOs?

10 A. My first experience in synthesizing, if
11 that -- if I can equate that to the same thing,
12 would have been in 2007.

13 Q. So while you were at Dupont, did you
14 ever have any experience designing a process for
15 synthesizing hydrofluoroolefins?

16 A. Hydrofluoroolefins specifically, no,
17 but other hydrofluoroolefin ethers, yes.

18 Q. So your -- your CV states you were
19 "Directly involved in the synthesis,
20 characterization and commercial process development
21 of next generation nonflammable, non-ozone
22 depleting and low global-warming potential
23 refrigerants and specialty solvents."

24 A. Right.

25 Q. Which refrigerants were you involved

1 with?

2 A. 1234yf.

3 Q. Okay. Which solvents?

4 A. HFX-110.

5 Q. Your CV states you "spearheaded the
6 development of new synthetic processes to
7 intermediates for 1234yf production."

8 A. Right.

9 Q. Can you explain what that means?

10 A. We -- we looked at alternative routes
11 to 1234yf starting with chlorocarbons. And one of
12 my job assignments was to look at new methods of
13 vapor phase production of certain chlorocarbon
14 intermediates.

15 Q. So you do have experience designing
16 chemical processes --

17 A. Well --

18 Q. -- that include 1234?

19 A. Chemical -- well, in that case I was
20 thinking a chemical step, but yes, that -- in those
21 terms, yes.

22 Q. Right. Okay. So I'm interested in
23 learning a little bit about the design process.
24 How does this work? I assume you start with a
25 reaction in mind that you want to --

1 A. Right.

2 Q. -- conduct?

3 A. Right.

4 Q. Would that be a reaction that occurs in
5 a CSTR in the context of the work you were doing in
6 your lab?

7 A. In one assignment, yes. In terms of
8 HFOs, that was more -- more batch process at that
9 point, and then we took certain aspects of those
10 reactions and developed them into vapor phase
11 continuous reactions, so not a CSTR, but a
12 continuous flow through vapor phase reactor.

13 Q. Did you ever have any experience while
14 you were at Dupont or Chemours where you were
15 conducting reactions in a CSTR that contained a
16 liquid?

17 A. Yes.

18 Q. Okay. Can you describe generally what
19 that process entailed?

20 A. Sure. The -- the process to make
21 HFX-110 takes a -- a fluoroolefin, a
22 perfluoroolefin, perfluoroheptene, and reacts that
23 in a heterogeneous -- heterogeneous liquid full
24 CSTR reactor setup with an aqueous phase containing
25 a caustic and methanol.

1 In that case, it's not a
2 dehydrohalogenation we're doing, but a nucleophilic
3 substitution fluoride elimination reaction.

4 Q. Okay. Is that the chemistry that's
5 described in a patent at issue bearing your name as
6 an inventor, the 8,592,630 patent?

7 A. Can you read off the title please?

8 Q. It's Process for Separating Components
9 in Alkyl Perfluoroalkene Ether Production.

10 A. Yes. Yes, that is the -- the
11 continuous process of making HFX-110 in a CSTR with
12 a continuous decanter through -- through a
13 continuous distillation train.

14 Q. Okay. And was KF a by-product of that
15 process?

16 A. Yes.

17 Q. And so, you were running this process
18 in the CSTR in your lab?

19 A. Yes.

20 Q. Tell me what was on the input side of
21 the reactor from a -- a flow standpoint?

22 A. All right. We had three inputs that
23 were liquid. One was potassium hydroxide. The
24 next was the organic feed, and the third was
25 methanol or a mixture of methanol and water, and

1 that was because this process was implemented in
2 Japan commercially, and there they have
3 flammability issues dealing with pure methanol. So
4 we had to also work with mixtures of methanol and
5 water.

6 Q. Okay. And then what was -- what were
7 the outputs from that reactor? What was coming out
8 of the reactor?

9 A. The output was an entrained organic
10 phase containing unreacted perfluoroheptene and
11 product HFX-110, and aqueous -- and an aqueous
12 phase containing KOH and KF. There was also a
13 catalyst involved as a small amount. That was
14 co-fed with the methanol stream.

15 Q. That was a phase-transfer catalyst?

16 A. Yes.

17 Q. The KOH and KF that were in the reactor
18 as part of that process, you didn't try to separate
19 those in the reactor, correct?

20 A. No. Sorry -- separate KF and KOH in
21 the reactor or --

22 Q. Yes.

23 A. -- separate the -- the aqueous mixture
24 of KOH and KF from the organic in the reactor.

25 Q. Well, let's start with the KF and the

1 KOH.

2 A. Okay.

3 Q. Did you try to separate those in the
4 reactor?

5 A. I don't know how you could do that.

6 Q. It's impossible to separate KF and KOH?

7 A. As far as I'm aware.

8 Q. So you also said that the output
9 included -- let me begin again.

10 You also said that the output from that
11 reactor included an entrained organic phase
12 containing unreactive fluoroheptane and product
13 HFX-110?

14 A. Yes.

15 Q. Did you do anything to try to recover
16 that entrained organic?

17 A. Well, yes, that is the product with the
18 perfluoroheptene, so that it went into the
19 continuous decanter --

20 Q. Okay.

21 A. -- where the -- the entrained organic
22 perfluoroheptene product would be taken off the
23 bottom.

24 Q. Okay. And what else were you -- so --
25 so you were separating out the -- the entrained

1 organic?

2 A. Right. We were separating the
3 entrained organic from the aqueous phase, and one
4 of the nonobvious aspects of the invention is the
5 fact that we got a third phase that was a mixture
6 of methanol, water, and our catalyst, which we
7 could then recover as a phase that we didn't -- we
8 had to do very minimal purification to send it back
9 into the reactor.

10 Q. Okay. So it sounds like it's desirable
11 to recover and reuse reactants wherever you can?

12 A. Well, in the case of the catalyst,
13 Japan has very strict laws on how you can dispose
14 of quaternary ammonium salts. They have --

15 THE REPORTER: I'm sorry?

16 THE WITNESS: Quaternary ammonium
17 salts.

18 They -- they -- as the process is
19 implemented now, we don't return it to the process,
20 because the overall process is not that big. It --
21 we recovered it so that we could dispose of the
22 aqueous waste and not have issues with
23 environmental disposal.

24 BY MR. BAUM:

25 Q. And then -- so what did you do with the

1 aqueous component?

2 A. The aqueous component, as far as I'm
3 aware, was sent to a waste-handling company.

4 Q. Okay. Now, in a full-scale commercial
5 process, is that a reasonable design solution, to
6 send it to a -- a waste handler?

7 MR. ROSE: Objection to form.

8 BY MR. BAUM:

9 Q. And I'm referring to the aqueous
10 component.

11 A. Well -- well, in the aqueous component
12 we had -- the majority of it was actually potassium
13 fluoride. The -- my Japanese colleagues looked at
14 several options, and one of those options was to
15 actually sell that waste and recover value from it.

16 Q. Were there other options that were
17 considered?

18 A. They did consider a recycle, such as
19 outlined in the '282 patent, but the capital
20 investment costs, or the overall project economic
21 cost, did not justify it. It would have -- it
22 would have exceeded the budget for that product,
23 plus the expected revenue from it.

24 Q. And so the process that you're
25 referring to in the '282 patent is converting KF to

1 KOH?

2 A. And -- and -- and calcium.

3 Q. Calcium fluoride.

4 A. Right.

5 Q. So that would have been -- let me begin
6 again.

7 So there -- there were several
8 alternatives. One was to sell it to a third party?

9 A. Right.

10 Q. Another was to have it incinerated or
11 disposed?

12 A. I -- I don't know. I don't know how
13 the waste handler actually --

14 Q. Okay.

15 A. -- does that, deals with it.

16 Q. But one option was to turn it over to
17 waste handlers, so --

18 A. Yes.

19 Q. So, so far we have two options. Give
20 it to the waste handler --

21 A. Right.

22 Q. -- or selling it to a third party?

23 A. Right. Or -- or recycling it for KOH,
24 but, again, the -- the project economics weren't
25 justified.

1 Q. Okay. So from a design standpoint,
2 recycling KF to KOH and calcium fluoride is a
3 reasonable design alternative; is that correct?

4 MR. ROSE: Objection to form.

5 THE WITNESS: Well, again, what is
6 reasonable? It really depends on the overall
7 project economics. KF, if you look at prices of KF
8 and KOH, if you have a fairly high concentration KF
9 stream, you can recover a lot of value from that.
10 In fact, KF and KOH prices in Alibaba are very
11 similar.

12 BY MR. BAUM:

13 Q. So you mentioned before that the
14 aqueous stream that you were taking out of the
15 reactor included both KOH and KF?

16 A. There was KOH there --

17 Q. So --

18 A. -- but it was a minor fraction of the
19 overall salt component in that aqueous stream.

20 Q. And it was -- you say it was a minor
21 component?

22 A. Yeah.

23 Q. Is -- is --

24 A. Less than 10 percent.

25 Q. Is that because you had run the

1 reaction to 90 percent conversion or better?

2 A. Yes, we tended to run with an excess of
3 organic. So we consumed up our KOH and a slight
4 excess of methanol over KOH.

5 Q. So even when you were at a rate of
6 conversion over 90 percent, you were still
7 withdrawing unreacted KOH from that CSTR reactor?

8 A. There was some unreacted KOH in that
9 stream.

10 Q. So it sounds like you do have fair
11 amount of experience with base mediated
12 dehydrohalogenation; is that correct?

13 A. Yes.

14 Q. And the dehydrohalogenating agent that
15 you mentioned before was not KOH; is that correct?
16 Or was it KOH?

17 A. It was KOH.

18 Q. Okay. Could you describe to me what
19 you -- your understanding of the continuous process
20 is?

21 A. Sure. I guess in a -- in a simple
22 definition, a continuous process has constant
23 inputs and constant outputs with something
24 happening in between.

25 Q. And what are those constant inputs?

1 A. Yes.

2 Q. Do you need a membrane to separate a
3 gas from a liquid?

4 MR. ROSE: Objection to form.

5 You may answer if you can.

6 THE WITNESS: To separate a gas from --
7 not necessarily, but you can.

8 BY MR. BAUM:

9 Q. How do you separate a gas from a
10 liquid?

11 A. Pervaporation is the technique.
12 Basically to dissolve gas in the liquid will --
13 will -- will permeate across the membrane and
14 evaporate on the other side.

15 Q. And what are the various ways to
16 separate a liquid from another liquid?

17 A. Distillation, phase separation, to name
18 two.

19 Q. So is distillation a form of phase
20 separation?

21 MR. ROSE: Objection to form.

22 THE WITNESS: I would say no. It's
23 very uncommon to be distilling two immiscible
24 liquids, but let me -- I haven't looked at it that
25 way in the past.

1 BY MR. BAUM:

2 Q. Okay. What types of equipment would
3 one typically use to achieve phase separation?

4 A. A decanter.

5 Q. Anything else?

6 A. Well, on a -- on a batch scale you
7 might use a separatory funnel.

8 Q. Okay. So you've submitted a
9 declaration in each one of these IPRs. You
10 understand there are three IPRs?

11 A. Yes.

12 Q. Okay. Did you draft those
13 declarations?

14 A. I drafted -- I was involved in the
15 drafting with counsel at Alston & Bird.

16 Q. So when you say you were "Involved with
17 drafting with counsel at Alston & Bird," how did
18 that work?

19 A. We would -- we got together, and we
20 went -- we -- we -- we formulated a strategy and --
21 I'm looking for a concise answer here. We -- we
22 were together. We would discuss the strategy. We
23 would discuss the technical aspects of it. I would
24 input my opinion to the technical aspects of it.
25 The drafts were sent to me, and I would clarify

1 technical aspects, writing in them, and then they
2 were sent back to Alston & Bird until we came up
3 with a final draft.

4 Q. Were these strategies you referenced
5 suggested by your counsel -- by Honeywell's
6 counsel?

7 A. Yes.

8 Q. In your expert reports you list a
9 number of documents that you considered in
10 connection with drafting your report. Were there
11 other documents that you reviewed that are not
12 reflected in the expert reports?

13 A. No.

14 Q. Did you review a copy of Arkema's
15 Petition for Inter Partes Review in any of these
16 IPRs?

17 A. Yes.

18 Q. Okay. That's not listed in your
19 report, is it?

20 A. I believe -- believe it is. Can I see
21 my report, please?

22 Q. Sure.

23 A. Which one -- is there any one in
24 particular?

25 Q. Start with -- why don't we start with

1 2015-915.

2 MR. BAUM: Let's go off the record.

3 THE VIDEOGRAPHER: The time is 12:46
4 p.m. We are now going off the record.

5 * * *

6 (Whereupon, there was a recess in the
7 proceedings from 12:46 p.m. to 12:46 p.m.)

8 * * *

9 THE VIDEOGRAPHER: The time is
10 12:46 p.m. again. And we're now going back on the
11 record.

12 (EXHIBIT 1002, Declaration of Leo E.
13 Manzer, Ph.D., was previously marked for
14 identification.)

15 BY MR. BAUM:

16 Q. So the witness has a copy of
17 Exhibit 1002 in IPR2015-00915. And if you turn to
18 Page 7 or Paragraph 14 of this declaration, you'll
19 see that there are a number of documents listed
20 that were considered by you in preparing the
21 declaration; do you see that?

22 A. That's where I'm looking.

23 Q. Okay. And you had mentioned that the
24 petition was considered, and I see that -- that
25 that is the case. Did you also review any expert

1 reports submitted in this 915 IPR by Dr. Leo
2 Manzer?

3 A. Yes.

4 Q. And is that reflected as something you
5 reviewed in your report?

6 A. I do not see it specifically listed
7 there, but I also note that I disagree with
8 Dr. Manzer's conclusions, so I am thinking that my
9 basis of that is the fact that I am including his
10 in this IPR2015-00915.

11 Q. Okay. But there's no specific
12 reference to Dr. Manzer's declaration in this
13 Paragraph Number 14, is there?

14 A. I -- I don't see it.

15 Q. Okay. Were there any other documents
16 that you considered in preparing the declaration
17 that are not described in Paragraph 14 of your
18 declaration in the 915 case?

19 MR. ROSE: I'll object to the form of
20 the question.

21 THE WITNESS: Yes, I did -- I did look
22 at Sadat, Exhibit 1005 and Smith, but I did not
23 list those in -- no, I did. They're part of the
24 exhibits. Okay. So I would say -- restate the
25 question again, please.

1 BY MR. BAUM:

2 Q. Were any other documents that aren't
3 listed in Paragraph 14 that you considered in --

4 A. I believe not.

5 MR. ROSE: Objection to the form.

6 BY MR. BAUM:

7 Q. If you would let me finish the question
8 first. I understand sometimes it's desirable to
9 jump in.

10 But anyway, to begin again, are there
11 any other documents that you reviewed in preparing
12 the declaration that are not listed in Paragraph
13 14?

14 MR. ROSE: Objection to the form.

15 THE WITNESS: I believe not.

16 BY MR. BAUM:

17 Q. Did you review the prosecution history
18 of the '282 patent in preparing your declaration?

19 A. I do not recall. So I would say no.

20 Q. Do you agree with everything that's
21 stated in your declaration?

22 A. Yes, I do.

23 Q. And is that true for the declarations
24 in the 916 and 917 IPRs?

25 A. Yes.

1 Q. Have you changed any of your opinions
2 since issuing your report in any of the three IPRs?

3 A. No.

4 Q. Are you aware that Honeywell and Dupont
5 have a manufacturing joint venture concerning 1234?

6 A. Yes, I am.

7 Q. Were you involved in any way in that
8 joint manufacturing venture?

9 A. I was not. Honeywell and Dupont set up
10 a firewall and only allowed certain employees to
11 be -- to be privileged to the -- what was going on.
12 I was outside that firewall.

13 Q. Did you have any interaction with
14 anyone at Honeywell while you were at Dupont?

15 A. No.

16 Q. Did you have any interaction with
17 anyone at Honeywell while you were at Chemours?

18 A. No.

19 Q. The firewall that you mentioned before
20 that existed between Dupont and Honeywell, did that
21 stay in place after Chemours was spun out as a
22 separate entity?

