

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

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT TRIAL AND APPEAL BOARD

BERKSHIRE HATHAWAY ENERGY COMPANY,	§	
	§	
Petitioners,	§	IPR2025-00274
	§	
VS.	§	(U.S. PATENT NO.
	§	10,343,114
	§	
BIRCHTECH CORP.,	§	
	§	
Patent Owner,	§	
	§	

ORAL DEPOSITION OF
EDWARD CICHANOWICZ, Ph.D.
MARCH 5, 2026

The Oral Deposition of EDWARD
CICHANOWICZ, Ph.D., produced as a witness at the
instance of the Petitioner, and duly sworn, was taken in
the above-styled and numbered cause on MARCH 5, 2026,
from 9:26 a.m. to 2:56 p.m., before Nicole A. Hatler,
CSR No. 11275 in and for the State of Texas, reported by
machine shorthand, at the Law Offices of Caldwell
Cassady Curry, P.C., 2121 N. Pearl Street, Suite 1200,
Dallas, Texas 75201, pursuant to the Federal Rules of
Civil Procedure.

---oOo---

1 APPEARANCES

2 For the Petitioner:

3 DAVID J. TOBIN
4 McDermott Will & Schulte LLP
5 2801 North Harwood Street, Suite 2600
6 Dallas, TX 75201
7 (214) 210-2793
8 DTobin@MWe.com

9 For the Patent Owner:

10 RICHARD COCHRANE
11 Caldwell Cassady Curry, P.C.
12 2121 N. Pearl Street, Suite 1200
13 Dallas, TX 75201
14 (214) 888-4854
15 RCochrane@CaldwellCC.com
16
17
18
19
20
21
22
23
24
25

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

INDEX	
	PAGE
Appearances.....	2
WITNESS:	
EDWARD CICHANOWICZ, Ph.D.	
Examination by MR. TOBIN.....	5, 164
Examination by MR. COCHRANE.....	160
Reporter's Certificate.....	172

1 EDWARD CICHANOWICZ

2 sworn as a witness

3 testified as follows:

4 THE REPORTER: Good morning. My name is
5 Nicole Hatler, Texas Certified Shorthand Reporter No.
6 11275. This deposition will be stenographically
7 reported pursuant to the rules governing depositions in
8 the State of Texas.

9 MR. TOBIN: Thank you.

10 Good morning, everybody. This is David
11 Tobin from the law firm McDermott, Will, & Schulte. I'm
12 here on behalf of petitioner, PacifiCorp.

13 MR. COCHRANE: And this is Richard Cochrane
14 from the law firm Caldwell, Cassady, & Curry, and I'm
15 here on behalf of the patent owner, Birchtech Corp.

16 MR. TOBIN: And, Counsel, just so we're
17 clear on the record, this deposition is a consolidated
18 deposition across eight proceedings, correct?

19 MR. COCHRANE: Yes, agreed.

20 MR. TOBIN: Okay. Great. And just so we
21 have the proceedings on the record, this deposition is
22 being taken in IPR 2025-00274 and IPR 2025-00278
23 regarding US Patent Number 10,343,114. It's also being
24 taken in IPR 2025-00280 and IPR 2025-00281 regarding US
25 Patent Number 10,596,517. It's being taken in IPR

1 2025-00422 and IPR 2025-00423 regarding US Patent
2 10,668,430. It's being taken in IPR 2025-00424 and IPR
3 2025-00425 regarding US Patent Number 10,589,225.

4 Mr. Cochrane, we're good with all that?

5 MR. COCHRANE: Yes.

6 Q. EXAMINATION BY MR. TOBIN: Thank you for your
7 patience, sir, about that.

8 Could you please state your full name for
9 the record.

10 A. My name is Joseph Edward Cichanowicz, Jr.

11 Q. It's Mr. Cichanowicz?

12 A. Yes.

13 Q. Mr. Cichanowicz, is there any reason you cannot
14 give complete and accurate testimony today?

15 A. No.

16 Q. Do you understand that you are giving sworn
17 testimony at this deposition and that your testimony
18 will be truthful and accurate just the same as if you
19 were testifying in front of a judge?

20 A. I do.

21 Q. I'll try to ask clear, precise, and not long
22 questions. If you don't understand a question, will you
23 let me know?

24 A. Of course.

25 Q. Great. I'll try to take breaks every hour or

1 so, but -- and I don't think our deposition will go all
2 day, but if you need any breaks between then, we can do
3 that.

4 A. Thank you.

5 Q. Sir, what did you do to prepare for your
6 deposition today?

7 A. I reviewed my -- my declarations, and I
8 reviewed the reference material that I cited in my
9 declarations.

10 Q. And I appreciate counsel doing this, but I
11 think you have copies of two declarations in front of
12 you; is that right?

13 A. Correct.

14 Q. Okay. So your first declaration is labeled
15 Exhibit 2047 in the bottom-right corner, and it was
16 signed by you on December 15th, 2025, is that right?

17 A. Correct.

18 Q. All right. Just for -- because both
19 declarations have the same exhibit number, I'll refer to
20 the one you signed on December 15th as Exhibit 2047.
21 And I think you wrote that on the page, right?

22 A. Correct.

23 Q. Thank you.

24 Then you have another declaration in front
25 of you also labeled Exhibit 2047 that you signed on

1 January 16th, 2025?

2 A. Correct.

3 Q. I'll label that -- again, just because they
4 have the same number, I'll call that 2047B. And you
5 wrote that on the page?

6 A. Correct. Yes.

7 Q. Thank you.

8 The declaration you signed on December 15th
9 was submitted in IPR 2025-274278280 and 281?

10 A. Correct.

11 Q. And that's the one we're referring today as
12 Exhibit 2047A?

13 A. Yes.

14 Q. Great. And then the one that we're referring
15 to as Exhibit 2047B you submitted in IPR 2025-00422,
16 423, 424, and 425?

17 A. Yes.

18 Q. The exhibit that you submitted -- actually, let
19 me take a step back and introduce the patents.

20 You understand across the two declarations
21 you submitted, four patents are at issue?

22 A. I understand.

23 Q. Great. I'll put the patents in front of you in
24 case you need to refer to them or want to refer to them.

25 And I appreciate Counsel doing this. I

1 think you also have electronic copies of most of the
2 documents you cite?

3 A. Yes.

4 Q. Okay. So if you want to use the paper copy or
5 the electronic copy, I don't care, that's fine, but just
6 let me know if you receive any kind of e-mail or notes
7 on the -- deposition during it, yes, not that I think
8 you would.

9 A. This -- it's not my laptop. I don't know how
10 to operate it.

11 Q. Okay. Fair enough.

12 Okay. I'm handing you four exhibits.

13 MR. TOBIN: Richard, do you need copies?

14 MR. COCHRANE: No. I'm good. Thank you.

15 MR. TOBIN: Okay.

16 Q. BY MR. TOBIN: So all the exhibits are labeled
17 1001, but do you see how, in front of you, you have a
18 Patent 10,343,114?