23 A. I -- I do not know for the fact that
24 I -- while I transitioned into Chemours I was on
25 roll; I was not required to report to work. So my

1 last day of work was in June, but I was not off the
2 rolls -- Chemours spun from Dupont in July --

3 Q. Okay.

4 A. -- first of July, and I was off the
5 rolls at the end of July. So I technically only
6 had one month with Chemours.

7 Q. Okay. So I think you testified before
8 that you didn't learn about phase separators in
9 college or graduate school; is that correct?

10 A. I learned continuous processes in -- at
11 Dupont.

12 Q. So your experience with regard to phase
13 separators is all practical hands-on experience; is
14 that correct?

15 A. That is correct.

16 Q. Before you defined a continuous process
17 for me. I want to confirm that I understood you
18 correctly. Is a continuous process a mode of
19 carrying out a chemical process in which, once the
20 process has been established, reagents are added to
21 a vessel in which the reaction is occurring and
22 products are simultaneously removed?

23 MR. ROSE: Objection to form.

24 THE WITNESS: Could you repeat that one
25 more time, please?

1 BY MR. BAUM:

2 Q. Is a continuous process accurately
3 described as a mode of carrying out a chemical
4 process in which, once the process has been
5 established, reagents are added to a vessel in
6 which the reaction is occurring and products are
7 simultaneously removed?

8 MR. ROSE: Objection to form.

9 THE WITNESS: Process -- what do you
10 mean by "processes established"?

11 BY MR. BAUM:

12 Q. Well, let's back up.

13 So in a continuous process --

14 A. Right.

15 Q. -- one where you're continuously adding
16 reactants and taking out products and by-products
17 there's a start-up period, correct?

18 A. That is correct.

19 Q. And during that start-up period, what
20 happens?

21 A. You -- you fill the reactor. You start
22 to take off products, but you may not have achieved
23 a steady-state. So are we talking about
24 steady-state?

25 Q. I think that's a good definition for

1 what's meant by once the process has been
2 established.

3 A. Okay.

4 Q. Using your definition of the process,
5 when the process has been established, is it
6 accurate to state that a continuous process is a
7 mode of carrying out a chemical process in which,
8 once the process has been established, reagents are
9 added to a vessel in which the reaction is
10 occurring and products are simultaneously removed?

11 MR. ROSE: Objection --

12 THE WITNESS: Yes.

13 MR. ROSE: -- to form.

14 THE WITNESS: Yes.

15 BY MR. BAUM:

16 Q. Is it fair to state that -- using your
17 definition of what it means that a process has been
18 established, is it correct to state that a
19 continuous process is a mode of carrying out a
20 chemical process in which, once the process has
21 been established, reagents are added to a vessel in
22 which the reaction is occurring and products and
23 by-products are simultaneously removed?

24 MR. ROSE: Objection to form.

25 BY MR. BAUM:

1 Q. You can answer if you can.

2 A. Yes. Yes.

3 Q. So have you had any experience
4 separating vapors from a liquid at Dupont or
5 Chemours?

6 A. What do you mean -- do you mean vapors
7 of the liquid or vapors of something different in
8 the liquid?

9 Q. Let's start with something different in
10 the liquid.

11 A. Yes.

12 Q. And can you describe that experience,
13 please.

14 A. I used a distillation in a
15 semi-continuous mode to feed a mixture into the top
16 of a column, and collect the prod -- product out
17 the bottom while the lighter vapors were taken off
18 the top.

19 Q. Is that a process that can be used --
20 well, let me begin again.

21 Is that a -- a step -- a process step
22 that can be used in a commercial process?

23 A. In -- in -- probably in limited
24 situations, because -- well, if you take product
25 out the bottom, yes, you -- you can do that.

1 In the -- in my -- in my case, what I
2 was doing is I was filling a -- a -- a still pot
3 with the product, and allowing the lower boiling
4 vapors to distil off the top as I -- as I fed into
5 that distillation system.

6 Q. Okay.

7 A. So I was collecting pure high boiling
8 product in the still pot.

9 Q. So if you were trying to separate a
10 organic vapor that was -- well, let me begin again.

11 You said before that if you were taking
12 the product out of the bottom of that distillation
13 column that that is a step that could be used in a
14 commercial process; is that correct?

15 A. Yes. If you're taking it off
16 continuous or semi-continuous, but if you're just
17 filling up a still pot, that's not necessarily
18 desirable for a commercial process unless it -- in
19 which case that -- where the process is trying
20 to -- to make a lot of quantity of material. There
21 are limitations to the size of still pots.

22 Q. Okay. Are you familiar with the term
23 "conversion" in describing a chemical reaction?

24 A. Yes.

25 Q. And what does the term "conversion"

1 mean?

2 A. I may have used it or defined it in
3 part of my declaration here. All right. I draw
4 your attention to Page 48, Paragraph 146. That's
5 the first time I use the word "conversion." And
6 conversion in this case was referring to the
7 fraction of 245eb that is being converted to
8 products.

9 Q. In Paragraph 148 you also mention
10 selectivity?

11 A. Yes, and in 146.

12 Q. Can you describe what you mean by
13 selectivity?

14 A. Selectivity is the fraction of 245eb
15 that has been converted, that has gone to a
16 specific product.

17 Q. So you state that "In your experience
18 an experiment that provided a conversion of about
19 50 percent and a selectivity of about 90 percent
20 would be sufficiently tested to demonstrate that it
21 will work for a commercial process."

22 A. Yes, that -- that is my expert opinion
23 based on working with the engineers at Dupont who
24 were developing commercial processes for, not only
25 1234yf, but FEA-1100, which is -- if you want me to

1 define it further, I will, but it is a -- it is a
2 blowing agent.

3 Q. So you said that's -- it's your expert
4 opinion? Is that --

5 A. Right.

6 Q. Is that something known to those of
7 ordinary skill in the art as well?

8 A. Possibly if they've had enough
9 experience post education.

10 Q. So would one of ordinary skill in the
11 art understand -- well, let's -- let's begin again.

12 In Paragraph 88 of your declaration you
13 describe the level of one of ordinary skill.

14 A. Okay.

15 Q. So you state that "A person of ordinary
16 skill in the art of the '282 patent would have
17 education or experience in the fields of chemistry
18 or chemical engineering and will have taken courses
19 in organic chemistry."

20 You go on to say that "Such a person
21 would, based on coursework, have a general
22 understanding of organic chemistry and expertise in
23 the techniques used for separating chemicals based
24 on their physical properties."

25 You further state that "Moreover, the

1 education and experience levels may vary between
2 persons of ordinary skill in the art with some
3 persons holding a bachelor's degree, but with at
4 least five years of relevant work experience, or
5 others holding a more advanced degree such as a
6 Ph.D., an MS, but having fewer years, i.e., two to
7 three years" --

8 A. Right.

9 Q. -- "of experience."

10 Do you see that?

11 A. Yes, I do.

12 Q. Okay. So now turning back to Paragraph
13 148 where you state that "In my experience, an
14 experiment that provided a conversion of about 50
15 percent and a selective -- selectivity of about 90
16 percent would be sufficiently tested to demonstrate
17 that it will work for a commercial process."

18 Do you see that?

19 A. Yes.

20 Q. Is that something that would be known
21 by one of ordinary skill in the art, as you have
22 defined a person of ordinary skill in the art?

23 A. That knowledge came about from my
24 industrial experience. I have a Ph.D. with 15
25 years of industrial experience post Ph.D. I know

1 this because I worked closely with engineers
2 that -- many also had Ph.D.s and equivalent or more
3 experience from me. So that is knowledge gained
4 from working.

5 So, for example, maybe a Ph.D. with two
6 to three years may not know what selectivity and
7 conversion is desirable for a commercial process.
8 So that's why I answered in -- in -- maybe.

9 Q. So it's your opinion it takes one of
10 ordinary -- let me begin again.

11 It's your opinion that it requires that
12 one be of extraordinary skill in the art to know
13 that --

14 A. No.

15 MR. ROSE: Let him finish his
16 question --

17 THE WITNESS: Okay.

18 MR. ROSE: -- and then let me object.

19 THE WITNESS: Okay. Sorry. I
20 apologize.

21 BY MR. BAUM:

22 Q. So it's your opinion it takes one of
23 extraordinary skill in the art to know that
24 conversion of about 50 percent and selectivity of
25 about 90 percent would be sufficiently tested to

1 demonstrate that a process will work commercially?

2 MR. ROSE: Objection to form.

3 THE WITNESS: No. Because a bachelor's
4 degree with more years of industrial experience
5 could very well know this, and that would be
6 someone of ordinary skill in the art.

7 BY MR. BAUM:

8 Q. So a person of ordinary skill in the
9 art would understand that an experiment that
10 provided a conversion of about 50 percent and a
11 selectivity of about 90 percent would be
12 sufficiently tested to demonstrate that it will
13 work for a commercial process, correct?

14 MR. ROSE: Objection to form.

15 THE WITNESS: Correct. Now that we've
16 gone through that, I understand.

17 BY MR. BAUM:

18 Q. Okay. Thank you.

19 MR. ROSE: Counsel, we've been going
20 for about an hour now.

21 MR. BAUM: Yeah.

22 MR. ROSE: It's time for a break.

23 MR. BAUM: Sure.

24 THE VIDEOGRAPHER: The time is now
25 1:06. We are now going off the record.

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(Whereupon, there was a recess in the
proceedings from 1:06 p.m. to 1:32 p.m.)

* * *

THE VIDEOGRAPHER: The time is 1:32
p.m. And we are now going back on the record.
BY MR. BAUM:

Q. Dr. Lousenberg, did you speak with
anyone during the break?

A. I -- I went to the break room with my
counsel, but we did not discuss anything.

Q. So you sat there and just looked at
each other. You didn't --

A. They weren't even in the room for most
of it.

Q. Okay. When they were in the room, did
you discuss anything?

A. No.

Q. Did you discuss your testimony --

A. No.

Q. -- during the break?

A. Counsel reminded me that they can't
discuss anything with me.

Q. So before the break we were talking
about Paragraph 148 of your declaration in the 915

1 IPR. And I just want to make sure I understand
2 your -- your testimony. So -- so your report says
3 that in your experience "An experiment that
4 provided a conversion of about 50 percent and a
5 selectivity of about 90 percent would be
6 sufficiently tested to demonstrate that it will
7 work for a commercial process."

8 And I believe that you testified
9 initially that it wasn't clear as to whether or not
10 one of ordinary skill in the art would know that?

11 A. That is correct.

12 Q. Okay. So taking into account your
13 definition of one of ordinary skill in the art,
14 there are two different types of ordinarily skilled
15 artisans that are described. You have one with at
16 least -- with a bachelor's degree and at least five
17 years of relevant work experience, and then others
18 holding a more advanced degree such as a Ph.D. or
19 MS, but having fewer years; an example two to three
20 years of experience?

21 A. Yes.

22 Q. And so keeping that in mind, would a
23 person of ordinary skill in the art understand that
24 an experiment that provided a conversion of about
25 50 percent and a selectivity of about 90 percent

1 would be sufficiently tested to demonstrate that it
2 will work for a commercial process?

3 MR. ROSE: Objection to form.

4 THE WITNESS: Yes. But I may add that
5 the person of ordinary skill in the art -- we
6 haven't -- we haven't delineated between a degree
7 in chemical engineering or a degree in chemistry.
8 So there may be -- that -- that -- that was the
9 reason for my initial hesitation to say that it
10 is -- it is somewhat degree dependent.

11 Someone who comes from a chemical
12 engineering background, even at a bachelor's level,
13 would probably know this, having taken their
14 process courses. But a chemist, coming from a
15 bachelor's degree, probably would not know that
16 unless they had several years of experience
17 already.

18 In my case, I learned that on the job
19 working with other engineers.

20 BY MR. BAUM:

21 Q. So how many years of experience did --
22 did you have when you first learned that?

23 A. I -- I was probably into my seventh
24 year with Dupont when I learned that.

25 Q. Okay. And it's not something you

1 learned in college or graduate school, correct?

2 A. That is correct.

3 Q. So with you having a Ph.D., and it took
4 seven years for you to understand that that
5 statement is correct, that an experiment that
6 provided a conversion of about 50 percent and a
7 selectivity of about 90 percent would be
8 sufficiently tested to demonstrate that it will
9 work for a commercial process, one of ordinary
10 skill with -- let me begin again.

11 So someone with only a chemistry
12 degree, and two or three years of experience, would
13 not know that an experiment that provided a
14 conversion of about 50 percent and a selectivity of
15 about 90 percent would be sufficiently tested to
16 demonstrate that it will work for a commercial
17 process?

18 A. Well -- well, let's put some context in
19 this. Here we're talking about a continuous
20 process for the most part. I wasn't exposed to
21 true continuous processes until I was in the
22 fluorochemicals business. I had always done
23 batch-related reactions.

24 There the standards for a process
25 that -- or a -- the standards that would define it

1 as a viable for a commercial process may -- may be
2 different.

3 So in a continuous process, a
4 conversion of 50 percent and selectivity of about
5 90 percent is acceptable if the material that
6 doesn't convert to product is not a yield loss, and
7 typically in continuous processes you have recycle
8 loops.

9 The key -- the key is selectivity. You
10 want the material that goes -- that you -- you want
11 the fraction of material that undergoes conversion
12 to go to -- to the desired product in high -- in
13 high selectivity.

14 Q. So in a continuous process you
15 typically have recycle loops. Why is that?

16 MR. ROSE: Objection. Form.

17 THE WITNESS: Because you run reactions
18 under steady-state conditions, and -- and in -- in
19 some cases, such as vapor phase reactions, you are
20 actually dealing with equilibria. You're -- you're
21 not going all the way to product, and some of your
22 product is converting back to starting materials.
23 So that starting material that is coming out with
24 your product you need to capture and send back
25 through the process.

1 BY MR. BAUM:

2 Q. And in a continuous process you
3 typically have starting material coming out with
4 the product?

5 A. Yes.

6 MR. ROSE: Objection to form.

7 THE WITNESS: Okay. And I believe I
8 stated that with HFX-110, where we had
9 perfluoroheptene coming out with the HFX-110
10 product, that perfluoroheptene was then recovered
11 in -- in -- in the continuous distillation step and
12 sent back to the process.

13 BY MR. BAUM:

14 Q. Did you do any modeling in connection
15 with your work in this matter?

16 A. In connection with -- can you be
17 specific?

18 Q. Sure. Preparing your dec -- any of
19 your declarations?

20 A. I -- I did some high-level analysis,
21 but I don't know that I would call it modeling.

22 Q. Okay. And in that high-level analysis,
23 was there a particular rate of conversion that you
24 chose?

25 A. Yes.

1 Q. And what was that rate of conversion?

2 A. I chose 50 percent.

3 Q. And what was your basis for choosing 50
4 percent?

5 A. My basis was, like you've asked me
6 here, what in my experience and experiment that
7 provided conversion of about 50 percent and
8 selectivity -- well, conversion is what we're
9 talking about -- of 50 percent would show
10 commercial viability.

11 And the reason is you would very much
12 like to have your -- your -- the -- the product
13 that you're making, the volume of product that
14 you're making much larger than your recycle or
15 larger than your recycle loops.

16 Q. Earlier you referred to operating at a
17 steady-state in a continuous process.

18 What did you mean by that?

19 A. At any given time the fraction of
20 starting material and product is at a constant
21 level. Temperature is constant. Volume is
22 constant. Flow rates are constant. Everything is
23 at steady-state conditions.

24 Q. In a continuous reaction where you're
25 trying to maintain steady-state, does that require

1 that you add an amount of reactant as that reactant
2 is being consumed so that the amount of reactant in
3 the reactor essentially stays the same?

4 MR. ROSE: Objection to form.

5 THE WITNESS: That -- that -- yes.

6 BY MR. BAUM:

7 Q. If you don't continuously add reactant
8 into a continuous reaction, what will happen to the
9 rate of reaction over time?

10 A. It will change.

11 Q. And will it go down or will it go up?

12 A. It depends on what -- if you don't --
13 if you don't continue -- sorry. Could you restate
14 that, please?

15 Q. If you don't continuously add reactant
16 into the reaction stream -- excuse me. Let me
17 begin again.

18 If you don't continuously add reactant
19 into a continuous reaction, what will happen to the
20 rate of reaction over time?

21 A. The reaction will decrease. The
22 reaction rate will decrease.

23 Q. Have you ever seen a continuous process
24 that was capable of achieving 100 percent
25 conversion?

1 MR. ROSE: Objection to form.

2 THE WITNESS: I don't recall.

3 BY MR. BAUM:

4 Q. How is conversion calculated? Is it
5 based on a single pass through a reactor, or is it
6 measured over multiple passes?

7 A. It -- well, if you're running a
8 steady-state process, you're going to measure it
9 multiple times as the process continues so that you
10 are -- you can ensure that you have achieved
11 steady-state conditions. You'd like to know that
12 the amount of conversion is constant as you run
13 that continuous steady-state process.

14 Q. So in a steady-state process you want
15 the amount of reactants to stay the same?

16 A. Yes.

17 Q. And how is it that you measure the rate
18 of conversion?

19 MR. ROSE: Objection to form.

20 THE WITNESS: The rate of conversion?

21 BY MR. BAUM:

22 Q. Yeah, so let's begin again.

23 How do you measure conversion in a
24 continuous reaction?

25 A. Well, you're not measuring the rate of

1 conversion. You're measuring the steady-state
2 level of conversion. It's not a rate measurement.

3 Q. Okay. Please explain.

4 A. Rate is conversion per unit time.

5 I'm -- I'm speaking more to composition in comp --
6 in -- in -- in -- when I'm talking about
7 conversion, so...

8 Q. What do you mean you're talking about
9 composition?

10 A. Well, if -- if you were -- the comp --
11 for example, the composition of the product and
12 starting material coming out of the reactor will
13 have a -- a certain fraction of starting material
14 and a fraction of desired product. The -- the
15 amount of conversion of that starting material is
16 in absolute terms one minus that fraction of
17 starting material that is in that mixture.
18 Assuming you start with 100 percent of the starting
19 material.

20 Q. So if the reactor is 50 percent full of
21 a reactant, you want that 50 percent level to stay
22 the same as the continuous process is being carried
23 out, correct?

24 MR. ROSE: Objection to form.

25 THE WITNESS: Can you state that again,

1 please?

2 BY MR. BAUM:

3 Q. Sure. So if you have, in a continuous
4 reaction, a reactor that's got 50 percent of
5 Ingredient A and 50 percent of Ingredient B that
6 are reactants --

7 A. Okay.

8 Q. -- you'll want those relative levels to
9 say [sic] the same -- stay the same as the
10 continuous process is being carried out --

11 A. Right.

12 Q. -- correct?

13 A. I believe so.

14 Q. Okay. And how do you --

15 A. That's at steady-state conditions. Are
16 you asking that at steady-state conditions?

17 Q. Yes.

18 A. Okay.

19 Q. Thank you. Paragraph 150 of your
20 report in the 915 IPR, can you turn to that,
21 please. The third sentence says, "Unlike 245eb" --

22 A. Sorry. Which --

23 Q. I'm sorry. Paragraph 150 of -- do you
24 have the right -- is it -- is that the 915?

25 A. Yeah. I heard 115.

1 Q. Okay. 915. The third sentence says,
2 "Unlike 245eb, 236ea is a more difficult
3 dehydrofluorination reaction."

4 Do you see that?

5 A. Yes.

6 Q. What does that mean with regard to
7 conversion?

8 A. With a given amount of
9 dehydrofluorinating agent, and a given amount of
10 236a [sic] or 245eb, both being the same amount,
11 there will be less conversion of the 236ea under
12 those conditions.

13 Q. And do you have an opinion as to the
14 relative amounts of conversion? So, for example,
15 is 245eb likely to have a conversion rate that's 10
16 percent higher than 236ea under identical reaction
17 conditions?

18 A. Well, I -- I did not compare identical
19 conditions for 236ea and 245eb, but I -- I do know
20 this, from experience and reading, that 236ea
21 dehydrofluorination is more difficult.

22 Q. And that means that as compared to --
23 let's move on.

24 Under what circumstances is it
25 desirable to recover unused reactants in a chemical

1 process?

2 A. Unused chemical reactants?

3 Q. Yeah.

4 A. When the overall process economics
5 justify doing that, the capital costs, the reagent
6 costs, the costs of employees to run that facility.
7 If those costs are less over time, a weighted time,
8 then the cost of doing something else with that
9 material other than recovering it, then that's when
10 you would recover it.

11 Q. So let's back up a minute and think
12 about the design process --

13 A. Sure.

14 Q. -- overall.

15 So, when you start designing a chemical
16 process, you start with the reaction that you want
17 to --

18 A. Sure.

19 Q. -- to accomplish, correct?

20 A. Yes.

21 Q. And at that point you start thinking
22 about what types of process steps you need to
23 implement; is that correct?

24 A. Yes.

25 Q. And so a first step, a first process

1 step is typically to have some kind of reaction
2 occur in a reactor; is that correct?

3 A. Correct.

4 Q. And then you have a choice, if you have
5 products, by-products and unreacted reactants
6 coming out of that reactor, in terms of what to do
7 with those, correct?

8 A. Yes.

9 Q. And at that stage of the design
10 process, what are your options with regard to
11 by-products?

12 A. Your options in terms of disposal?
13 Could you --

14 Q. Yeah.

15 A. Options in how you would treat them?

16 Q. Yes.

17 A. You have options for disposal. You can
18 recycle. Some by-products you might sell.

19 Q. So three options are available for
20 by-products coming out of a continuous reactor that
21 include disposal, recycle, and sell, correct?

22 A. Yes.

23 Q. Are there any others?

24 A. Not that I can think of at the moment
25 of...

1 Q. With regard to unreacted reactants
2 coming out of a reactor in a continuous process,
3 what are your design choices with regard to what to
4 do with those unused reactants?

5 A. Recover. Sorry. Well, you could
6 probably do the same three things that you did with
7 products and by-products -- or by-products.

8 Q. And so, one of the options for
9 recovering by-products -- let me begin again.

10 One of the options, in terms of
11 additional process steps after a by-product comes
12 out of a reactor in a continuous phase reaction is
13 to somehow recover that by-product; is that
14 correct?

15 MR. ROSE: Objection to form.

16 THE WITNESS: That is one option.

17 BY MR. BAUM:

18 Q. So of the -- you mentioned three
19 options before with regard to by-products. You
20 mentioned disposal, recycle, and sell. Is recovery
21 a fourth option, or does -- is recovery part of
22 recycling?

23 A. Well, we --

24 MR. ROSE: Objection to form.

25 THE WITNESS: -- specifically defined

1 recovery in terms of the '282 patent. Are you --
2 I'm not sure what you mean. If -- if you're saying
3 is recovery -- we've got it defined here, and if
4 you go to --

5 BY MR. BAUM:

6 Q. Yeah, I'm using your --

7 A. Okay. Okay.

8 Q. -- definition of recovery.

9 A. Okay. So are we sub -- substantially
10 separating something from something else in
11 recovery?

12 Q. Well, let's back up.

13 I'm using your definition of
14 recovery --

15 A. Okay.

16 Q. -- throughout, okay?

17 So you mentioned three options with
18 regard to by-products coming out of a continuous
19 reactor. You mentioned from a design standpoint
20 you can either dispose, recycle or sell, correct?

21 A. Correct.

22 Q. In order to recycle, you have to
23 recover, correct?

24 A. Not as we've used it.

25 Q. Okay.

1 A. You could collect it, which is
2 something not necessarily as we've defined the
3 recovery in the '282 patent.

4 Q. So with regard to unused reactant in a
5 continuous process, what are your options with
6 regard to further processing steps for those unused
7 reactants?

8 A. Collect, and once you've collected it,
9 dispose it -- of it.

10 Q. Any other --

11 A. Recover it, separate it from other
12 things, and maybe sell it. Either before or after
13 recovery.

14 Q. So under what circumstances is it
15 desirable to recover unused reactant coming out of
16 a continuous process rather than dispose or sell
17 that product?

18 MR. ROSE: Objection to form.

19 THE WITNESS: When -- when you would
20 want to recycle it in -- into the process --
21 process.

22 BY MR. BAUM:

23 Q. So it's desirable to recover unused
24 reactants coming out of a continuous process when
25 your objective is to recycle that unused reactant;

1 is that correct?

2 A. Sure. Yet -- may I add one more thing?
3 You may also want to recover if that improves the
4 quality of the material that you intend to sell.

5 Q. So before you met with Honeywell's
6 counsel, you had seen the '282 patent?

7 A. Uh-huh.

8 Q. Did you ever form an opinion as to
9 whether it would be desirable to recover spent KOH?

10 A. Did I form an opinion? I didn't think
11 that deep into the patent.

12 Q. Okay. When you were working at -- at
13 Dupont, earlier you had testified that you were
14 working on a process -- a continuous process that
15 included KF as one of the by-products?

16 A. Yes.

17 Q. At that time did you believe that it
18 was desirable to convert KF to KOH --

19 A. No.

20 Q. -- using lime?

21 So earlier you mentioned you're
22 familiar with phase-transfer catalysts. What type
23 of reactions are phase-transfer catalysts typically
24 used in?

25 A. Reactions -- reactions where the --

1 where the two -- where two reactants exist in
2 different phases, heterogeneous reactions in
3 miscible phases.

4 Q. Okay. Are there other ways to achieve
5 reaction between two immiscible phases without the
6 use of a phase-transfer catalyst?

7 A. Yes, high shear rate mixing. If you
8 can create small enough droplets of each phase,
9 then you can create a high surface area to
10 facilitate the reaction.

11 Q. So in your experience, phase-transfer
12 catalysts are sometimes used in the manufacture of
13 refrigerants?

14 A. I don't know. I -- I would not
15 anticipate a phase-transfer catalyst in the --
16 in -- in -- in the current process that is used
17 for -- at least as Dupont and Honeywell practice
18 it. I believe it is all vapor phase reactors.
19 They do not do liquid phase.

20 Q. And you know that from publicly
21 available documents?

22 A. Yes.

23 Q. So for this next question I want you to
24 assume that we're dealing with a continuous
25 reaction where we've got an immiscible aqueous

1 phase and an organic phase.

2 Can one of ordinary skill in the art
3 typically determine the amount of phase-transfer
4 catalysts needed to effect the desired reaction
5 with limited experimentation?

6 MR. ROSE: Objection to form.

7 THE WITNESS: What -- what is limited
8 experimentation?

9 BY MR. BAUM:

10 Q. Well, have you used that term in the
11 past?

12 A. Limited experimentation?

13 Q. Yeah.

14 A. Possibly. Are we talking one, two,
15 five, ten reactions?

16 Q. Well, when one of ordinary skill uses
17 the term "limited experimentation," what does that
18 mean to you?

19 A. Not a lot.

20 Q. If one of ordinary skill in the art
21 knew the reactant's process conditions and the --
22 and the identity of phase-transfer catalysts, could
23 one of ordinary skill in the art determine the
24 amount of phase-transfer catalysts needed to effect
25 the desired reaction with limited experimentation?

1 MR. ROSE: Objection to form.

2 THE WITNESS: Possibly.

3 BY MR. BAUM:

4 Q. Possibly or yes, they could?

5 MR. ROSE: Objection to form.

6 THE WITNESS: I --

7 MR. ROSE: Asked and answered.

8 THE WITNESS: I don't know. I don't
9 have enough detail.

10 BY MR. BAUM:

11 Q. Is there any additional information
12 you'd need to determine whether or not one of
13 ordinary skill in the art could determine an
14 effective amount of phase-transfer catalysts needed
15 to effect the desired reaction with limited
16 experimentation?

17 MR. ROSE: Objection to form.

18 THE WITNESS: Yeah, what -- had --
19 sorry.

20 Can you restate the question?

21 BY MR. BAUM:

22 Q. Is there any additional information you
23 need to know to tell me whether or not one of
24 ordinary skill in the art could select an effective
25 amount of phase-transfer catalyst needed to effect

1 the desired reaction with limited experimentation?

2 MR. ROSE: Objection to form.

3 THE WITNESS: I guess I don't know what
4 limited experimentation is and who we're talking --
5 we are talking about a person of ordinary skill,
6 but I still don't know the level of experimentation
7 that person would need to do.

8 I -- I'd say they -- I'd say they need
9 to do more than three reactions to find optimum
10 conditions. I mean, if you want to find optimum
11 conditions, you -- you might typically want to
12 generate a trend, and typically to generate a trend
13 of a reaction you would probably want to have more
14 than three data points.

15 BY MR. BAUM:

16 Q. Is -- is three data points enough for
17 one of ordinary skill in the art to select
18 phase-transfer catalyst -- let me begin again.

19 Is three data points enough for one of
20 ordinary skill in the art to select an effective
21 amount of phase-transfer catalysts to achieve the
22 desired reaction?

23 MR. ROSE: Objection to form.

24 THE WITNESS: Yes.

25 BY MR. BAUM:

1 Q. So then you agree that one of ordinary
2 skill in the art that knew the reactants, the
3 process conditions, the identity of the
4 phase-transfer catalyst, would be able to select an
5 effective amount of phase-transfer catalyst needed
6 to effect a desired reaction with limited
7 experimentation?

8 MR. ROSE: Objection to form.

9 THE WITNESS: I can't -- I -- I don't
10 know. There are -- there are too many -- too many
11 variables there that I would have to assume. Are
12 we doing a continuous -- are we doing -- are we
13 doing this continuously to start off in
14 experimentation? Are we doing batch typically?

15 BY MR. BAUM:

16 Q. Continuous -- in a continuous process.
17 Let me back up and ask the question
18 again just to make sure --

19 A. All right.

20 Q. -- we are all on the same page.

21 So in a continuous process that has a
22 liquid organic phase and an immiscible liquid
23 aqueous phase, would one of ordinary skill in the
24 art, with knowledge of the reactants, process
25 conditions, and the identity of the phase-transfer

1 catalyst be able to select an effective amount of
2 phase-transfer catalyst needed to effect a desired
3 reaction with limited experimentation?

4 MR. ROSE: Objection to form.

5 THE WITNESS: And in this limited
6 experimentation, are we running the process out to
7 steady-state conditions for several -- several
8 reactor volume or several -- several reactor
9 residence times? Again, that goes -- is that -- is
10 that a limited experiment then?

11 BY MR. BAUM:

12 Q. Well, the question said or presumed
13 that this person of ordinary skill in the art knew
14 the reactants, the process conditions, and the
15 identity of the phase-transfer catalyst.

16 A. Okay.

17 Q. So the reaction conditions,
18 steady-state is included as a reaction condition.

19 A. Okay.

20 Q. So --

21 A. So --

22 MR. ROSE: Are you finished with your
23 question?

24 MR. BAUM: No. Why don't we just --

25 MR. ROSE: Well, I wanted -- I wanted

1 to lodge an objection.

2 MR. BAUM: Yes.

3 MR. ROSE: It didn't sound like a
4 question.

5 MR. BAUM: Yeah, so let's go back and
6 I'll ask the question again.

7 MR. ROSE: Fair enough.

8 MR. BAUM: Okay.

9 MR. ROSE: Fair enough. I just didn't
10 want to interrupt.

11 MR. BAUM: Yeah, and I -- I appreciate
12 that. So...

13 BY MR. BAUM:

14 Q. In an organic -- well, let me begin
15 again.

16 In a continuous process that has a
17 liquid organic phase and an immiscible liquid
18 aqueous phase, would one of ordinary skill in the
19 art with knowledge of the reactants, process
20 conditions, and the identity of the phase-transfer
21 catalyst be able to select an effective amount of
22 phase-transfer catalyst needed to effect a desired
23 reaction with limited experimentation?