19 A. I see that. Yes.

20 Q. If I refer to that as the '114 patent, you'll
21 understand what I mean?

22 A. I will.

23 Q. You also have a patent in front of you
24 10,596,517?

25 A. Yes.

1 Q. If I refer to that as the '517 patent, will you
2 understand that?

3 A. I will.

4 Q. Great. You also have in front of you Patent
5 No. 10,668,430?

6 A. Yes.

7 Q. If I refer to that as the '430 patent, will you
8 understand that?

9 A. Yes. I will.

10 Q. And then you have in front of you patent
11 10,589,225?

12 A. Yes.

13 Q. You'll understand that's the '225 patent?

14 A. Yes.

15 Q. And then over the course of today, I am -- I
16 may reference the term ME2C.

17 Do you know who ME2C is?

18 A. I do.

19 Q. What's that mean to you?

20 What or who does that mean to you?

21 A. Midwest Emissions Corporation.

22 Q. That's pretty close, but you understand that
23 they're the patent owner?

24 A. I do.

25 Q. Okay. So if I may refer to the '114, '517,

1 '430, and '225 collectively as the ME2C patents, will
2 you understand that?

3 A. Repeat that, please.

4 Q. I may refer to the four patents, the '114,
5 '517, '430, and '225 patents, collectively as ME2C
6 patents.

7 A. I understand.

8 Q. Okay. And if you need a qualifying answer and
9 say, well, it's applicable to one patent, but not the
10 other, feel free to do that.

11 A. Okay.

12 Q. Thank you.

13 MR. TOBIN: I'm just going to hand the
14 court reporter these exhibits we talked about in the
15 case just in case she needs to check any of them. Put
16 them on this chair.

17 Q. BY MR. TOBIN: The declaration you signed on
18 December 15th concerns the '114 and '517 patents?

19 A. Yes.

20 Q. The declaration you signed on January 16th
21 concerns the '430 and '225 patents?

22 A. Yes.

23 Q. So starting with the declaration you submitted
24 for the '114 and the '517 patent, it has 79 paragraphs?

25 A. Yes.

1 Q. You then submitted another declaration roughly
2 a month later concerning the '430 and '225 patents,
3 correct?

4 A. Yes.

5 Q. The declaration concerning the '430 and '235
6 patent has 76 paragraphs?

7 A. Yes.

8 Q. Would you agree -- you start -- you used your
9 December 15th declaration as the starting point for your
10 January 16th declaration?

11 A. That is correct.

12 Q. And it looks like you swapped out the patent
13 numbers and then deleted the last three paragraphs, but
14 other than that, the two are largely identical; is that
15 fair?

16 MR. COCHRANE: Object to form.

17 THE WITNESS: Working from memory, I think
18 that's correct.

19 Q. BY MR. TOBIN: So I'll be referencing, largely,
20 paragraphs in your first declaration on the '114 and
21 '517 patent, but I think the paragraph numbers are, by
22 and large, the same, so feel free to reference whichever
23 one you like.

24 A. Thank you.

25 Q. So in preparing today, you mentioned you

1 reviewed your declarations and the materials you cite,
2 correct?

3 A. Correct. Yes.

4 Q. And I presume you had some meetings with
5 counsel?

6 A. Yes.

7 Q. And I'll ask specific questions. I don't want
8 to invade any kind of privilege. So specifically, who
9 did you meet with -- and I just need names -- to prepare
10 for your deposition?

11 A. Richard, Justin, and Eric.

12 Q. Those are all outside counsel for ME2C?

13 A. Correct.

14 Q. What's your best estimate of how much time you
15 spent preparing for your deposition?

16 A. Including yesterday --

17 Q. Yes.

18 A. -- and some time in my office, probably three
19 days, three and a half days.

20 Q. Okay. Are those three full days?

21 A. Approximately. Maybe three-quarter full days.

22 Q. So you're pretty familiar with the content of
23 your declaration?

24 A. Yes.

25 Q. Normally, I see experts disclose this in their

1 declaration, but I didn't see it in yours.

2 Are you being compensated for your time in
3 this matter?

4 A. I am.

5 Q. What is the hourly rate?

6 A. \$475 per hour.

7 Q. Is that the same rate regardless of the task?

8 A. For this client?

9 Q. Yes.

10 A. Yes.

11 Q. Is that your ordinary and customary rate?

12 A. It depends. Sometimes less, sometimes more.

13 Q. Can you elaborate on that answer?

14 A. Well, I've had some -- some work higher, and
15 I've had -- if I'm doing long-term work where I'm out at
16 the -- where I'm out at the power plant and it's lots of
17 hours, that's lower to -- to maybe 350 or 375.

18 Q. And that's the highest rate you'll charge?

19 A. The highest has been 600.

20 Q. What kind of work was that for?

21 A. That was for a legal dispute. I think it's
22 public. The Department of Justice of Canada versus an
23 independent power producer.

24 Q. Okay.

25 A. And I was defending the Department of Justice

1 of Canada.

2 Q. Got it.

3 And I won't ask for many details, but at a
4 high level, did that pertain to certain technology?

5 A. Not emissions control technology, but power
6 generation technology.

7 Q. Okay. Sir, when were you first retained by
8 ME2C in this matter?

9 A. Early December, the 1st week of December, I
10 believe.

11 Q. Which year?

12 A. Pardon.

13 Q. Which year?

14 A. I'm sorry. 2024.

15 Q. So over a year ago?

16 A. 2025.

17 Q. Okay. So you were first retained by ME2C in
18 this matter in December 2025?

19 A. That's correct.

20 Q. Can you give me your best estimate of when in
21 December 2025 you were retained by ME2C?

22 A. The 5th or 6th of December, that first week, I
23 believe.

24 Q. All right. If it helps you place the time more
25 approximately, your first declaration, Exhibit 2047A,

1 was signed by you on December 15th, correct?

2 A. Correct.

3 Q. So you would have been retained before
4 December 15th?

5 A. Yes.

6 Q. And it was about a week or two before you
7 signed your declaration?

8 A. Maybe 10 or 11 days.

9 Q. Between the time you were retained by -- let me
10 back up.

11 And by "retained," did you understand I
12 mean signed some kind of an agreement with them?

13 A. Yes.

14 Q. Okay. So between -- how far in advance were
15 you first contacted by ME2C before December 5th or 6th?

16 A. Probably the day before.

17 Q. Did you just get a cold call?

18 A. I was referenced by a mutual friend.

19 Q. Who referenced you?

20 A. A fellow named Scott Hinton, H-I-N-T-O-N.

21 Q. Is Scott Hinton an engineer?

22 A. Yes.

23 Q. Who does Mr. Hinton work for?

24 A. He is self-employed.

25 Q. What -- do you know what the connection is

1 between Mr. Hinton and ME2C?