24 MR. ROSE: Objection to form.

25 THE WITNESS: Well, the '282 patent

1 does not deal with phase-transfer catalyst, but in
2 a case where it -- where you would use a
3 phase-transfer catalyst, you could probably
4 determine the effective amount of phase-transfer
5 catalyst with limited experimentation, maybe three
6 experiments.

7 BY MR. BAUM:

8 Q. Do you have experience in determining
9 the period of reaction time to produce a reaction
10 product mixture in a chemical reaction?

11 A. I would have to say yes.

12 Q. Can one of ordinary skill in the art
13 typically determine the period of reaction time to
14 produce a reaction product mixture in a chemical
15 reaction through routine experimentation?

16 A. Yes.

17 Q. Do you have any experience selecting
18 the molar ratios of reactants that may be used in
19 a --

20 THE REPORTER: Can you say that again?

21 MR. BAUM: Yes.

22 BY MR. BAUM:

23 Q. Do you have any experience selecting
24 the molar ratios of reactants that may be used in a
25 chemical reaction?

1 A. Yes.

2 Q. Can one of ordinary skill in the art
3 typically select an appropriate molar ratio
4 reactant that can be used in a chemical reaction?

5 A. Yes.

6 Q. So one of ordinary skill in the art can
7 modify the relative amounts of reactants to achieve
8 a desired outcome?

9 MR. ROSE: Objection to form.

10 THE WITNESS: Yes.

11 BY MR. BAUM:

12 Q. Do you have any experience concerning
13 the placement of outtakes on a three-phase decanter
14 for each phase or combined phases?

15 A. Three-phase, no.

16 Q. So you have experience concerning the
17 placement of outtakes on a two-phase decanter?

18 A. Yes. Let me elaborate.

19 Q. Please.

20 A. Earlier I stated that in HFX-110 we had
21 an aqueous phase, an organic phase, and a top
22 methanol layer. In that case we were running
23 the -- we -- we were running that process in the
24 laboratory, and we took the aqueous phase, and
25 the -- the -- the phase-transfer catalyst methanol

1 phase as one and then dealt with that later.

2 Q. And when you say you dealt with that
3 one later, you dealt with it in a -- another
4 two-phase decanter?

5 A. In our case, no, because it was --
6 we -- we just separated it in -- in a sep funnel
7 in -- in a batch -- batch mode separation.

8 Q. Can one of ordinary skill in the art
9 typically select proper placement of the outtakes
10 in a two-phase decanter for each phase?

11 A. Someone with multiple years of
12 experience, yes. This is going to an engineering
13 question, so I -- I can't speak to that, because
14 it's more of an engineering issue. I learned how
15 to do it by talking with engine -- engineers, so I
16 can't say -- in this case the person of ordinary
17 skill in the art was -- was probably an engineer,
18 so I can't really speak to that person of ordinary
19 skill in the art and --

20 Q. So when it comes to engineering of
21 separation vessels, you are not one of ordinary
22 skill in the art; is that correct?

23 MR. ROSE: Objection to form.

24 THE WITNESS: Well, in -- in that way,
25 yes, I would consider myself of ordinary skill in

1 the art for -- for that. It was trial and error,
2 so if trial and error is an allowable method,
3 then --

4 BY MR. BAUM:

5 Q. So when you're trying to figure out
6 placement of the outtakes on a two-phase decanter,
7 all you're really doing is figuring out where the
8 level of the organic phase and the immiscible
9 aqueous phase meet and then placing the outtakes,
10 no?

11 A. No.

12 Q. Okay.

13 A. No, there's more than that.

14 Q. Why don't you explain it to me, please.

15 A. A continuous decanter typically has an
16 outflow at the site for the top phase.

17 Q. Okay.

18 A. And then an outflow at the bottom,
19 which is a U-tube siphon-type process, and the
20 height of that siphon relative to the top
21 determines where that phase separation will occur
22 under steady-states.

23 There is -- there is a -- there is a
24 mathematical formula to -- to determine that that's
25 based on densities of the phases coming out of

1 that. I don't recall it offhand, but I do recall
2 being exposed to the mathematics of how you place
3 an outflow on a two-phase decanter in order to get
4 your phase sep -- where -- where the phase
5 separation is going to occur in your decanter. Or
6 at least the face -- the interface between the
7 phases.

8 Q. The decanter that you just described,
9 that's a generic description of a two-phase
10 decanter, correct?

11 A. As -- as I understand it, working with
12 engineers. I did not go into the research of
13 different types of decanters, if they exist that
14 much. So what I learned from the engineers was not
15 an academic learning. They just said this is what
16 a decanter typically looks like. This is -- this
17 is the mathematics behind it. Here, go look at
18 this. That's what I did, and then designed it from
19 that, so...

20 Q. So the engineers that you were
21 describing, they told you that this decanter
22 configuration that you just described is a typical
23 two-phase canter [sic] --

24 A. As far as --

25 Q. -- design?

1 A. -- I understood talking to them.

2 Q. And that two-phase canter -- decanter
3 that you described, that's a fairly common decanter
4 used in chemical processes, correct?

5 A. As far as --

6 MR. ROSE: Objection to form.

7 THE WITNESS: As far as I'm aware.

8 BY MR. BAUM:

9 Q. As far as you're aware, yes?

10 A. Yes.

11 Q. Do you have any experience in the
12 recovery of phase-transfer catalysts?

13 A. Just -- just in my laboratory
14 experience with development of HFX-110.

15 Q. And in your laboratory experience with
16 HFX-110, which included a phase-transfer catalyst,
17 did you use a decanter of the configuration that
18 you previously described to accomplish separation
19 of the phase-transfer catalyst from any other
20 materials present?

21 A. No, like I said, we used the
22 two-phase -- the phase de -- the two-phase phase
23 decanter to separate an organic layer and an upper
24 aqueous layer that contained a very tiny layer of
25 the phase-transfer catalyst. We took those -- we

1 took that aqueous layer, and that phase-trans --
2 transfer catalyst layer together and did a
3 subsequent separation.

4 In theory you could have run it through
5 a second decanter step to do that continuously, but
6 at the laboratory scale it didn't -- it didn't make
7 sense to demonstrate that.

8 Q. So phase-transfer catalysts that are
9 typically used in a process for manufacturing HFOs,
10 are they typically organic compounds?

11 MR. ROSE: Objection to form.

12 THE WITNESS: I believe so.

13 BY MR. BAUM:

14 Q. Earlier you mentioned that quaternary
15 ammonium salts --

16 A. Yeah.

17 Q. -- are typically used in chemical
18 processes for manufacturing HF -- HFOs.

19 Are those quaternary ammonium salts
20 organic compounds?

21 A. Yes.

22 Q. What are known methods for separating
23 organics like a phase-transfer catalyst?

24 A. A decanter --

25 Q. Anything --

1 A. -- and a continuous process.

2 Q. Anything else?

3 A. Well, in a batch process you can use a
4 separatory funnel.

5 Q. In a continuous process, are you aware
6 of any other separator that can be used to --

7 A. I'm not aware.

8 Q. Let me go back and ask the question.

9 Hold off just a minute --

10 A. Okay.

11 Q. -- until I get the question out.

12 In a continuous process are you aware
13 of any other separator that can be used to separate
14 or recover phase-transfer catalysts in a continuous
15 process?

16 A. Well, you --

17 MR. ROSE: Objection to form.

18 BY MR. BAUM:

19 Q. Yeah, let me begin again.

20 A. Okay.

21 Q. In a continuous process are you aware
22 of any other separator that can be used to recover
23 phase-transfer catalysts?

24 MR. ROSE: Objection to form.

25 THE WITNESS: Well, you can -- you

1 could use extraction, but, again, that is just a
2 slight variation of a decanter, because you're
3 extracting, not into its own phase, into a -- into
4 a different phase, like another organic liquid, for
5 example.

6 BY MR. BAUM:

7 Q. Like methylene chloride?

8 A. Right.

9 Q. Can you turn to Paragraph 107 of your
10 report in the 915 IPR, please.

11 A. 107?

12 Q. Yeah.

13 A. Okay.

14 Q. And then the '282 patent.

15 (EXHIBIT 1001, U.S. Patent Number
16 8,710,282, was previously marked for
17 identification.)

18 MR. BAUM: I am placing before the
19 witness a copy of U.S. Patent Number 8,710,282,
20 also referred to as the '282 patent, and it's
21 Petitioner's Exhibit 1001.

22 BY MR. BAUM:

23 Q. And I'd like you to turn to Column 13,
24 Lines 31 to 34. If you want to take some time to
25 read that paragraph, go ahead.

1 A. Okay. 31 to 34?

2 Q. Yeah.

3 A. Okay.

4 Q. So this paragraph says that "The
5 product stream containing spent dehydrohalogenating
6 agent typically carries with it some dissolved
7 organics (example HFC-236ea and/or HFC-245eb)."

8 And the next sentence says, "By
9 stopping the stirrer and then removing spent
10 dehydrohalogenating agent, during the time
11 agitation is stopped, separation of
12 dehydrohalogenating agent and such organic can be
13 facilitated."

14 Do you see that?

15 A. Yeah.

16 Q. How does stopping the stirrer
17 facilitate separation of the dehydrohalogenating
18 agent?

19 A. It allows the organic phase and the
20 aqueous phase containing the dehydrohalogenating
21 agent to separate.

22 Q. In Paragraph 109 in your expert report,
23 you describe this high-shear mixing that you
24 referred to --

25 A. Right.

1 Q. -- earlier today?

2 So is my understanding correct that
3 when you stop stirring there's no longer a force
4 applied to the liquid such that the droplets of
5 organic and aqueous phase separate into two
6 distinct phases?

7 A. I would characterize it as energy in
8 the system -- you're no longer putting energy into
9 the system, and once you do that, the two phases
10 can't separate.

11 Q. So if you turn to the examples in the
12 '282 patent, and, in particular, Example 1.

13 A. Okay.

14 Q. Line 34 says, "The stirrer is stopped
15 for 10 minutes while the feed -- the feeds still go
16 in."

17 A. Uh-huh.

18 Q. Is it your opinion that during that 10
19 minutes the organic and immiscible aqueous phases
20 will separate in the reactor?

21 A. The process of separation will be
22 occurring, yes. Will it be complete in 10 minutes?
23 I don't know.

24 Q. If the stir was not stopped, and you
25 began to remove the mixture from the bottom of the

1 reactor, would you expect the dissolved organics to
2 still be entrained in the aqueous phase?

3 A. Yes.

4 MR. BAUM: Let's go off the record.

5 THE VIDEOGRAPHER: The time is 2:28
6 p.m. And we're now going off the record.

7 * * *

8 (Whereupon, there was a recess in the
9 proceedings from 2:28 p.m. to 2:50 p.m.)

10 * * *

11 THE VIDEOGRAPHER: The time is now
12 2:50. We're going back on the record.

13 BY MR. BAUM:

14 Q. Dr. Lousenberg, I'd like to ask you if
15 you've had any experience with separating gases
16 from liquids?

17 A. In?

18 Q. Chemical processes. Let me begin
19 again.

20 Dr. Lousenberg, I'd like to ask you if
21 you have any experience --

22 A. Let me -- I'm sorry.

23 Q. -- separating gases from liquids in
24 chemical processes?

25 A. Yes.

1 Q. Could you explain that experience?

2 A. I removed, I believe, a low boiler
3 similar to 1234yf that was contaminating a higher
4 boiling fluorocarbon liquid through a
5 semi-continuous distillation process.

6 Q. Can you describe the semi-continuous
7 distillation process, please.

8 A. As I define it, and I believe it's the
9 common term, I would -- the contaminated liquid was
10 pumped into a distillation column somewhere along
11 its length, possibly the middle.

12 The -- the system was set up to reflux
13 at steady-state the higher boiling liquid so as the
14 contaminated liquid entered the column above the
15 still pot, the low boiling contaminated was
16 preferentially swept out through the condenser
17 system which was operated at the temperature above
18 the boiling point of the gaseous contaminant.

19 Q. Are there other ways that you're aware
20 of to separate a liquid from a gas other than
21 distillation?

22 A. Yes. In my -- in my current job,
23 although I do not do the work, the company I work
24 for does build pervaporation systems just for that
25 purpose.

1 Q. Can you describe what a pervaporation
2 system is first?

3 A. It is a membrane that is selective for
4 the gaseous contaminant, but does not allow passage
5 of the liquid to any great extent.

6 Q. Is this a -- a new type of equipment
7 for separating gases from liquids or have they been
8 around for a while?

9 A. I think they've been around for a
10 while. One of the big applications for the
11 equipment that my current employer makes is for
12 purification of transformer oils. They can pick up
13 moisture and other gases.

14 Now, water is not typically a gas, but
15 in the case -- in -- in the mode of operation of
16 these pervaporation systems, typically the
17 contaminated transformer oil goes in one side at
18 ambient pressure and a vacuum is applied to the
19 other side, so the water that permeates the
20 membrane ends up as a gas on the other side.

21 Q. So the term "pervaporation," that
22 indicates that there's some crossing of the vapor
23 through a membrane; is that correct? Or is it a
24 broader term?

25 A. I'm not entirely familiar with the

1 definition of the term. I just know that's what it
2 is called and that's how it operates.

3 Q. Have you ever heard of a vapor and
4 liquid separator?

5 A. A vapor and liquid separator? I'd have
6 to say no, unless I've seen it in operation or
7 heard by another name that I can't recall.

8 Q. Have you ever heard of a gas liquid
9 separator?

10 A. Is -- is this a specific device that's
11 called a gas liquid separator? Well, a
12 pervaporation system is a gas liquid separator.

13 Q. Are there other types of equipment that
14 can separate a liquid from a gas?

15 A. I don't -- none come to mind at the
16 moment. I'm not aware at this moment.

17 Q. So in reviewing your report, there were
18 several terms -- well, let me back up.

19 In reviewing your report you construe a
20 number of terms. You give a claim construction for
21 a number of terms. There are also a number of
22 terms that -- that you don't construe.

23 So, for example, you define recovering,
24 but you don't define concentrating. You didn't
25 construe the term "concentrating," did you, in your

1 report?

2 A. I don't believe so.

3 Q. You didn't construe the term "alkane
4 recycle stream" in your report, did you?

5 A. No, I don't believe I did.

6 Q. You didn't construe the term
7 "dehydrohalogenating agent" in your report, did
8 you?

9 A. I think I did.

10 Q. Could you show me where you defined the
11 term "dehydrohalogenating," please.

12 A. "The person of ordinary skill in the
13 art would understand spent refers to DHA or KOH."

14 So DHA -- okay. I think a person of
15 ordinary skill would understand that KOH is a
16 dehydrohalogenating agent and -- and such DHA.

17 Q. Is calcium hydroxide also a
18 dehydrohalogenating agent?

19 A. In -- in my expert opinion, yes, it can
20 be. Not an effective one, but it is a hydroxide.

21 Q. And one of ordinary skill in the art
22 would understand that calcium hydroxide is a
23 dehydrohalogenating agent, correct?

24 A. Yes.

25 Q. You didn't define the term

1 "withdrawing" in your report, did you?

2 A. I believe I did not define withdrawing.

3 Q. Do you think it's a term that needs to
4 be construed for a PHOSITA to understand what the
5 term "withdrawing" means?

6 A. I think a PHOSITA would understand it
7 as its ordinary and customary meaning.

8 Q. And what is its ordinary and customary
9 meaning?

10 A. To remove.

11 Q. You didn't define the term "alkane
12 recycle stream" in your report, did you?

13 A. No, I didn't.

14 Q. Do you think it needs to be construed
15 for a PHOSITA to understand what the term "alkane
16 recycle stream" means?

17 A. No, because we do define recycle, and
18 let me just read it. "Recycling is returning the
19 component of the reaction back to the reaction."

20 So that component would be alkane, as
21 you've said it.

22 Q. Thank you. When you say, "We define,"
23 who do you mean by "we"?

24 A. When I say "we," I use it in the
25 term -- in the sense that when I was drafting the

1 declaration it was in the presence of counsel, so
2 "we" includes counsel, but most -- most -- more
3 specifically refers to me.

4 Q. You don't define the term "separation
5 method" in your report, do you?

6 A. I do not.

7 Q. Do you think separation method is a
8 term that needs to be construed for a PHOSITA to
9 understand what that term means?

10 A. I do not.

11 Q. What does the term "separation method"
12 mean to you?

13 A. A method of separating components.

14 Q. And examples of such separation methods
15 are?

16 A. Distillation, phase separation.

17 Q. Any others?

18 A. None that come to mind at the moment.

19 Q. So before you said that you don't
20 define the term "converting" in your report. Do
21 you think that converting is a term that needs to
22 be construed for a PHOSITA to understand what that
23 term means?

24 A. No. I would give it a customary
25 meaning.

1 Q. What is the customary meaning of
2 converting?

3 A. A transformation.

4 Q. What kind of transformation?

5 A. It depends on what -- what is being
6 converted. It could -- it could -- it could mean a
7 chemical reaction. It could mean going from a
8 solid to a liquid. I think the context needs to be
9 stated to understand what converting --

10 Q. So in the context of converting KF to
11 KOH and calcium hydroxide, what does the term
12 "converting" mean?

13 MR. ROSE: Objection to form.

14 THE WITNESS: That -- that is a
15 chemical transformation.

16 BY MR. BAUM:

17 Q. You don't define the term
18 "concentrating" in your report, do you?

19 A. No. I think we asked that.

20 Q. Do you think the term "concentrating"
21 is a term that needs to be construed for a person
22 of ordinary skill in the art to understand what the
23 term "concentrating" means?

24 A. No.

25 Q. What does the term "concentrating" mean

1 to you?

2 A. The term "concentrating" means to me
3 increasing the fraction of a component in a mixture
4 to a higher level.

5 Q. And can you explain how concentrating
6 can be accomplished in a chemical process?

7 A. It can be -- it can be accomplished
8 through distillation. It can be accomplished
9 through a chemical reaction such as converting KF
10 to KOH.

11 Q. In the context of the '282 patent, the
12 term "converted KOH" is used. You don't construe
13 the term "converted KOH" in your report, do you?

14 A. Sir, could you state that --

15 Q. You don't construe the term "converted
16 KOH" in your report, do you?

17 A. Construe meaning?

18 Q. Interpret.

19 A. We're still sticking with the 915?

20 Q. Yeah.

21 A. Okay. Can you state the sentence one
22 more time, please?

23 Q. You don't construe the term "converted
24 KOH" in your report, do you?

25 A. I believe I do. I'm looking at Page

1 38, 114, "As construed, 'recovering' deals with
2 'spent DHA' or 'spent --

3 THE REPORTER: Can you speak up?

4 THE WITNESS: Oh, sorry.

5 "As construed, 'recovering' deals with
6 'spent DHA' or 'spent KOH,' while the separation of
7 the calcium fluoride would necessarily occur after
8 the KF is gone, as it has been converted to KOH.
9 Thus, at the point in the system where calcium
10 fluoride would be separated, there would not be any
11 'spent KOH' or 'spent DHA.'

12 As defined above, 'spent KOH' and
13 'spent DHA' necessarily consist of 'an aqueous
14 solution containing [DHA or KOH] and by-product
15 salts."

16 Q. So just to make sure I understand what
17 you're saying is that converted KOH is KOH that has
18 been converted from K --

19 A. Spent -- spent KOH through a chemical
20 reaction.

21 Q. Okay. In your report you don't define
22 the term "continuously stirred tank reactor," do
23 you?

24 A. Do you mean defined continuously
25 stirred tank reactor as CSTR? What do you mean --

1 what do you mean by "define"?

2 Q. In your report you don't construe the
3 term "continuously stirred tank reactor." You
4 don't explain what's meant by that term, correct?

5 What is a continuously stirred tank
6 reactor?

7 A. It is a reactor that is continuously
8 stirred as reagents go in and products and other
9 streams come out.

10 Q. What are -- what do those other streams
11 include that are coming out of the reactor?

12 A. Product streams.

13 Q. Any other streams?

14 A. By-product streams.

15 Q. Any other streams?

16 A. Possibly. It depends on what you're
17 doing in the reactor. In my case with HFX-110 we
18 had one stream coming out which was a combination
19 of products, starting material, and aqueous phase.
20 Gas -- gas streams possibly.

21 Q. So the continuously stirred tank
22 reactor is a reactor that is continuously stirred
23 as reagents go in and products, by-products, and
24 reactants come out, correct?

25 A. Sure. Correct.

1 (EXHIBIT 1005, English translation of
2 Publication Number 2,940,968, was previously marked
3 for identification.)

4 BY MR. BAUM:

5 Q. Dr. Lousenberg, I'm going to hand you a
6 copy of Petitioner's Exhibit 1005.

7 Have you seen this document before?

8 A. Yes.

9 Q. Have you spent a fair amount of time
10 looking at this document --

11 A. Yes.

12 Q. -- in connection with this case?

13 So you're fairly familiar with the
14 contents of this document; is that correct?

15 A. Yes.

16 Q. I'm going to turn to Example 1, which
17 starts on Page 10.

18 A. Okay.

19 Q. And at the same time I'm also going to
20 refer to the figure that's at Page 17.

21 Do you see the figure?

22 A. Which page again, please?

23 Q. 17 of the exhibit.

24 A. Yes.

25 Q. In looking at the description of the

1 Example 1, it states that "Figure 1 gives the
2 diagram for one embodiment of the present
3 invention."

4 Figure 1 is the figure I've referred to
5 on Page 17, correct?

6 A. Okay.

7 Q. Okay. So -- okay. So your Figure 1 --

8 A. Uh-huh.

9 Q. -- as described in the example you have
10 now before you, Figure 1, which is on Page 17 of
11 the example, correct?

12 A. Correct.

13 Q. And the description describes "A
14 stirred Reactor 1 made of nickel, equipped with a
15 device for heating and measuring the temperature of
16 the reaction medium, containing water and KOH
17 mixture, is continuously fed with a solution of
18 molten KOH(2)."

19 A. Yes.

20 Q. And so do you see in Figure 1 where the
21 Line 2 goes into Reactor 1?

22 A. Yes.

23 Q. The example goes on to state that KOH
24 is present at 60 percent by weight in the water and
25 with 236ea, correct?

1 A. Yes, that is 236ea.

2 Q. And you see that KOH is present in the
3 amount of 60 percent by weight of water, correct?

4 A. Yes. May I ask, what is a solution of
5 molten KOH?

6 Q. What do you understand the term
7 "solution of molten KOH" to mean?

8 A. I know what a solution is. I know what
9 molten is. It is normally a melt. So what is a
10 solution of molten? I've never seen them used
11 together.

12 Q. Well, what's a solution?

13 A. It's a component dissolved in a larger
14 liquid component.

15 Q. And what is molten KOH?

16 A. It -- it is a -- as I understand it,
17 molten is melted KOH, but is it a solution? Does
18 it have any other component in it? Is it --

19 Q. Well, if you look further into
20 Example 1 you'll see that there's an Evaporator 11,
21 which is where Line 2 comes from, which then feeds
22 into Reactor 1; do you see the Evaporator 11?

23 A. Yes.

24 Q. And Evaporator 11 is delivering 60
25 percent by weight of KOH in water, correct?

1 A. That is correct.

2 Q. And so does that suggest to you that
3 the solution being referred to is a solution that's
4 formed that has 60 percent -- that's formed -- let
5 me begin again.

6 And does that suggest to you that the
7 solution being referred to is a solution that is
8 formed from molten KOH that has 60 percent KOH in
9 water?

10 A. No, I don't understand the term
11 "molten."

12 Q. You don't understand what the term
13 "molten" means?

14 A. I know -- molten in this context.

15 Q. Well, it's molten KOH that's been
16 dissolved in water, correct?

17 A. So you're taking the melt of KOH and
18 dissolving it in water?

19 Q. Yes.

20 A. And -- okay.

21 Q. Does that term now make sense to you?

22 A. I do understand it now.

23 Q. Thank you. So the example goes on to
24 say that "The temperature is kept at 160 degrees C,
25 and the pressure in the reactor is 1.2 bar

1 absolute."

2 Do you see that?

3 A. I do see that.

4 Q. The example goes on to say, "The
5 gaseous product exits reactor by an Orifice 4
6 located in the cover."

7 Do you see that Orifice 4?

8 A. Yes.

9 Q. The example further states the water
10 contained in the gas stream is removed by
11 condensation, 13.

12 Do you see the Condenser 13?

13 A. Yes.

14 Q. "The Outlet 5 to Reactor 1" -- do you
15 see the Outlet 5 to Reactor 1?

16 A. Yes.

17 Q. -- "is connected to the inlet of
18 Reactor 6."

19 Do you see where 5 is connected to 6?

20 A. Yes.

21 Q. "And therefore provides Reactor 6 with
22 a supply of potassium fluoride."

23 Do you see that?

24 A. Yes.

25 Q. "The example further states that the

1 potassium fluoride may be in suspension or in the
2 aqueous medium."

3 Do you see that?

4 A. Yes.

5 Q. "Example further states that 10 percent
6 by weight suspension of calcium hydroxide and water
7 is introduced into Reactor 6 via Line 7."

8 Do you see that description in the
9 example on the figure?

10 A. Yes.

11 Q. "Reactor 6 is kept at a temperature
12 between 100 and 120 degrees."

13 Do you understand that?

14 A. Yes.

15 Q. "The outlet of Reactor 6 is connected
16 to a Filter 8 in order to separate the calcium
17 fluoride from the reaction medium."

18 Do you see that?

19 A. Yeah.

20 Q. "And then it's washed with water 9 to
21 obtain a purified calcium fluoride 12."

22 Do you see that as well?

23 A. Yes.

24 Q. "The example further states the aqueous
25 medium is separated from the calcium fluoride, and

1 also the calcium fluoride washing arms are then
2 recycled to Reactor 1 after adjustment of the
3 concentration in Evaporator 11."

4 Do you also see all of that?

5 A. Yes.

6 Q. "The mixture of molten KOH supplying
7 Reactor 1 is prepared by evaporation, removal of
8 water 15 of an aqueous solution of 50 percent by
9 weight of KOH."

10 Do you also see that reflected --

11 A. Yes.

12 Q. -- in the figure?

13 Is there anything about Example 1 that
14 you don't understand?

15 A. Okay. All right. Just to confirm that
16 the Evaporator 11 is being supplied with a 50
17 percent solution of KOH in water?

18 Q. Where do you see that?

19 A. The last sentence, "The mixture" --
20 I'm -- "The mixture of molten KOH supplying the
21 Reactor 1 was prepared by evaporation, removal of
22 water 15 of an aqueous solution of 50 percent by
23 weight of KOH."

24 Q. So I believe that refers to the KOH
25 that's exiting the evaporator and being supplied to

1 the Reactor 1; is that correct?

2 A. No. Because you say here that a
3 stirred reactor -- "Reactor 1 is supplied by in
4 which the KOH is present at 60 percent by weight in
5 the water."

6 Q. Okay. So you're saying that the 50
7 percent by weight KOH, that's describing what's
8 going into Evaporator 11, and that what comes out
9 the other side of the evaporator that goes into
10 Reactor 1 is 60 percent KOH?

11 A. Right. Now that goes back to my
12 definition of what is molten. Because in no -- in
13 no place in this procedure does the KOH ever exist
14 in a molten state. It is always in an aqueous
15 solution.

16 Q. Okay. So let's back up a little bit
17 then. So there's -- in that very last paragraph of
18 Example 1 there is a reference to 14. "So the
19 mixture of molten KOH supplying Reactor 1 is
20 prepared by evaporation, removal of water 15."

21 So the water goes off through Line 15.

22 A. Uh-huh.

23 Q. And then there's an -- an aqueous
24 solution of 50 percent by weight KOH 14?

25 A. Other -- other than the recycle line

1 from 8 going into 11 and 14, those are the only
2 inputs of KOH into that evaporator.

3 Q. Okay. So we have some concentration of
4 KOH and water that's coming from the recycle line?

5 A. Yes.

6 Q. Going into Evaporator 11, and then 14
7 is a supply of 50 percent KOH going into the
8 evaporator?

9 A. An aqueous solution.

10 Q. An aqueous solution. Okay. And then,
11 out of that comes a 60 percent aqueous solution of
12 KOH --

13 A. Yes.

14 Q. -- via Line 2 and 3 reactors?

15 A. I -- I totally agree with that. I
16 have -- I just don't know what --

17 Q. Okay.

18 A. -- molten KOH is.

19 Q. Okay. Fair enough. So -- so you're
20 just -- you've got issues with the term "molten"
21 being used, but as far as the way the process
22 works, you understand the process?

23 A. If I ignore the term "molten," then I
24 can rationalize it, but that -- I can see that as
25 an issue. If someone wanted to implement Sedat,

1 someone of ordinary skill might run into the same
2 issue that I have. How do you do this?

3 Q. So you don't know how to make a 60
4 percent --

5 A. I do. I just don't know how to make a
6 solution that's 60 percent in water that has molten
7 KOH.

8 Q. Okay. So we'll come back to molten
9 later.

10 A. Fine. Okay.

11 Q. Let's move on for now. So --

12 A. Okay.

13 Q. So looking at the process, other than
14 the term "molten," is there anything else that you
15 don't understand about Example 1 or Figure 1?

16 A. Well, if you look in my declaration, I
17 don't understand how you feed the 236ea into that
18 reactor and have a pressure of 1.2 bar, where in my
19 declaration -- if I can have a moment --

20 Q. Sure.

21 A. -- I'll find exactly what I said.

22 Yes. Starting on -- on Page 42 I
23 discuss the issues with the pressure and the vapor
24 pressure, and the vapor of 236ea at the temperature
25 that the reactor is operating, and in my example I

1 use the lower limit of temperature disclosed by
2 Sedat of 80 C. And 236ea at 80 C has a pressure of
3 10 bar. Sedat is silent as to how you do that and
4 maintain that pressure.

5 Q. Okay. We'll get to that.

6 A. Okay.

7 Q. Is there anything else with regard to
8 Example 1 that you don't understand or Figure 1
9 that you don't understand?

10 A. It's not that I don't understand the
11 figure, and maybe you will go on to question me
12 about our argument that Sedat is silent to anything
13 else in that spent KOH that exits Reactor 1 and
14 goes into the Reactor 6, where it is mixed with
15 lime, and the spent KOH is converted back to KOH.

16 In -- in a CSTR I think we've had
17 several examples where we've said that under
18 high-shear mixing there are entrained organics in
19 that system. Sedat doesn't stop or facilitate the
20 phase separation of it, so there's continuous
21 energy going into that. Sedat is silent to any
22 organics going into this.

23 Q. All right. So let's turn to Page
24 113 -- excuse me. Paragraph 113 of your report.

25 A. Yes, and that's -- that's what I've

1 said.

2 Q. Okay. So it's your opinion that there
3 would be organics entrained in the aqueous phase
4 reaction medium as a result of the shear mixing in
5 Reactor 1 in order to facilitate the reaction, and
6 there would be no phase separation under these
7 conditions, correct?

8 A. There would be no phase separation
9 going from Reactor 1 into 6.

10 Q. So in your report you state that --
11 it's your opinion that there would be "Organics
12 entrained in the aqueous phrase reaction medium as
13 a result of the shear mixing in Reactor 1. In
14 order to facilitate the reaction there would be no
15 phase separation under these conditions."

16 Would a person of ordinary skill in the
17 art also recognize that reading Sedat?

18 A. I think so, yes.

19 Q. And I think you just testified that
20 dissolved organics or entrained organics would exit
21 Reactor 1 with the aqueous spent KOH; is that
22 correct?