2 A. I do not.

3 Q. Had you heard of ME2C before you were retained
4 in this matter?

5 A. Yes.

6 Q. In what context?

7 A. I've spent my life on environmental control
8 technology for coal-fired power plants, and in attending
9 the very large matrix of technical symposium meetings, I
10 ran into them at that time.

11 Q. Do you recall which specific people from ME2C
12 you ran into?

13 A. John Pavlish.

14 Q. Anyone else?

15 A. I can picture him, but I can't think of his
16 name. It's a name that's on the patents.

17 Q. Ed Olson and Mike Holmes?

18 A. Michael Holmes.

19 Q. Had you ever met Ed Olson?

20 A. I have not.

21 Q. Have you ever collaborated with John Pavlish,
22 Michael Holmes, or anyone else at ME2C before were you
23 retained in this matter?

24 A. Not professionally, no.

25 Q. Have you collaborated socially with them?

1 MR. COCHRANE: Object to form.

2 THE WITNESS: Attending these conferences,
3 it's hard not to have coffee in the hallway.

4 Q. BY MR. TOBIN: Okay.

5 A. Plus, John is always reminding me about the
6 Fighting Sioux, S-I-O-U-X, if you're asking what the
7 Fighting Sioux is.

8 Q. Now I have to ask.

9 Who are the Fighting Sioux?

10 A. John and I are both avid fans of college ice
11 hockey. John, of course, is associated with the
12 University of North Dakota. He would be forgiven for
13 not knowing a couple of people on team U.S.A. came
14 through UNEC.

15 My undergraduate school is 18 miles from
16 the Canadian border, and we play D1 hockey, too, so we
17 always have a little back and forth about college ice
18 hockey.

19 Q. So you two are in a pretty good mood since the
20 Olympics?

21 A. Yes.

22 Q. As you should be.

23 A. I didn't mean for that diversion, but that's
24 about the extent that I have discussions with John.

25 Q. Okay. When was the first time you reviewed any

1 of ME2C's patents?

2 A. Probably in this case.

3 Q. So the first time you looked at one of ME2C's
4 patents would have been after December 5th or 6th, 2025?

5 A. I believe that is correct. Yes.

6 Q. And other than discussions with counsel, which
7 I'm not asking about right now, have you had discussions
8 with anyone else in preparing your declarations?

9 A. No.

10 Q. Have you spoken to John Pavlish after you were
11 retained in this case?

12 A. No.

13 Q. Did you ask to speak to John Pavlish?

14 A. I did not.

15 Q. Have you reviewed any trial testimony from John
16 Pavlish or any other ME2C people?

17 A. I reviewed the depositions of John Pavlish and
18 of Dr. Niksa. I think that was it. I might have
19 reviewed Michael Holmes, but I can't remember.

20 Q. Do you remember the -- when -- did you review
21 the deposition of John Pavlish that was taken within the
22 last couple weeks or much older?

23 A. Both.

24 Q. Okay.

25 A. There was an early one and one recently.

1 Q. What do you understand Mr. Pavlish's technical
2 background to be?

3 A. He is a very experienced, hands-on engineer, I
4 think, with good insight to technology.

5 Q. Do you consider him more mechanical, more
6 chemical, crossover, something else?

7 MR. COCHRANE: Object to form.

8 THE WITNESS: Probably a mix of both, and I
9 say that because I consider myself a mix of both.

10 Q. BY MR. TOBIN: What about Dr. Niksa, do you
11 consider him a mix of chemical and mechanical?

12 A. Yes.

13 Q. One of the documents you cite is Exhibit 2046,
14 which is a lengthy declaration from John Pavlish -- do
15 you recall that?

16 A. I do.

17 Q. And as one example is in paragraph 61 of your
18 declarations towards the bottom.

19 A. Okay.

20 Q. And are you aware that you signed his
21 declaration -- or his first declaration on
22 December 12th, 2025?

23 A. I wasn't aware of that.

24 Q. Did you review a final declaration from
25 Mr. Pavlish or a draft?

1 A. I don't recall.

2 Q. And, again, if it helps -- if it helps you
3 recall, if you look at paragraph 61 of your report,
4 which is actually on page 25.

5 A. I'm sorry. Which paragraph number?

6 Q. Paragraph 61 on page 25.

7 A. Why do I have it on 24?

8 Q. It starts on page 24 and continues to page 25.

9 A. Okay, okay.

10 Q. Do you see Exhibit 26 is one of the materials
11 you rely on?

12 A. I see that. Yes.

13 Q. Does that help you recall whether you reviewed
14 a final version of his declaration or a draft?

15 A. I don't recall. This came together -- it
16 could -- it could indeed have been assigned, because I
17 believe I was finishing it on the 14th, so -- of
18 December, so that's -- I don't recall.

19 Q. And you signed your declaration on
20 December 15th. So why do you think you were finishing
21 it on the 14th?

22 MR. COCHRANE: Object to form.

23 THE WITNESS: Well --

24 MR. COCHRANE: Object. I'll caution the
25 witness not to reveal any privileged information.

1 THE WITNESS: I like to proofread things
2 with my name on them before they go into a formal
3 proceeding.

4 Q. BY MR. TOBIN: That's a good practice.

5 Do you recall how long you spent reviewing
6 Exhibit 2046, Mr. Pavlish's declaration, before you
7 signed your declaration?

8 A. I know I looked at virtually every page, so
9 whatever that takes to go through each page and make
10 sure you understood it.

11 Q. Would you say you studied it, you skimmed it,
12 or somewhere in between?

13 A. Oh, I did not skim it.

14 Q. Was the bulk of your declaration written before
15 you saw Mr. Pavlish's Exhibit 2046 declaration?

16 A. I had detailed drafts that I had prepared on
17 the technical issues, and I may have seen something in
18 advance, I can't remember, but I would -- you know, his
19 declaration is important, and I went into a lot of
20 detail. I can't give you any more resolution on time
21 than that.

22 Q. Sure.

23 Do you recall -- did you do the first draft
24 of your declaration?

25 A. I did the draft of the bulk of or all of the

1 technical aspects. No surprise there's areas where I
2 start out saying, "I'm not an attorney." All those
3 would be dangerous for me to draft, so I had help from
4 counsel on it.

5 Q. Between when the time you were retained on
6 December 4th or 6th and the time you started actually
7 typing up your declaration, how many days was that?

8 A. I think it was pretty much almost a full, you
9 know, count the days and weekends don't matter, right,
10 they're all busy. I mean, I put a lot of time into it.
11 They may not have been full days, but --

12 Q. What's your best estimate of number of hours
13 you spent between the time you were retained -- first
14 retained and the time you signed your declaration on
15 December 15th?

16 A. Well, if I was retained on the 5th or 6th and
17 we submitted on the 14th, that would be eight or nine
18 working days. I don't think I worked every one of
19 those, so say maybe five --

20 Q. Okay.

21 A. -- and so say, maybe, 40 hours.

22 Q. So I want to follow up on something you
23 mentioned earlier. I think you said you consider
24 yourself a hybrid mix -- or a mix of chemical and
25 mechanical engineering; is that right?