23 A. Yes.

24 Q. And then those dissolved or entrained
25 organics would then be introduced into Reactor 6 in

1 Sedat as well; is that correct?

2 A. Yes.

3 Q. And when I say "Sedat," you understand
4 that I'm referring to --

5 A. Exhibit 1005.

6 Q. Thank you. So earlier you testified
7 that calcium hydroxide, like KOH, is a
8 dehydrohalogenating agent, correct?

9 A. It can be. It is -- it is in that
10 class of chemicals.

11 Q. And in Reactor 6 of Sedat, calcium
12 hydroxide is present; is that correct?

13 A. That is correct.

14 Q. So would dehydrohalogenation be
15 occurring in Reactor 6 as a result of the presence
16 of calcium hydroxide and dissolved or entrained
17 organics?

18 A. I don't know. Sedat is silent as to
19 that.

20 Q. Would you expect that to occur based on
21 the knowledge of one of ordinary skill in the art
22 reading Sedat?

23 A. Calcium -- my experience with calcium
24 hydroxide, even though it is claimed in a lot of
25 patent applications, is -- is never used. It is

1 just there as to fill out the example and fill out
2 the claims. It is -- it is not an effective
3 dehydro -- dehydrohalogenating agent. So I would
4 say in as far as I know that, I would not expect
5 any significant substantial dehydrohalogenating to
6 occur in 6.

7 Q. Why is it that you say calcium
8 hydroxide is not an effective dehydrohalogenating
9 agent?

10 A. Solubility issues. It has extremely
11 low solubility over a wide range of temperatures.

12 Q. But you can't say that
13 dehydrohalogenation would not be occurring in
14 Reactor 6 of Sedat, correct?

15 A. I cannot say that some would not be
16 occurring, but effective in the sense that it aids
17 in the commercial -- this as a commercial process I
18 would not say that it is effective in that --

19 Q. Would -- would a person of ordinary
20 skill in the art reading Example 1 of Sedat also
21 believe that some dehydrohalogenation of calcium
22 hydroxide would be occurring in Reactor 6 as a
23 result of the presence of dissolved or entrained
24 organics and calcium hydroxide?

25 A. Probably not. I mean, most people do

1 not work with calcium hydroxide. They don't even
2 explore it. So someone of ordinary skill in the
3 art would probably be looking at potassium or
4 sodium hydroxide.

5 Q. Would it be desirable to have dissolved
6 or entrained organics present in Reactor 6 of
7 Sedat?

8 MR. ROSE: Objection to the form.

9 THE WITNESS: Sedat is silent. If
10 you're asking my opinion to that, I would say it
11 would not be desirable to have them in that.

12 BY MR. BAUM:

13 Q. Why would it not be desirable to
14 have -- let me begin again.

15 Why would it be undesirable to have
16 dissolved or entrained organics present in
17 Reactor 6 --

18 A. Well --

19 Q. -- of Sedat?

20 A. -- with entrained organics, once you --
21 once you -- well, when you're in Reactor 6, it is
22 not -- it's not doing anything. So why would you
23 want to have your reagents go through Reactor 6 and
24 not do anything when their next step is to go to 8
25 where you could potentially have them escape with

1 your calcium fluoride.

2 The other big issue there is most
3 environmental permitting agents would have a big
4 issue with having your organic in that system,
5 because now you have -- you have -- you're handling
6 a solid, and you have -- you have a path to escape
7 out of a closed system. There could be a very big
8 issue with -- with safety. Personnel could be
9 exposed to this material, and just general escape
10 into the environment. It's an environmental
11 hazard.

12 Q. So if you wanted to remove dissolved or
13 entrained organics before they got to Reactor 6 in
14 Sedat, how would one of ordinary skill in the art
15 accomplish that separation?

16 A. Probably by applying some of the
17 techniques of the '282 patent. You could stop
18 stirring intermittently and facilitate a recovery
19 where you are separating the organic, similar to
20 what the '282 patent did.

21 Q. Could you also use a decanter as you've
22 described previously?

23 A. Sure, and -- and the '282 patent the --
24 the PCC -- the SPCC is a form of decanter. It may
25 not be a continuous decanter as applied to the

1 laboratory experiments, but --

2 Q. But you can just use a typical decanter
3 in between Reactor 1 --

4 A. Right.

5 Q. -- and Reactor --

6 A. Right.

7 Q. -- 6 of Sedat, correct?

8 A. Right.

9 MR. ROSE: Objection to form.

10 Let him finish his question.

11 THE WITNESS: Sorry. Excuse me. I
12 lost --

13 BY MR. BAUM:

14 Q. But you could just use a typical
15 decanter in between Reactor 1 and Reactor 6 of
16 Sedat to accomplish that separation, correct?

17 MR. ROSE: Objection to form.

18 THE WITNESS: Possibly not, because
19 even though you remove the entrained organics
20 through phase separation, you ultimately approach
21 the limiting solubility of those organics, and
22 depending on the organic 236ea, I don't know what
23 the environmental regulations are that limiting
24 solubility could be an issue as it goes further
25 through the process.

1 BY MR. BAUM:

2 Q. But you could, using a decanter between
3 Reactor 1 and Reactor 6 of Sedat, remove
4 substantially all of the entrained or dissolved
5 organics, correct?

6 A. That --

7 MR. ROSE: Objection, form.

8 THE WITNESS: In -- in my -- it's not
9 disclosed in Sedat, so in my expert opinion, maybe.
10 It's not clearcut.

11 BY MR. BAUM:

12 Q. And why isn't it clearcut?

13 A. Because the limiting -- I -- I -- I do
14 not know what the environmental regulations are in
15 terms of having 236ea escape into the environment.
16 Is that limiting solubility with a regular decanter
17 sufficient? I don't know.

18 Q. So my question wasn't whether you would
19 be complying with environmental regulations or not.

20 A. Oh.

21 Q. My question really was just could you
22 use a typical decanter in between Reactor 1 of
23 Sedat and Reactor 6 of Sedat to separate out any
24 dissolved or entrained organics?

25 MR. ROSE: Objection to form.

1 THE WITNESS: You could -- you could --
2 sorry, could you repeat -- how did you phrase the
3 entrained organics -- entrained organics? How did
4 you --

5 BY MR. BAUM:

6 Q. So I'm using the term just the way you
7 are in your report.

8 A. Substantially?

9 Q. Well, let's just start, you know --
10 you've defined in your report --

11 A. Recovery as substantially separating
12 spent KOH from anything else in the stream.

13 Q. Right. And so my question isn't
14 whether you would be complying with --

15 A. Okay.

16 Q. -- regulatory standards or not. My
17 question is simply: Would one of ordinary skill in
18 the art be able to remove any of the dissolved or
19 entrained organics -- well, let me begin again.

20 My question is just whether one of
21 ordinary skill in the art would be able to remove
22 dissolved organics by placing a typical decanter
23 between Reactor 1 and Reactor 6 of Sedat?

24 MR. ROSE: Objection to form.

25 THE WITNESS: They might substantially

1 remove dissolved organics, but possibly not
2 completely.

3 BY MR. BAUM:

4 Q. Thank you.

5 MR. ROSE: Counsel, it's been about an
6 hour, so if you're at a shifting over point, I
7 don't want to break up --

8 MR. BAUM: Sure.

9 MR. ROSE: -- your line --

10 MR. BAUM: Let me just --

11 MR. ROSE: -- of questioning, but --

12 MR. BAUM: Let me finish looking
13 through something here.

14 MR. ROSE: Sure. Sure.

15 MR. BAUM: I'm close.

16 Okay. This is a good time to stop.

17 Thanks.

18 THE VIDEOGRAPHER: The time is 3:42.

19 And we are now going off the record.

20 * * *

21 (Whereupon, there was a recess in the
22 proceedings from 3:42 p.m. to 4:06 p.m.)

23 * * *

24 THE VIDEOGRAPHER: The time is 4:06.

25 We're going back on the record.

1 (EXHIBIT 1003, International
2 Publication No. W0 2009/138764 A1, was previously
3 marked for identification.)

4 MR. BAUM: I'm placing before the
5 witness a copy of Petitioner's Exhibit 1003, a PCT
6 publication W0 2009/138764.

7 BY MR. BAUM:

8 Q. Are you familiar with this document,
9 Dr. Lousenberg?

10 A. Yes, I am.

11 Q. Is this another document that you spent
12 a fair amount of time studying during your
13 involvement in this matter?

14 A. Yes, I have.

15 Q. Is this a document that you understand
16 to be referred to as "Smith"?

17 A. Yes, it is.

18 Q. I'm directing you to look at the bottom
19 of Page 1, please. The paragraph at the bottom of
20 the page says that "The subject invention addresses
21 the deficiencies of known methods for preparing
22 1234yf by providing a process for the preparation
23 of 1234 comprising contacting HFP with hydrogen in
24 the presence of a hydrogen catalyst to produce
25 236ea."

1 A. Uh-huh.

2 Q. "Defluorinating [sic] 236ea to produce
3 1225ye; contacting 1225ye with hydrogen in the
4 presence of a hydrogen catalyst to present 245eb;
5 and then dehydrofluorinating to 245eb to produce
6 1234yf."

7 Do you see that?

8 A. Yes, I do.

9 Q. And do you see in the very -- the very
10 next Page 2, the second full paragraph says, "Each
11 of Steps A to D," which I just read to you --

12 A. Uh-huh.

13 Q. -- "may be carried out batchwise or
14 continuously, preferably continuously."

15 Do you see that?

16 A. Yes.

17 Q. And then that paragraph further states
18 that "A stirred tank reactor may be used."

19 Do you see that?

20 A. Yes.

21 Q. The paragraph following that says that
22 "Any of the aspects of the process of the invention
23 described herein, the products from Steps A, B, C,
24 and/or D, may be subject to a purification step."

25 A. Uh-huh.

1 Q. "The purification may be achieved, for
2 example, by separation of desired products or
3 reagents by one or more distillation, condensation
4 or phase separation steps and/or by scrubbing with
5 water or aqueous base."

6 Do you see that?

7 A. I do.

8 Q. Okay. If you next turn to Page 11.
9 The second full paragraph says, "Another preferred
10 method of effecting the dehydrofluorination in
11 steps B and D is by contacting 236ea and/or 245eb
12 with a base-mediated dehydrofluorination.
13 Preferably, the base is a metal hydroxide or amide
14 (preferably a basic metal hydroxide or amide.)
15 Example, an alkali or alkaline earth metal
16 hydroxide or amide."

17 And then if you'd skip down to the next
18 paragraph, you'll see that potassium hydroxide is
19 listed as one of the alkali metal hydroxides; do
20 you see that?

21 A. Yes, I do.

22 Q. And then if you skip over to Page 12
23 and you look at the third full paragraph, it says
24 that "A preferred base is an alkali metal hydroxide
25 selected from a group consisting of lithium

1 hydroxide, sodium hydroxide, potassium hydroxide,
2 more preferably, sodium hydroxide and potassium
3 hydroxide, and most preferably potassium
4 hydroxide."

5 Do you see that?

6 A. Yes, I do.

7 Q. The last full paragraph on that Page 12
8 says, "The base is typically present in an amount
9 from 1 to 50 percent by weight, based on the total
10 weight of the components which make up Steps B and
11 D. Preferably, the base is present in an amount
12 from 5 to 30 percent by weight."

13 Do you see that?

14 A. Yes, I do.

15 Q. And then the first sentence of the
16 penultimate paragraph, "As mentioned above, the
17 base-mediated dehydrofluorination may preferably
18 employ water as the solvent."

19 Do you see that?

20 A. Yes.

21 Q. And then turning to Page 13, "The
22 base-mediated" -- this is the first full paragraph.
23 "The base-mediated dehydrofluorination steps of B
24 and D is preferably conducted in the presence of a
25 catalyst. The catalyst is preferably a

1 phase-transfer catalyst which facilitates the
2 transfer of ionic compounds into an organic phase
3 from, for example, a water phase."

4 Do you see that?

5 A. Yes, I do.

6 Q. And then the next paragraph down on
7 Page 13 says, "An effective amount of the
8 phase-transfer catalyst should be used in order to
9 effect the desired reaction, influence selectivity
10 to the desired products or enhance the yield; such
11 as an amount can be determined by limited
12 experimentation once the reactants, process
13 conditions, and phase-transfer catalyst are
14 selected."

15 Do you see that?

16 A. Yes.

17 Q. If you could turn to Page -- excuse me,
18 Paragraph 118 of your expert report in IPR915,
19 please.

20 A. Could you repeat the page?

21 Q. I'm sorry. Paragraph 118.

22 A. 118. Yes.

23 Q. Do you see you say there, "A person of
24 ordinary skill in the art would understand that an
25 alkali halide salt (example KF) would be present as

1 a reaction by-product of the base-mediated
2 dehydrofluorination steps purportedly disclosed in
3 Smith"?

4 A. Yes.

5 Q. And so it's your opinion that Smith --
6 let me begin again.

7 So it's your opinion that a person of
8 ordinary skill in the art would understand that an
9 alkali halide salt such as KF would be present as a
10 reaction product of the base-mediated
11 dehydrofluorination steps purportedly disclosed in
12 Smith, correct?

13 MR. ROSE: Object to --

14 THE WITNESS: As a re --

15 MR. ROSE: -- the form.

16 THE WITNESS: As a reaction by-product.

17 BY MR. BAUM:

18 Q. Yes. I understand. Earlier, before
19 the break, we were talking about the Sedat
20 reference?

21 A. Uh-huh.

22 Q. Do you recall that?

23 A. Yes.

24 Q. And specifically, in Sedat Reactor 6
25 discloses KF conversion to KOH plus calcium

1 fluoride --

2 A. Yes.

3 Q. -- correct?

4 So on the one hand, Smith teaches a
5 by-product KF, and on the other Sedat teaches how
6 to convert KF back to KOH, correct? Let me -- let
7 me rephrase that.

8 Is it correct that Smith teaches a
9 by-product KF, and Sedat teaches how to convert KF
10 back to KOH?

11 MR. ROSE: Objection. Form.

12 THE WITNESS: Yes.

13 BY MR. BAUM:

14 Q. Is there any reason why one of ordinary
15 skill in the art in 2010 would not have looked to
16 Sedat for teaching concerning what to do with that
17 by-product KF present in Smith?

18 A. Yes.

19 Q. And what is that reason?

20 A. Well, Smith does disclose the
21 by-product KF, but he does not disclose any
22 appreciable amount of spent KOH, which is KOH and
23 KF. If there's no KOH, I think I said before that
24 KF is a valuable product. You don't have to
25 recycle that. You can sell that and avoid the

[illegible]

[illegible]

23 Q. And so do you agree that under some
24 circumstances it would make sense to convert the KF
25 to KOH and calcium fluoride?

1 A. Yes.

2 Q. And besides conversion, there are two
3 other options that you mentioned, sell and
4 disposal, correct?

5 A. Correct.

6 Q. And there are no other options,
7 correct?

8 MR. ROSE: Object to form.

9 THE WITNESS: I'm not aware of other
10 options. I don't know that there are no other
11 options.

12 BY MR. BAUM:

13 Q. And just to make sure we have a clear
14 question, so there are no other options in terms of
15 further processing for by-product KF other than
16 conversion to KOH and calcium fluoride on the one
17 hand or disposal or sale on the other; is that
18 correct?

19 MR. ROSE: Objection to form.

20 THE WITNESS: Can you say that one more
21 time, please?

22 MR. BAUM: Could you read the question
23 back, please?

24 (The following question was read back:

25 Q: And just to make sure we have a

1 clear question, so there are no other options in
2 terms of further processing for by-product KF other
3 than conversion to KOH and calcium fluoride on the
4 one hand or disposal or sale on the other; is that
5 correct?)

6 THE WITNESS: I am not aware of other
7 options. I don't know that there are no other
8 options.

9 BY MR. BAUM:

10 Q. So Smith discloses by-product KF.
11 We've already discussed that, correct?

12 A. Uh-huh.

13 Q. And Sedat teaches conversion of
14 by-product KF to calcium hydroxide -- excuse me. I
15 will begin again.

16 Sedat teaches conversion of by-product
17 KF to calcium fluoride and potassium hydroxide,
18 correct?

19 A. Smith teaches production of byproduct
20 KF, yes, I agree. But there's a subtle difference
21 in Sedat. Sedat teaches conversion of KF in spent
22 KOH to KOH.

23 Q. Does the presence of spent KOH in the
24 Reactor 6 of Sedat impact the chemistry -- well,
25 let me rephrase that.

1 Does the presence of spent KOH in
2 Reactor 6 of Sedat impede the reaction of KF plus
3 calcium hydroxide to give KOH and calcium fluoride?

4 MR. ROSE: Objection to form.

5 THE WITNESS: I don't know, but if
6 you're asking my expert opinion, I would say that
7 no, it does not impede the conversion of calcium
8 fluoride to calcium hydroxide.

9 BY MR. BAUM:

10 Q. So then ignoring the presence of
11 dissolved organics in Sedat --

12 A. Okay.

13 Q. -- why wouldn't one of ordinary skill
14 combine the teaching in Sedat with regard to KF
15 conversion to the KF by-product from Smith?

16 A. Cost of implementing that process.
17 There is a capital cost and increased fixed and
18 variable costs that you have to incur. You have to
19 recoup your investment somehow. So now the product
20 that you are making is more expensive than a
21 product that someone just looking at Smith would
22 say, hey, I've got a KF stream. I can sell this.
23 I do not have to invest in a plant to convert this.
24 So that's the difference.

25 Q. So earlier you testified there's three

1 options with regard to what to do with that KF.

2 A. Right.

3 Q. You can convert it back to KOH. You
4 can sell it. Or you can dispose of it; those are
5 your options?

6 A. I didn't say all options were equal.

7 MR. ROSE: Objection to form. Asked
8 and answered.

9 BY MR. BAUM:

10 Q. Okay. So from a design -- let me begin
11 again.

12 From a chemical process design
13 standpoint, all three of those options are
14 reasonable options to pursue, correct?

15 A. Not with Smith.

16 Q. And why is that?

17 A. Because Smith doesn't -- doesn't --
18 doesn't disclose any spent KOH remaining in that --
19 or any KOH remaining in that spent KOH that would
20 need to be recovered.

21 Q. Smith does disclose --

22 A. You're not throwing -- Smith does not
23 disclose spent KOH.

24 Q. Smith does disclose spent KF though --
25 let me begin again.

1 Smith does disclose --

2 A. Right.

3 Q. -- by-product KF --

4 A. Right.

5 Q. -- correct?

6 A. Right.

7 Q. So isn't that reason enough in and of
8 itself to look to the KF conversion process in
9 Sedat so that you can reuse the KF?

10 MR. ROSE: Objection to form.

11 THE WITNESS: No.

12 BY MR. BAUM:

13 Q. Why not?

14 MR. ROSE: Objection. Asked and
15 answered.

16 THE WITNESS: I answered it earlier.
17 Because there is no reason to spend the excess
18 capital to make an efficient process. Yeah, you've
19 made your -- you've made your process more
20 expensive.

21 BY MR. BAUM:

22 Q. So a few minutes ago you testified that
23 under at least some circumstances that it makes
24 sense to convert KF --

25 A. Right.

1 Q. -- back to KOH?

2 A. And -- and -- and I believe I answered
3 that when there is actually KOH in that mixture.
4 There is no KOH. Smith doesn't -- is silent to any
5 KOH remaining in that mixture.

6 Q. What does the presence of KOH in Smith
7 have to do with the desire to convert the KF
8 by-product in Smith back to KOH?

9 MR. ROSE: Objection to form.

10 THE WITNESS: Well --

11 MR. ROSE: You can answer if you can.

12 THE WITNESS: With that KOH there and
13 KF mixture, you're limited in what you can do with
14 it, if you know -- if you know it's still an
15 appreciable fraction of KOH. You can't necessarily
16 sell it as a mixture like that, so if you're
17 disposing of it, you're throwing away KOH.

18 In Smith it's KF. You're not throwing
19 away KOH, but you can sell the KF.

20 BY MR. BAUM:

21 Q. Do you know how much KOH cost in 2010?

22 A. I did a high-level Google search. KF,
23 it -- it ranges on -- somewhere around \$1,000 a
24 ton, same with KOH. They're very similar in price.

25 Q. So 2010 it's your testimony that both

1 KOH and KF sold for about \$1,000 a ton?

2 A. Approximately.

3 Q. Do you know what the cost in 2010 of
4 disposing of one ton of KF was?

5 A. No, I do not.

6 Q. So as you sit here today, you have no
7 idea whether or not in 2010 it was more or --
8 expensive to dispose of KF than to convert it back
9 to KOH?

10 MR. ROSE: Objection to form.

11 THE WITNESS: Can you say that again,
12 please.

13 MR. BAUM: Could you read the question
14 back?

15 (The following question was read back:

16 Q: So as you sit here today, you have
17 no idea whether or not in 2010 it was more or --
18 expensive to dispose of KF than to convert it back
19 to KOH?)

20 THE WITNESS: I do not, but I do know
21 that it would be more expensive to dispose it than
22 to sell it.

23 BY MR. BAUM:

24 Q. So of the three options, convert KF
25 back to KOH, sell it, or dispose of it, disposing

1 of it wouldn't make any sense, because it would
2 cost more than selling it, correct?

3 A. Exactly. That's -- that's -- that's a
4 negative dollar input to the process, whereas
5 selling it is a positive dollar input to the
6 process.

7 Q. So in your mind, in 2010, your options,
8 with regard to what to do with that by-product KF
9 in Smith were to either convert it back to KOH or
10 sell it, correct?

11 MR. ROSE: Objection to form.

12 THE WITNESS: I don't know that
13 converting it -- the fixed and variable and capital
14 costs of converting it justify doing that over
15 disposing it.

16 BY MR. BAUM:

17 Q. Do you know what the fixed and variable
18 costs of converting KF to KOH would have been in
19 2010?

20 A. It would be the cost of a plant.
21 Plants typically run in the tens of millions of
22 dollars. So the overall process economics would
23 have to incorporate that into the business model.

24 Q. Well, it's really not the cost of a
25 plant, right? I mean, what we're really talking

1 about here is some equipment that happens to be in
2 a plant that already exists to make --

3 A. How do we know this?

4 Q. Well, let's explore that.

5 A. This could be total -- total greenfield
6 plant. You may -- you may have to -- let's --
7 okay. Let's explore that. We agree that, as
8 outlined, we're really talking about four steps to
9 make 1234yf. Two of those steps require a
10 dehydrofluorination. So let's assume for argument
11 sake that those two dehydrofluorination steps are
12 the same scale, right?

13 So you need -- so your -- your -- your
14 investment for four steps is some dollars. Now you
15 have to invest in plant capability that may not be
16 50 percent of that, but you really have to be able
17 to handle the output of two steps.

18 So realistically you've increased your
19 costs by argument sake from maybe 25 to 50 percent
20 in the design of your plant.

21 Q. So the -- let's talk about the
22 equipment that is --

23 A. Sure.

24 Q. -- involved in a KF conversion such as
25 that in the Sedat.

1 A. Okay. If we're going to do that, we --
2 we should discuss what they're made out of.

3 Q. So the Sedat says that they're -- so
4 what kind of reactor would you need?

5 A. Well, let's look at what we're dealing
6 with. We're dealing with 60 percent by weight KOH
7 in water. We're operating under pressure. We're
8 operating under 160 degrees?

9 Q. Right.

10 A. That's just for the dehydrofluorination
11 reactor. We're looking at some very costly
12 equipment made out of high alloys like Hastelloy
13 and Inconel to do this process.

14 Q. That's with regard to Reactor 1 of --

15 A. Right.

16 Q. -- Sedat, correct?

17 A. Look -- look at the next step. We
18 still have a fairly hot process, over a hundred
19 degrees. The -- we have potassium fluoride itself.
20 Fluoride is a corrosive. We are converting that
21 fluoride back to caustic, and it -- it may not meet
22 the pressure requirement, but it's still an
23 expensive process; plus if we're doing this for two
24 steps, it pretty much needs to be twice as big.

25 Q. Smith, you said, teaches four steps?

1 A. Right.

2 Q. You need a lot of expensive equipment
3 for those four steps, correct?

4 A. Okay. Well, let's take this to the
5 extent that Sedat --

6 MR. ROSE: Let him ask his question.

7 THE WITNESS: Sorry.

8 BY MR. BAUM:

9 Q. So your sunk costs in a plant, whether
10 you have this KF conversion or not, there's a huge
11 expense involved in just the equipment you need for
12 the four steps you've described in Smith, correct?

13 A. Yes. Let's assume that we're doing
14 vapor phase hydrogenation with a noble metal
15 catalyst. Those -- yes, those are typically made
16 out of -- those vapor Phase 2s are typically made
17 out of high alloy too as well.

18 Q. Okay. And that's what Smith
19 discloses --

20 A. Yeah.

21 Q. -- correct?

22 So if we were going to add a KF
23 conversion step to that existing equipment from
24 Smith to conduct those four steps, what we're
25 talking about adding is an additional reactor which

1 is Reactor 6 in Sedat, as well as some filtration
2 and washing equipment?

3 A. Are you going to cam -- run your plant
4 in campaign mode, which is less efficient than
5 running two steps parallel, so, yes, you could do
6 that. But probably you would want to have one for
7 each step, possibly.

8 Q. Well, let's assume that whoever is --
9 well, let me begin again.

10 So whether you've got one step of KF
11 conversion or two, that's still going to be an
12 addition over all the expensive equipment that
13 you --

14 A. Right.

15 Q. -- already have --

16 A. Right.

17 Q. -- to have in place for Steps 1
18 through -- or A through D of Smith, correct?

19 A. Yes.

20 Q. So what we're really talking about here
21 is the incremental expense of adding the KF
22 conversion capability to an already very expensive
23 plant, correct?

24 A. Well, we're -- we're arguing extent of
25 dollars. Everything being equal, my argument that

1 to do that 25 to 50 percent increase in capital
2 cost, not to mention the variable costs that you've
3 now incurred, lime is not free. You can sell the
4 calcium fluoride, of course, but all of the
5 utilities and manpower required to run that,
6 it's -- it's not just the cost of the plant. It's
7 also the cost in order to run the plant.

8 Q. And what's your basis for saying that
9 the cost will be 25 to 50 percent higher with KF
10 conversion?

11 A. It's -- it's just based on four steps
12 of a given side, and for simplicity sake I said
13 they were more or less the same, but I had two
14 outputs of KF that needed to be converted to KOH,
15 so it needs to be about twice the -- twice the size
16 of those two dehydrofluorination steps.

17 Q. Do you know what the cost of a
18 commercial-size Hastelloy reactor was in 2010?

19 A. Offhand, no.

20 Q. In rendering your opinion that it would
21 be more expensive to convert K -- to convert KF to
22 KOH than to sell the KF, did you take into account
23 the price of a Hastelloy reactor in 2010?

24 A. I did not.

25 Q. Earlier you mentioned that the sale --

1 the price -- let me begin again.

2 Earlier you mentioned that the price of
3 KF and KOH was about \$1,000 per ton; is that
4 correct?

5 A. Yes.

6 Q. And you've mentioned that there was
7 some document that you saw this in, correct?

8 A. Let me clarify. I quoted a price that
9 I saw on Alibaba. I don't know that those were
10 2010 prices. I --

11 Q. Okay. That's -- I appreciate your
12 honesty. So the Alibaba quotation you're referring
13 to, that's not listed in your materials of things
14 you reviewed --

15 A. Right.

16 Q. -- in your declaration?

17 A. You -- you are correct. I -- I did --
18 I did a Google search of market prices for KF and
19 KOH.

20 Q. When -- when did you do that Google
21 search?

22 A. In November, I believe.

23 Q. So as you sit here today, you can't
24 tell me what the cost of the equipment needed to
25 implement KF conversion in the process of Smith

1 would cost, correct?

2 A. In absolute dollars, no.

3 Q. And you can't tell me what the cost of
4 equipment needed to implement KF conversion in the
5 process of Smith would have cost in 2010, correct?

6 A. I cannot.

7 Q. So to summarize, there are two
8 realistic options for what to do with the
9 by-product KF in Smith. One option is to convert
10 KF to KOH, and you've told me that you can't tell
11 me what the real cost of that would have been in
12 2010.

13 And the other option would have been to
14 sell KF, and you can't tell me what the price of KF
15 was in 2010, correct?

16 MR. ROSE: Objection. Form. Asked and
17 answered. And argumentative.

18 BY MR. BAUM:

19 Q. Answer, if you can.

20 A. Okay. No, I cannot tell you that.

21 Q. So of the two options that we've been
22 discussing for what to do with by-product KF from
23 Smith, on the one hand, converting it to KOH, and
24 on the other hand, selling it, in 2010 both would
25 be reasonable options to pursue, correct?

1 MR. ROSE: Objection to form.

2 THE WITNESS: I don't know. I know
3 that what I know is less investment is preferred if
4 you have another option for stream.

5 BY MR. BAUM:

6 Q. But in 2010 a person of ordinary skill
7 in the art would have looked at both options in
8 designing a process, correct?

9 A. I don't think things have changed that
10 much in six years.

11 Q. Well, let --

12 A. The cost of reactors has not -- does
13 not cycle up and down. It typically goes up at a
14 steady rate. Reactors never get cheaper.

15 Q. So does that mean, as a responsible
16 process design chemist, you wouldn't consider
17 converting KF to KOH if you only have two options?

18 MR. ROSE: Objection to form.

19 THE WITNESS: I would consider it.

20 MR. ROSE: Argumentative.

21 THE WITNESS: But I don't think it
22 would be the preferred option if all I have is KF.

23 BY MR. BAUM:

24 Q. If KF, in 2010, was a lot more
25 expensive than you think it was, would it make

1 sense to convert KF to KOH instead of selling it to
2 a third party?

3 MR. ROSE: Objection to form.

4 THE WITNESS: More expensive than what?

5 BY MR. BAUM:

6 Q. \$1,000 a ton?

7 A. Well, if it was more expensive -- yes,
8 if it's more expensive, it makes more sense to sell
9 it.

10 Q. If it's less expensive, wouldn't it
11 make sense -- well, let me rephrase.

12 If KF, in 2010, was a lot less
13 expensive than you think it was, would it make
14 sense to convert KF to KOH instead of selling it to
15 a third party?

16 MR. ROSE: Objection to form.

17 THE WITNESS: Again, it would be
18 relative to -- let me -- let me think about that a
19 little bit in detail. If KF was less expensive --
20 because we really -- I mean, in terms of salts
21 here, we have KF, KOH and calcium fluoride. So if
22 KF was less expensive, now wouldn't -- I don't know
23 that I can answer that question accurately without
24 knowing in relation to what, because we have the
25 KF, the KOH, plus the lime. I would need -- I

1 would need to know the prices of each relative to
2 each other when that KF was less expensive in order
3 to give an accurate or reasonable answer.

4 BY MR. BAUM:

5 Q. And sitting here today, you don't know
6 what the prices of any of those salts are, correct?

7 A. Well, I know the price of KF and KOH
8 is -- is -- is about \$1,000 a ton. I know that
9 lime is on the order of \$100 a ton. It may be in
10 that give or take. And calcium fluoride fluorspar
11 is a couple hundred dollars a ton.

12 Q. The price that you're quoting for these
13 salts, that's in 2016, 2015?

14 A. Yes.

15 Q. They're not the prices as they were in
16 2010, correct?

17 A. I don't know.

18 Q. Are there any concerns in removing KF
19 from an otherwise closed system?

20 A. It is an environmental hazard, KF; it
21 is corrosive.

22 Q. So there's safety concerns --

23 A. Yes.

24 Q. -- too?

25 A. But I don't think they're concerns that

1 can't be mitigated in a well-run plant. And I
2 don't think they're concerns that require a large
3 investment to actually handle.

4 Q. So it's more of an environmental issue?

5 A. Yeah.

6 Q. That's true today?

7 A. Sure.

8 Q. Was that true back in 2010 as well?

9 A. Sure. I -- in my expert opinion, I
10 believe that would be true. Properties of KF have
11 been known for a long time.

12 Q. And earlier today you mentioned some
13 environmental concerns with regard to environmental
14 release of 236 or 245?