1 A. Yes.

2 Q. Your bachelor's degree is in mechanical
3 engineering, right?

4 A. Correct.

5 Q. And I assume every engineer takes one or --
6 were you on a semester system or a quarter system?

7 A. Semester.

8 Q. I assume every engineer takes one or two
9 semesters of general chemistry; is that right?

10 A. Yes.

11 Q. And you took one or two semesters of general
12 chemistry?

13 A. As an undergraduate, yes,

14 Q. Was it one or two semesters?

15 A. Two.

16 Q. Did you take any other chemistry courses for
17 your undergraduate degree?

18 A. Other than the fact that thermodynamics has
19 some chemistry in it, high-temperature thermodynamics is
20 more, but at the undergraduate degree, that was pretty
21 much the limit of it.

22 Q. And by "thermodynamics," that's things like
23 Otto cycle and Rankine cycle? That's the thermodynamics
24 you're talking about?

25 A. Those are two thermodynamic cycles, yes.

1 Q. Did you take classes in gas thermodynamics?

2 A. High-temperature thermodynamics is gas
3 thermodynamics. In fact, I think, now that you say it,
4 that's what the title was on the book.

5 And, again, this is all undergraduate
6 still.

7 Q. Was kinetic theory covered in your
8 thermodynamics class, do you recall?

9 A. That we saved for graduate school.

10 Q. Okay. So what chemistry courses did you have
11 -- did you take in graduate school?

12 A. Graduate school was, basically, mostly gas
13 phase kinetics because we were modeling combustion
14 processes.

15 Q. What are combustion processes?

16 A. Pardon?

17 Q. Well, you -- combustion processes?

18 A. Yes.

19 Q. What were you referring to?

20 A. For whatever reason, in my early 20s, I got
21 very interested in flame structure. I thought it was
22 the most interesting thing in the world in how air and
23 fuel mixed and what made a flame. And that was the bulk
24 of my focus in graduate school at Berkeley.

25 Q. So in graduate school, were you studying flame

1 structure in terms of coal combustion or gasoline and
2 cars or something else?

3 A. It was more fundamental in terms of hydrocarbon
4 fuels, not necessarily coal, but also something in 1975
5 I thought nobody would ever be interested in, and that's
6 fire and hydrogen. I thought why would anybody want to
7 fire hydrogen, and, of course, that became very popular
8 in the last few years.

9 Q. Yes. You were ahead of your time. So --

10 A. Only by accident.

11 Q. So I want to go over some just -- I think that
12 you might consider them basic chemistry to make sure
13 we're using the right terminology.

14 You're, obviously, familiar with what an
15 atom is, correct?

16 A. Yes.

17 Q. An atom is a single unit of a chemical element?

18 A. Yes.

19 Q. An atom consists of one or more protons, one or
20 more electrons, and in every case, other than hydrogen,
21 one or more neutrons?

22 A. Yes.

23 Q. And you're also familiar with what an ion is,
24 correct?

25 A. Yes.

1 Q. An ion is the state of an atom when it gains or
2 loses one or more electrons?

3 A. Yes. Correct.

4 Q. When an atom gains electrons, it has a negative
5 charge?

6 A. Yes.

7 Q. When an atom loses electrons, it has a positive
8 charge?

9 A. Yes.

10 Q. The negative ion is often given an i-d-e
11 suffix?

12 A. I don't know that I've seen that before, i-d-e.

13 Q. Sulfide, fluoride --

14 A. Oh.

15 Q. -- chloride.

16 A. Yes. In terms of the word describing the
17 compound, yes.

18 Q. Oxide would be another example, correct?

19 A. Yes.

20 Q. Okay. And you're also familiar with what the
21 term "radical" is, and not in the political Berkeley
22 sense, but in the chemical sense, correct?

23 A. Yes.

24 Q. All right. So certain -- and stepping aside
25 for a second, certain chemical elements can exist by

1 themselves in a stable state in nature, yes?

2 A. Yes.

3 Q. Examples include gold or mercury?

4 A. Yes.

5 Q. Elemental mercury is also called metallic
6 mercury?

7 A. Yes.

8 Q. Its symbol is Hg with a little 0 superscript?

9 A. It is, yes.

10 Q. Elementary mercury does not have a charge on
11 it, correct?

12 A. Correct.

13 Q. Now, turning to the radical piece. When Cl or
14 Br exist in their atomic form, they have an odd number
15 of valence electrons, right?

16 A. Yes.

17 Q. And for the case of Cl and Br, they have an
18 unpaired electron?

19 A. Correct.

20 Q. So when Cl or Br exist in their atomic form,
21 they have seven electrons in their valence shell?

22 A. I believe that's correct. Yes.

23 Q. That makes Cl or Br atoms very reactive, right?

24 A. Yes.

25 Q. When Cl or Br exist in atomic form, they do not

1 have a charge, correct?

2 A. Correct.

3 Q. So the Cl atom is different than a chloride
4 ion?

5 A. Yes.

6 Q. A Cl atom is designated just Cl, but a chloride
7 ion is designated Cl-?

8 A. Yes.

9 Q. Similarly, a bromine atom is different than a
10 bromide ion?

11 A. Yes.

12 Q. Bromine atom is just referred to as Br, but a
13 bromide ion is referred to as Br-?

14 A. Yes.

15 Q. So I'm sure you're familiar with what a
16 molecule is, right?

17 A. Yes.

18 Q. A molecule is two or more atoms chemically
19 bonded together as a discrete unit?

20 A. Yes.

21 Q. In a molecule, the atoms can be the same
22 element or the atoms can be different elements?

23 A. Yes.

24 Q. A molecule is typically thought of as the atoms
25 are held together by covalent bonds?

1 A. Yes.

2 Q. Molecules are considered electrically neutral?

3 A. Correct.

4 Q. Electrically neutral is another term for
5 uncharged?

6 A. Yes.

7 Q. An example of a molecule with the same elements
8 could be O₂?

9 A. Yes.

10 Q. An example of a molecule with the same atoms
11 could be Br₂?

12 A. Yes.

13 Q. An example of a molecule with different
14 elements might be H₂O?

15 A. Yes.

16 Q. Now, let's turn to compound. A compound is a
17 substance composed of two or more different elements
18 chemically combined together in fixed proportions?

19 A. Yes.

20 Q. So an example of a compound is NaCl?

21 A. Yes.

22 Q. A compound -- example of compound of mercury --
23 withdrawn.

24 An example containing mercury might be
25 HgBr₂?

1 A. Yes.

2 Q. Would you call HgBr_2 mercuric bromide?

3 A. I usually don't put names on it. I just look
4 at the compound as written.

5 Q. You would just call it HgBr_2 ?

6 A. Yes.

7 Q. HgBr_2 is charged neutral, correct?

8 A. Yes.

9 Q. Within the HgBr_2 the mercury is oxidized?

10 A. Yes.

11 Q. And mercury can exist in nature as elemental
12 mercury or oxidized mercury, right?

13 A. Yes.

14 Q. When mercury exists in nature as elementary
15 mercury, it is denoted Hg_0 ?

16 A. Yes.

17 Q. When mercury in nature is oxidized, it will be
18 part of a compound like HgBr_2 or HgCl_2 ; is that right?

19 A. Yes.

20 Q. When mercury is bound to activate a carbon
21 sorbent, is the mercury in elemental form, oxidized
22 form, or something else?

23 A. I think, from what I've read, it can depend.
24 It depends on the carbon surface itself and whether it's
25 donating electrons or accepting electrons, but I've

1 seen -- I've read different papers with different
2 interpretations.

3 Q. Is that because experts in the field disagree
4 as to the chemical bonding that occurs between mercury
5 and activated carbon?

6 A. I've read papers that have different
7 interpretations. I've read papers that have -- that
8 have talked about carbon being both a Lewis base and a
9 Lewis acid, and I would conclude that they do have
10 different -- experts do have different interpretations,
11 or perhaps the experiment was conducted -- if it was an
12 experiment -- conducted differently.

13 Q. So is it fair to say that it is not yet settled
14 science as to the chemical reaction between activated
15 carbon and mercury?

16 A. I don't know that it's not settled science or
17 not. All I'm saying is that, in reviewing papers, I've
18 seen different interpretations of -- of what can happen.

19 Q. So people disagree as to the reaction mechanism
20 between mercury and activated carbon?

21 A. Perhaps, or else it was just a different
22 interpretation of -- of a different type of experiment
23 that was conducted.

24 Q. What is a halogen?

25 A. A halogen is a -- on the periodic table, they

1 all sit in a nice vertical row, and I've forgotten
2 which -- which row it is.

3 Q. Have you heard of halogens also as group 7?

4 A. Yes.

5 Q. And you said row. I think you meant column?

6 A. I did. I meant column.

7 Q. Exemplary halogens are flourine. That's one?

8 A. Yes.

9 Q. Chlorine is a halogen?

10 A. Yes.

11 Q. Bromine is a halogen?

12 A. Yes.

13 Q. A little less common, but astatine is a
14 halogen?

15 A. If you say so.

16 Q. You're not sure?

17 A. I can't remember. Yeah.

18 Q. Okay. It's below iodine.

19 A. Okay.

20 Q. So I want to, again, make sure our notation
21 is -- is proper on some of the terms we'll be using.

22 In this case, I'm sure you've heard the
23 term "bromine" and you've heard the term "bromide"?

24 A. Yes.

25 Q. Would you agree that the word "bromine" with an

1 "n," by itself, refers to a neutral or uncharged
2 chemical element that exists naturally as a diatomic
3 molecule?

4 A. Yes.

5 Q. The word bromide with a "d" refers to either a
6 bromide ion with a charge of negative 1. That's one
7 thing it can refer to?

8 A. Yes.

9 Q. Bromide with a "d" can also refer to when Br is
10 part of an ionic compound like potassium bromide?

11 A. Yes.

12 Q. You would agree that bromine with an "n" and
13 bromide with a "d" are different?

14 A. Yes.

15 Q. So like you're out making -- it's a Venn
16 diagram or some other diagram, I can't remember the name
17 of. But let's start with bromine with an "n."

18 Bromine is -- I think you said it's a
19 chemical element with the simple Br, correct?

20 A. Yes.

21 Q. In its elemental form in nature, bromine exists
22 as Br₂?

23 A. Yes.

24 Q. Br₂ is also referred to as molecular bromine
25 with an "n"?

1 A. Yes.

2 Q. Br₂ is a diatomic molecule?

3 A. Yes.

4 Q. Br₂ is a neutral uncharged molecule?

5 A. Correct.

6 Q. At room temperature, Br₂ exists as a fuming,
7 reddish-brown liquid?

8 A. Yes.

9 Q. Toxic?

10 A. Yes.

11 Q. You certainly would not want to get near Br₂
12 unless you were in a vent hood or had a respirator on,
13 right?

14 A. As you describe Br₂, yes.

15 Q. And do you know what happens when people
16 breathe molecular bromine?

17 A. I imagine the results are not good.

18 Q. Yeah, lung damage?

19 A. Likely.

20 Q. Okay. So now we talk about bromine with an
21 "n." I want to talk about bromide with a "d." A
22 bromide ion is written with BR -- withdrawn.

23 A bromide ion is written as Br with a
24 superscript hyphen or Br⁻, correct?

25 A. Yes.

1 Q. A bromide ion carries a negative charge?

2 A. It does.

3 Q. A bromide ion forms when a bromine atom gains
4 an electron?

5 A. Yes.

6 Q. Br⁻ is formed when a bromide salt is dissolved
7 in water?

8 A. Yes.

9 Q. Does Br⁻ exist in nature by itself?

10 MR. COCHRANE: Object to form.

11 THE WITNESS: Not for long periods of time.

12 Q. BY MR. TOBIN: Outside of a plasma, does Br⁻
13 exist in nature?

14 A. It depends what you mean by "nature."

15 Q. Can you elaborate?

16 A. I think within a flame zone, there might be --
17 there there will be Br⁻ for short periods of time.

18 Q. Short periods are like nanoseconds?

19 A. Nanoseconds, milliseconds.

20 Q. Do you know whether solid salt contain ions?

21 A. As they sit on a table, it's -- as we discussed
22 earlier, it's a stable compound.

23 Q. So solid salts do not contain ions until you
24 put the solid salt in water and it dissolves, right?

25 A. Or you inject it into a flame and it

1 disassociates.

2 Q. When it -- well, we'll get to that.

3 Any other times that a solid salt would
4 contain ions other than when it's in a flame and when
5 it's in an aqueous solution?

6 A. I don't think so.

7 Q. And I guess, when the solid salt is in an
8 aqueous solution, it's no longer solid salt, right?

9 A. Correct.

10 Q. It's dissolved?

11 A. Yes.

12 Q. And when a solid salt is in a flame, it is also
13 no longer a solid salt by that point in time. It's in
14 the gas phase and has disassociated?