15 A. Right.

16 Q. That's true today?

17 A. Yes.

18 Q. And that was true back in 2010 as well?

19 A. Probably -- probably a lot more is
20 known about these materials now than they were in
21 2010. As you know, 1234yf and related
22 intermediates, are relatively new products, and
23 part of the commercialization process has been
24 evaluation of these properties, specifically 1234yf
25 for toxicity and its environmental fate. It's a

1 low global-warming refrigerant. That's why it's
2 being phased in favor of 134a, at least in
3 automotive applications.

4 So there has been a lot of ongoing
5 testing that I may not be aware of, but one -- one
6 of the -- the -- at least in the 1234yf and 1225ye,
7 those are low -- low global-warming, low greenhouse
8 ozone-depleting materials. With the 236ea and
9 245fa those are relatively higher global-warming
10 materials, and I don't know about their -- how
11 long -- exactly how long their atmospheric
12 lifetimes are, but I don't think they're ozone
13 depleting. I don't know for sure.

14 Q. So, as a general matter, the release of
15 organic reactants into the environment is
16 problematic today?

17 A. Yes, right now the reason we are -- we
18 are phasing out 134a is because it is an automotive
19 refrigerant; most automotive refrigeration systems
20 leak, and so it is contributing to global warming.

21 Q. And back in 2010 the release -- the
22 environmental release of 236 or 245 would also have
23 been problematic?

24 A. No, because I don't think there was a
25 lot produced in the world at that time. It's

1 really scaled up in the last decade.

2 Q. The price of potassium fluoride that
3 you gave earlier, was that for relatively pure KF?

4 A. I saw a range of prices that ranged
5 from probably about \$800 a ton, maybe up to \$1500 a
6 ton. I didn't delve deeply into the purity of the
7 material. And for all the materials that I looked
8 at, like KF or KOH, I looked at a solid form. I
9 didn't look at solutions.

10 Q. Okay. So I'd like you to turn to
11 Paragraph 113 of your report, please. In this
12 paragraph you indicate, "It is my position that
13 there would be organics entrained in the aqueous
14 phase reaction medium as a result of the shear
15 mixing in Reactor 1 in order to facilitate the
16 reaction, and there would be no phase separation
17 under these conditions."

18 Do you see that?

19 A. Yes, I do.

20 Q. And in this paragraph you're referring
21 to Reactor 1 of Sedat, correct?

22 A. That is correct.

23 Q. So would entrainment of organics 236
24 and 245 lead to a reaction?

25 A. Sorry. I don't understand the

1 question.

2 MR. ROSE: Objection to form.

3 THE WITNESS: A reaction -- a reaction
4 of what with what?

5 BY MR. BAUM:

6 Q. A reaction of 236 or 245 with 1225.
7 Let me rephrase.

8 MR. BAUM: Let's take about a
9 five-minute break and come back.

10 THE WITNESS: Okay.

11 THE VIDEOGRAPHER: We are now going off
12 the record. The time is 4:53.

13 * * *

14 (Whereupon, there was a recess in the
15 proceedings from 4:53 p.m. to 5:06 p.m.)

16 * * *

17 THE VIDEOGRAPHER: The time is 6:06
18 [sic], and we're now going back on the record.

19 BY MR. BAUM:

20 Q. Dr. Lousenberg, I'd like to direct your
21 attention back to the Sedat reference --

22 A. Sure.

23 Q. -- which is Exhibit 1005.

24 A. Okay. I'll look at those numbers.
25 There it is.

1 Q. And if you could look to Figure 1,
2 please, on Page 17.

3 A. Okay.

4 Q. You see there's a stir depicted in
5 Reactor 1?

6 A. Yes.

7 Q. Do you see that?

8 A. Yes.

9 Q. And then you see there's a Line 3
10 coming in to Reactor 1?

11 A. Yes.

12 Q. And then if you recall from the
13 Example 1 description it says that that is 236ea --

14 A. Yes.

15 Q. -- reactant coming in?

16 In looking at this figure, does it
17 depict inserting the 236ea at close proximity to
18 the stir of Reactor 1?

19 A. It appears that it does.

20 Q. Would you expect one of ordinary skill
21 in the art to recognize that it would be desirable
22 to insert the 236ea in close proximity to the stir?

23 MR. ROSE: Objection to form.

24 THE WITNESS: Yes.

25 BY MR. BAUM:

1 Q. Going back to your report in IPR11 --
2 excuse me -- IPR915, Paragraph 113.

3 A. Uh-huh.

4 Q. You state it's your opinion that there
5 would be "Organics entrained in the aqueous phase
6 reaction medium as a result of the shear mixing
7 Reactor 1 in order to facilitate the reaction, and
8 there would be no phase separation under these
9 conditions."

10 Do you see that?

11 A. Yes, I do.

12 Q. What is the reaction that you're
13 referring to in Paragraph 113?

14 A. The reaction of 236ea with the
15 dehydrohalogenating agent to make 1225ye.

16 Q. The dehydrohalogenating agent is KOH,
17 correct?

18 A. Yes. As presented in the Example 1.

19 Q. Is it your opinion that a reaction
20 would occur between 236ea being inserted into the
21 reactor and KOH present in the reactor?

22 A. Yes.

23 Q. I'd like to turn to Paragraph 127 of
24 your report.

25 A. Yes.

1 Q. And in Paragraphs 127 through 132 --

2 A. Uh-huh.

3 Q. -- you make some calculations, correct?

4 A. Correct.

5 Q. And what do those calculations address?

6 A. The vapor pressure of 236ea in
7 equilibrium with its liquid and vapor.

8 Q. Do those calculations address anything
9 else?

10 MR. ROSE: Object to form.

11 THE WITNESS: They -- they -- sorry.

12 Would you say the question again?

13 BY MR. BAUM:

14 Q. Do those calculations address anything
15 other than the vapor pressure of 236ea and
16 equilibrium with its liquid and vapor?

17 A. The -- yeah, the calculations
18 address -- address the -- they show that the -- the
19 pressure of 236ea is greater than the pressure that
20 is disclosed for operation of the reactor.

21 Q. So in Paragraph 130 you state, "For
22 this reaction to occur without reactants escaping
23 the reactor, the dehydrofluorination reaction for
24 236ea would need to occur at a pressure of 10 bar,
25 and for 245eb it would need to occur at a pressure

1 of 6 bar."

2 Do you see that?

3 A. I do.

4 Q. Did the calculations that you conducted
5 that enabled you to reach that conclusion take into
6 account the fact that there's shear mixing
7 occurring in Reactor 1 of Sedat?

8 A. They do not, but I'm not aware that
9 shear mixing is a factor in the vapor pressure,
10 because they are immiscible fluids. If they were
11 miscible or dissolved, then the vapor pressure
12 would be lower, but they're not. There's no
13 significant dissolving of the 236ea in the water.
14 So the vapor pressure of the 236ea I would expect
15 to be very close to the pure vapor liquid
16 equilibrium pressure of 236ea.

17 Q. But it's still your opinion that there
18 is reaction occurring in Reactor 1 of Sedat between
19 236ea and KOH, correct?

20 A. That is correct.

21 Q. Does your opinion expressed in -- let
22 me begin again.

23 Is your conclusion that "For the
24 reaction to occur between 236 and KOH without
25 reactants escaping the reactor the

1 dehydrofluorination for 236ea would need to occur
2 at a pressure of 10 bar, and for 245eb would need
3 to occur at a pressure of 6 bar, taking into
4 account the fact that 236ea is introduced below the
5 surface of the liquid KOH present in Reactor 1 of
6 Sedat?"

7 A. All right. What I don't know from
8 Sedat is the rate of reaction and how fast the
9 reaction goes. So given that, it's reasonable to
10 assume that some 236ea will make it into the vapor
11 space of that reactor.

12 Q. And the remainder of the 236ea will
13 react with the KOH, correct, or become -- let's
14 begin again.

15 So you're saying that some portion of
16 the 236 that's introduced into Reactor 1 is going
17 to go out in the overhead?

18 A. Yes, it's reasonable to assume that.

19 Q. And that some of it is going to react
20 with KOH to form --

21 A. 1225.

22 Q. -- 1225?

23 A. Yes.

24 MR. BAUM: I'm going to mark a new
25 exhibit. It will be Petitioner's Exhibit 1021.

1 (PETITIONER'S EXHIBIT 1021, Document
2 titled Fluoroolefins - Note 1. Cis and trans
3 1,2,3,3,3-pentafluoropropylene, was marked for
4 identification.)

5 BY MR. BAUM:

6 Q. So what I've just handed you marked as
7 Petitioner's Exhibit 1021 is actually an English
8 language translation of a Italian language
9 document. I'm going to hand you the original
10 Italian language document as well. We're going to
11 mark that as Exhibit 1022.

12 THE WITNESS: All right.

13 (PETITIONER'S EXHIBIT 1022, Original
14 Italian version of document titled Fluoroolefins -
15 Note 1. Cis and trans
16 1,2,3,3,3-pentafluoropropylene, was marked for
17 identification.)

18 MR. BAUM: And then I'm going to mark
19 as Exhibit 1023 a Certification of Translation.

20 (PETITIONER'S EXHIBIT 1023,
21 Certification of Translation, was marked for
22 identification.)

23 BY MR. BAUM:

24 Q. Dr. Lousenberg, is this a document --
25 well, let me --

1 A. Yes, it is.

2 Q. It is a document. Thank you very much.
3 It's late in the afternoon.

4 Is this a document that you have seen
5 before? And I'm referring to Exhibit 1021.

6 A. Yes, I have seen it before.

7 Q. And when did you first see this
8 document?

9 A. It was sent to me by counsel not too
10 long ago. I do not know the date of the e-mail
11 offhand, but I believe it was sometime last week.

12 Q. According to the English language
13 translation the title of this document is
14 Fluoroolefins - Note 1. Cis and trans
15 1,2,3,3,3-pentafluoropropylene?

16 A. Yes.

17 Q. And its authors are Dario, D-A-R-I-O,
18 Sianesi, S-I-A-N-E-S-I; and Renzo, R-E-N-Z-O,
19 Fontanelli, F-O-N-T-A-N-E-L-L-I; do you see that?
20 Do you see that?

21 A. Yes. Oh, yes, I do.

22 Q. And at least according to the English
23 language translation, Footnote 1 indicates that
24 this was published in the Journal of Chemical
25 Society 1592 in 1953; do you see that?

1 A. Yes, I do.

2 Q. So are you familiar with this document?

3 A. I am somewhat familiar. Since I've
4 only had it for a week, I have not read it in
5 detail, but I have looked through it.

6 Q. Okay. Are you comfortable with its
7 contents?

8 MR. ROSE: Objection to form.

9 THE WITNESS: As far as I've read it,
10 yes.

11 BY MR. BAUM:

12 Q. So you're generally familiar with its
13 contents?

14 A. Yes.

15 Q. If you look at the third page of this
16 document --

17 A. Yes.

18 Q. -- there's a Subparagraph B.

19 A. Yes.

20 Q. It's entitled Dehydrofluorination with
21 Basic Agents; do you see that?

22 A. Yes.

23 Q. And it says, "The most immediate method
24 for the dehydrofluorination of C₃F₆H₂ is found to
25 be simple passage of the compound in gaseous form

1 through a liquid phase constituted of an aqueous
2 solution of KOH with a high titre (70 to 80
3 percent), maintained at a temperature of about 150
4 degrees."

5 Do you see that?

6 A. Yes, I do.

7 Q. Do you understand that reference to 150
8 degrees to be 150 degrees Celsius?

9 A. Since this is an Italian paper, I will
10 assume that 150 C is 150 Celsius.

11 Q. I notice there's no reference to
12 pressure. Would you assume atmospheric pressure in
13 the absence of a reference to a specific pressure
14 with regard to that sentence?

15 A. It's -- it's not disclosed. I don't
16 know. But you might -- as I read this, there was
17 the actual experimental section. Let me see if
18 there's anything more I can pull out of that.

19 There, again, in the experimental it
20 doesn't cite a pressure.

21 Q. So when you were reading -- go ahead.

22 A. But I -- I will concede that it's very
23 likely that it was atmospheric pressure.

24 Q. So it says, "The most immediate method
25 for the dehydrofluorination of C₃F₆H₂ is found to

1 be simple passage of the compound and gaseous form
2 through a liquid constituted of an aqueous KOH
3 solution with a high titre of 70 to 80 percent,
4 maintained at a temperature of about 150 degrees."

5 It goes on to say that "This operation
6 in point of fact gave a virtually quantitative
7 dehydrofluorination: the reaction product is only
8 1-hydropentafluoropropylene, constituted mainly of
9 isomer I, with minor contents, about 5 percent, of
10 isomer II."

11 Do you see that?

12 A. Yes, I do.

13 Q. What's your understanding of the term
14 "quantitative dehydrofluorination"?

15 A. Virtually 100 percent.

16 Q. Is there any reference here to stirring
17 in this paragraph?

18 A. No, there isn't.

19 Q. So in terms of quantitative
20 dehydrofluorination, when you say it means
21 virtually 100 percent, does that mean virtually 100
22 percent of isomer I versus isomer II?

23 A. No. That means virtually -- that means
24 that virtually 100 percent of the starting 236ea
25 dehydrofluorinated.

1 Q. Well, it says, "This operation in point
2 of fact gave a virtually quantitative
3 dehydrofluorination:" And then it says "The
4 reaction product is only
5 1-hdropentafluoropropylene, constituted mainly of
6 one isomer, with minor contents, of 5 percent of
7 isomer II."

8 A. Right.

9 Q. So doesn't that indicate to you that
10 what we're talking about here is selectivity?

11 A. Exactly. So 5 percent selectivity to
12 isomer II, 95 percent selectivity to isomer I.

13 MR. BAUM: Okay. We're done.

14 MR. ROSE: Okay.

15 THE VIDEOGRAPHER: This concludes the
16 deposition of Mr. Robert Lousenberg. The time is
17 approximately 5:24 p.m. We are now off the record.
18 This concludes for today only.

19 (WHEREUPON, the deposition was
20 concluded at 5:24 p.m.)

21 (The witness reserves the right to read
22 and sign this transcript.)
23
24
25

SIGNATURE OF DEPONENT

DEPONENT: ROBERT D. LOUSENBERG, Ph.D.

DEPOSITION DATE: APRIL 14, 2016

REPORTER: CINDY A. HAYDEN

AWR JOB #: 160414Lousenberg

CASE CAPTION: Arkema France vs. Honeywell
International Inc.

(Please return both Signature of Deponent pages)

I, the undersigned, ROBERT D. LOUSENBERG,
Ph.D., do hereby certify that I have read the
foregoing deposition and find it to be a true and
accurate transcription of my testimony, with the
following corrections, if any:

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SIGNATURE OF DEPONENT (CONTINUED)

DEPOSITION DATE: APRIL 14, 2016
REPORTER: CINDY A. HAYDEN
AWR JOB #: 160414lousenberg
CASE CAPTION: Arkema France vs. Honeywell
International Inc.

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ROBERT D. LOUSENBERG, Ph.D. Date

I, Cindy A. Hayden, Notary Public for the State of North Carolina at Large, do hereby certify that the deponent was advised of his or her right to read and sign said deposition both verbally and in writing. If the deponent fails to execute and return foregoing Signature of Deponent pages within the thirty (30) days allowed pursuant to the Rules of Civil Procedure, the original transcript may be filed with the court.

Cindy A. Hayden, RMR, CRR
My Commission expires
April 7, 2017

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CERTIFICATE OF REPORTER

I, Cindy A. Hayden, Registered Merit Reporter and Notary Public for the State of North Carolina at Large, do hereby certify that the foregoing transcript is a true, accurate, and complete record; that reading and signing was requested.

I further certify that I am neither related to nor counsel for any party to the cause pending or interested in the events thereof.

Witness my hand, I have hereunto affixed my official seal this 18th day of April, 2016 at Charlotte, Cabarrus County, North Carolina.

Cindy A. Hayden, RMR, CRR
My Commission expires
April 7, 2017

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