15 A. That is correct.

16 Q. Br₂ contains only bromine atoms, correct?

17 A. Yes.

18 Q. The two Br atoms in Br₂ are covalently bonding?

19 A. I believe so.

20 Q. Br₂ is not an ionic compound, right?

21 A. Correct.

22 Q. Br₂ does not contain a positively charged Br ion
23 with a negatively charged Br ion?

24 A. No.

25 Q. By "no," you mean I was correct?

1 A. Yes.

2 Q. Thank you. We have the double negative.

3 Potassium bromide has the symbol KBr?

4 A. Yes.

5 Q. Potassium bromide is an example of a bromide
6 with a D compound, correct?

7 A. Yes.

8 Q. Is Br₂ a subcategory of HBr?

9 MR. COCHRANE: Object to form.

10 THE WITNESS: I don't think of it that way.

11 Q. BY MR. TOBIN: Is HBr a subcategory of Br₂?

12 MR. COCHRANE: Object to form.

13 THE WITNESS: I don't think of it that way.

14 Q. BY MR. TOBIN: I don't either, for that matter.

15 Br₂ is also called molecular bromine?

16 A. Yes.

17 Q. Br₂ is not a type of bromide compound, correct?

18 A. I think of it as a molecule.

19 Q. Right. Because -- you think of it as a
20 molecule, in part, because the two atoms are the same in
21 Br₂?

22 A. Yes.

23 Q. You've heard of the chemical HBr?

24 A. Yes.

25 Q. Would you refer to that as hydrogen bromide?

1 A. Yes.

2 Q. HBr is a hydrohalide?

3 A. I don't assign words. I look at the chemical
4 compound.

5 Q. HBr exists as a gas at room temperature?

6 A. I believe so. Yes.

7 Q. HBr does not exist as a solid crystal leg at
8 room temperature, correct?

9 A. I didn't search it, but you don't know its
10 structural form at room temperature.

11 Q. But you would expect, at least, that HBr is a
12 gas at room temperature?

13 A. Yes.

14 Q. In HBr, the H and Br are covalently bonded to
15 one another?

16 A. I think so. Yes.

17 Q. So HBr would not be an ionic compound. It
18 would be a molecule?

19 A. Yes.

20 Q. Have you ever worked with Br₂ or HBr raw
21 materials?

22 A. No.

23 Q. Would you expect that HBr is also toxic?

24 A. Yes.

25 Q. When HBr meets water, it forms hydrobromic

1 acid?

2 A. It probably should.

3 Q. That's analogous to an HCl, in the gas phase,
4 meets water, it forms hydrochloric acid?

5 A. Yes.

6 Q. Okay. So I think we'll be consistent in
7 terminology. Thank you for that.

8 Can you take a look at your technical
9 background, please. It's on Exhibit 2047. It --

10 A. 2047A or B?

11 Q. I -- I believe they're the same, but if you
12 think they're different, let me know.

13 It was your intent that the technology
14 background section would be the same between your two
15 declarations?

16 A. Can you remind me what page, please?

17 Q. Yes. So if you look at the bottom right corner
18 of the document, there's a page numbering underneath
19 Exhibit 2047.

20 A. Yes.

21 Q. And then I guess because you have a title page,
22 you have a print page number that's a little different.
23 Do you see that?

24 So Exhibit 2047, page 14 corresponds with
25 page 11 of your declaration.

1 MR. TOBIN: Am I speaking at an okay
2 cadence for you?

3 THE WITNESS: I lost track of the pages.

4 Q. BY MR. TOBIN: Can you hold up your declaration
5 for a second and let me see what page you're on?

6 A. Well, the picture -- you want the picture?

7 Okay. Section 5, page -- oh, I see what
8 you mean. Okay.

9 Q. No. Previous page. There you go. All right.
10 So let's reset that.

11 If you look at the page you're on right
12 now, in the center of the page at the bottom is the page
13 number 11.

14 Do you see that?

15 A. Yes.

16 Q. And at the bottom-right corner, it also says
17 page 14. Do you see that?

18 A. Yes.

19 Q. Okay. Just so we can -- for the sake of
20 clarity, I'll typically refer to the page by the
21 bottom-right corner. So you're on page 14 right now of
22 Exhibit 2047.

23 A. Thank you.

24 Q. Yep. And starting at page 14 of
25 Exhibit 2047 -- you're in Exhibit 2047A?

1 A. Correct.

2 Q. Starting at page 14, you have a technology
3 background that spans paragraphs 30 to 47.

4 Do you see that?

5 A. Yes, I do.

6 Q. And if you look at the other declaration you
7 have in front of you and go to the same corresponding
8 page, please.

9 A. Yes.

10 Q. And your declaration for the '430 and '225
11 patents, Exhibit 2047, you have a technical background
12 that, again, spans paragraphs 30 to 47.

13 A. Yes.

14 Q. Was it your intention that the technology
15 background would be the same between your two
16 declarations, Exhibit 2047?

17 A. Yes.

18 Q. So I'll refer to -- do you have your 2047A
19 declaration in front of you?

20 A. I do.

21 Q. Okay. So I'm going to ask you some questions
22 about your technology background. And I intend for it
23 to cover both of your 2047 declarations because I think
24 they're the same, but if you need to qualify your answer
25 and say, well, in this one, but not that one, will you

1 do so?

2 A. I will.

3 Q. Thank you.

4 Okay. So in paragraph 30, you state, "A
5 POSITA would be aware of the technology explained in the
6 remainder of this section."

7 Do you see that?

8 A. I do.

9 Q. And do you understand "POSITA" to be a person
10 of skill in the art?

11 A. I do.

12 Q. Okay. It's one of those geeky acronyms patent
13 lawyers use.

14 A. I had never encountered it until December 5th
15 or 6th.

16 Q. You were a better person back then.

17 Okay. What is your understanding of the
18 relevance of a person of skill in the art in the context
19 of the declarations you submitted?

20 MR. COCHRANE: Objection. Calls for a
21 legal conclusion.

22 You can answer.

23 THE WITNESS: A person that's -- that has a
24 technical background, ideally an engineering or a
25 chemistry degree or physics, that has been around

1 process equipment, not reading about it, but working in
2 a lab building things, inspecting power plants and the
3 like for at least two years.

4 Q. BY MR. TOBIN: Okay. And I think you did this,
5 but let me know if not, that the perspective for your
6 declaration is you're not viewing the technology and the
7 issues in this case from your perspective with your
8 50 years of experience, right?

9 A. Correct.

10 Q. You're trying to put yourself in the mindset of
11 someone who is a person of skill in the art back in
12 around 2004; is that fair?

13 A. Yes.

14 Q. So I think you understand that your experience
15 is far more than what a person of ordinary skill in the
16 art would have, yes?

17 A. Yes.

18 Q. Okay. So in paragraph 30, when you state that
19 a person of skill in the art would be aware of the
20 technology explained in the remainder of this section,
21 are you -- by this section, are you referring to
22 paragraphs 30 to 47?

23 A. Yes.

24 Q. So a person of skill in the art would have been
25 aware of all of the technology you describe in

1 paragraphs 30 to 47 of your declarations, right?

2 A. Yes.

3 Q. And a person of skill in the art would be aware
4 of all of the technology explained in paragraphs 30 to
5 47 of Exhibit 2047 by 2004, correct?

6 A. Yes.

7 Q. So you were not -- am I correct that you are
8 not trying to state that a person of skill in the art
9 would be aware of paragraphs 30 to 47 as of today?

10 You were putting yourself in the mindset
11 back in 2004, right?

12 A. Yes.

13 Q. And I think you understand that what a person
14 of skill in the art knows now is not really relevant to
15 the case as to what someone knew back in 2004 time
16 frame?

17 MR. COCHRANE: Objection. Calls for legal
18 conclusion.

19 You can answer.

20 THE WITNESS: Agreed. Times change.

21 Q. BY MR. TOBIN: Yes.

22 Now, when you say a person -- I think you
23 mentioned this a little while earlier. A person of
24 skill in the art isn't necessarily a bookworm. It's
25 someone who has education and practical experience,

1 right?

2 A. Yes.

3 Q. So in paragraph 30, when you state that a
4 person of skill in the art would be aware of the
5 technology explained in paragraphs 30 to 47, are you
6 saying that a person of skill in the art would have
7 needed to consult reference textbooks, or are you trying
8 to say that what's in paragraph 30 to 47 of your
9 declaration is really just basic engineering knowledge
10 to a person of skill?

11 A. I'm not sure I understand the distinction.
12 Could you try again, please?

13 Q. Yeah. And let me try a shorter question.
14 Apologies for that.

15 I want to focus on the word "aware" in
16 paragraph 30. You state that a person of skill in the
17 art would be aware of the technology explained.

18 Now, someone can be aware of something.
19 They just know it. It's part of their day-to-day
20 activities. Similar to how you're aware of the
21 difference between an ion and an atom. That's one
22 example of being aware of something, right?

23 A. Yes.

24 Q. The other way of being aware of something is if
25 I were to, for example, ask you about the boiling point

1 of hydrogen bromide, sitting here today, could you tell
2 that to me?

3 A. No.

4 Q. But I bet you could look up a CRC Handbook or a
5 Perry's Chemical Engineering Handbook and in a few
6 minutes tell me what the boiling point of HBr is, right?

7 A. You're giving away your background.

8 Q. It's public knowledge.

9 A. Yes.

10 Q. Okay. So you agree they're -- in context of
11 how you use the term "aware" in paragraph 30, there's
12 different levels of aware, there's something you just
13 know from your experience and your training as part of
14 your day-to-day work, and there's other things that
15 maybe you don't have top of mind, but you could find out
16 pretty easily and would know where to look, right?

17 A. Yes.

18 Q. So how did you use the term "aware" in
19 paragraph 30 of your declaration?

20 A. Oh, my context was based on the fact that I've
21 worked with and hired a lot of people over the decades
22 that both understood and were familiar with this type of
23 process equipment, and perhaps they couldn't off the top
24 of their head come up with an answer, but could
25 essentially chase down their, perhaps, college text, if

1 this was in the '80s and '90s, before the internet, and
2 figure out what information they needed.

3 Q. So is it fair to say that the technology
4 background you provide in paragraphs 30 to 47 would be
5 considered pretty basic and fundamental to a person of
6 skill in the art?

7 A. Yes.

8 Q. I'd like you to turn to paragraph 50 of your
9 declaration, please. It's on page 23 of Exhibit 2047.

10 Before you do that, by the way, do you
11 still have a paper copy of the CRC?

12 A. I do.

13 Q. Do you consider a CRC a pretty reliable source
14 for tables?

15 A. I don't look at it anymore. It more holds my
16 monitor up at a high level. If I need data, I do a
17 search.

18 Q. Okay.

19 A. I still have my copy. I can't give it away.
20 My wife does not understand this.

21 Q. All right. So paragraph 50, you say, "At the
22 time of invention, a POSITA would believe the
23 following."

24 Do you see that?

25 A. I do.

1 Q. By "time of invention," what specific year are
2 you talking about?

3 A. That 03/04 time frame.

4 Q. In paragraph 50, you provide five bullet
5 points.

6 Do you see that?

7 A. Yes.

8 Q. In the 2003/2004 time frame, a person of skill
9 in the art would have been familiar with each of the
10 five bullet points you identify in paragraph 50?

11 A. Yes.

12 Q. And by "aware," you understand that I'm asking
13 would a person of skill in the art as being just
14 familiar as just a basic aspect of their work practice
15 would the five bullet points you provide in paragraph
16 50?

17 A. Basically aware, yes.

18 Q. Can you turn to paragraph 6 of your
19 declaration, please?

20 A. Paragraph 6?

21 Q. 6, yes, please. It's on Exhibit 2047, page 5?

22 A. Yes, I have it.

23 Q. I'd like to talk to you about the Electric
24 Power Research Institute or EPRI. What is EPRI?

25 A. The short story is that it's a research

1 consortium that is funded by the bulk of electric
2 utilities in the country, the purpose being to pool
3 their resources so work that's common and that all power
4 companies can benefit from is conducted in a
5 collaborative manner at scale and with -- with attention
6 to solving technical problems.

7 Q. Was EPRI a reliable source for information
8 about coal power plants?

9 A. You're welcome to interpret the following with
10 incredible bias, but I think it was the gold or platinum
11 standard.

12 Q. I'm not going to argue with you on that.

13 When did you work at EPRI, what years?

14 A. May 1st of 1978 through June 18th or 19th of
15 1993.

16 Q. Was Ramsay Chang at EPRI when you were there?

17 A. He was.

18 Q. What was is it Dr. Chang or Mr. Chang?

19 A. It's Dr. Chang.

20 Q. What --

21 A. Ph.D. from Stanford.

22 Q. In the 2003/2004 time frame, what was Dr.
23 Chang's role at EPRI?

24 A. By 03/04, I had been gone for a while, but I
25 know that he has -- he was bought in and he focused in

1 on developing mercury control technologies.

2 Q. Would you consider Dr. Chang an expert in the
3 field of mercury control?

4 A. I do.

5 Q. You state in paragraph 6 that among your
6 responsibilities were managing tests on six pilot
7 plants?

8 A. Yes.

9 Q. What years were you managing tests on the six
10 pilot plants?

11 A. The first one probably started up in 1980, and
12 I think several were still running in '93 when I -- when
13 I left.

14 Q. What tests did you manage on the pilot plants?

15 A. These tests were directed to adopting to the
16 U.S. the technology of selective catalytic reduction to
17 control nitrogen oxides. There had been experience with
18 this technology in Germany, but the fuels we use here,
19 the coals, are very different, so the purpose of the
20 program was to get experience with coals in the U.S.

21 Q. Selective catalytic reduction, is that
22 abbreviated as SCR?

23 A. Yes.

24 Q. The nitrogen oxides you mention, is that
25 abbreviated as capital NOx?

1 A. Correct.

2 Q. Do you call that NOx?

3 A. Yes.

4 Q. How are the coals different in Germany than
5 they are in the United States?

6 A. The coals in Germany, the ones that were -- had
7 the bulk of experience were -- looked a lot like some of
8 our Appalachian fuels and with lower content of sulfur
9 and lower content of -- of -- of alkaline material.

10 So when we were looking to put this
11 technology on eastern high-sulfur, bituminous coals, or
12 Appalachian high-sulfur coals, or coals from the
13 well-known Powder River Basin in Wyoming, those were
14 very different, and the concern was that the trace
15 elements in the U.S. coals would act differently and
16 change the rate of which the catalysts would poison.

17 Q. Is one of the problems with sulfur and coal is
18 that it creates SOx?

19 A. Yes.

20 Q. SOx is capital S, capital O, lower case x?

21 A. Yeah. We mostly think of it as sulfur dioxide
22 SO₂, and then there's always a little bit that gets
23 oxidized further to sulfur trioxide, SO₃.

24 Q. Was Germany using lignite coals?

25 A. They were.

1 Q. Do you consider lignite coal to be higher coal
2 or lower-end coal or somewhere in between?

3 A. Lignite is pretty lower-end coal.

4 Q. I think you mentioned sulfur content compared
5 to coals in Germany compared to the United States.

6 Can you elaborate on that?

7 A. Well, they -- all coals vary. And so, what was
8 important was that, in Germany, they were high enough to
9 where they needed scrubbers for SO₂, and, of course, in
10 this country after the Clean Air Act amendments, we
11 deployed scrubbers on a lot of units. But, basically,
12 the -- the key difference, a lot of applications of what
13 EPRI members were, were on higher sulfur coals and also
14 coals that had -- I had not mentioned this yet -- that
15 had arsenic, which not only is a notorious human poison,
16 but is a notorious catalyst poison.

17 Q. Is it fair to say that, the more sulfur in the
18 coal source, the higher the need for a scrubber?

19 A. Yes.

20 Q. And so, if -- Germany, if the coals had less
21 sulfur in them, they would have less of a need of a
22 scrubber than, for example, coals in the United States?

23 A. No, I -- I -- I think the -- not necessarily.

24 Q. Can you elaborate?

25 A. Yes. Unless the content of the sulfur is

1 almost de minimus, a scrubber is needed and were needed
2 in Germany. What was different here was -- was the 1990
3 Cleaner Act amendments allowed utilities to trade
4 imbalance emissions. So a utility could have a choice
5 of scrubbing all their units or they would scrub
6 three-quarters of them really, really, really deeply,
7 gain those credits for SO₂, and be able to weigh those
8 against other units that they didn't have to put
9 scrubbers on, the message being it was a more
10 cost-effective means, plus, you'll love this, politics
11 entered into the frame.

12 Q. Shocking. What does it mean to poison a
13 catalyst?

14 A. Basically, to either physically block up the
15 pore, like the way an English muffin might have a lot of
16 pores, people go to great effort to have -- create pores
17 for catalyst as well as activated carbon. So it's
18 either physically blocked, or in the case of arsenic, it
19 will defuse into the pore and, basically, tie up and
20 render ineffective some of the active ingredients,
21 particularly, for this application, vanadium pentoxide.

22 Q. That's VN05?

23 A. V205.

24 Q. Does SO₂ also poison activated carbon?

25 A. SO₃, which will go hand in hand with SO₂, will

1 basically fight its way to the surface of a carbon and
2 effectively poison it, occupy a site that normally
3 mercury would want to go to.

4 Q. Do lignite coal, generally, have less sulfur
5 than other kinds of coal?

6 A. It varies. I think -- here in Texas, I think
7 the lignites here tend to be of lower sulfur, but I
8 think, in North Dakota, basically, they're higher in
9 sulfur, which I think was a lot of the basis for EERC
10 being born from -- from the state.

11 Q. How would you rank the sulfur content between
12 lignite and bituminous?

13 A. You know, again, they vary all over the place.
14 You can find bituminous coal that's called a compliance
15 coal, and that's because -- and this is where the
16 politics came in -- the level of SO2 limits, nationally,
17 were set such that certain bituminous coals could be
18 fired without a scrubber.

19 Q. Let's take a break.

20 A. Okay. You sure?

21 Q. Yeah.

22 A. Okay.

23 (A recess was held from 10:36 a.m. to 10:50 a.m.)

24 Q. BY MR. TOBIN: Sir, can you please turn to
25 Exhibit 2047, page 16, paragraph 33.

1 A. Yes.

2 Q. And this is the general area where you're
3 discussing components of a boiler?

4 A. Correct.

5 Q. Do you use the term "boiler" and "furnace"
6 interchangeably?

7 A. No.

8 Q. Do you use the terms "boiler" and "combustion
9 chamber" interchangeably?

10 A. No.

11 Q. All right. Describe for me the differences,
12 please.

13 A. I think of the boiler as the entire device that
14 has actually six or seven or eight individual heat
15 exchangers aligned in it. Okay. I think of furnace,
16 F-U-R-N-A-C-E, as the lower region where there's only
17 one heat exchanger, and it -- it -- if you want to know
18 the details, it's designed to mostly take heat by
19 thermal radiation.

20 And I think of combustion chamber as really
21 the sort of a subset of the furnace, which is, for lack
22 of a better word, the kernel or the envelope within
23 which -- kernel, K-E-R-N-E-L, or envelope within which
24 most of the fuel and air mix and -- at least get through
25 the bulk of the -- of the -- of the combustion process.

1 Q. Have you heard of others in the industry use
2 the term "boiler" and "combustion chamber"
3 interchangeably, at least in the colloquial manner?

4 A. Nobody I know.

5 Q. Does a -- a coal furnace in a power plant has
6 different zones, right?

7 A. A boiler has different zones.

8 Did you ask, specifically, for a furnace?

9 Q. I did.

10 A. Okay. Yes.

11 Q. Are you familiar with the term "primary
12 combustion zone"?

13 A. Yes.

14 Q. What is a primary combustion zone?

15 A. That is where the initial heat release takes
16 place, where if you're a coal particle, you see this
17 flux of heat and the particle starts devolving, it
18 starts becoming liquid, and starts nixing with air and
19 burning, but it's not completely gone all the way to
20 completing the combustion process.

21 Q. A primary combustion -- excuse me. Withdrawn.

22 Primary combustion zone is where most of
23 the coal is burned?

24 A. Probably, yeah.

25 Q. Are you familiar with something called a reburn

1 zone?

2 A. Yes.

3 Q. What is a reburn zone?

4 A. Reburn is an niche technology that's hardly
5 used any more that was invented and commercialized to
6 control nitrogen oxides. The strategy was to create
7 almost a second very weak flame zone where you could set
8 the chemistry to reduce nitrogen oxides.

9 Q. So most of the coal would be burned in the
10 primary combustion zone, but then some coal would
11 continue to burn in the reburn zone?

12 A. I don't think the coal would be burning. I
13 think you would have at that point mostly gas phase
14 constituents that would be, essentially, exposed to
15 hydroxyl radicals -- hydroxyl, H-Y-D-R-O-X-Y-L,
16 radicals -- that then can reduce nitrogen oxides. But I
17 cannot think of one boiler in the United States that's
18 using reburn now. So it was a technology that -- I
19 won't say it failed. It just didn't provide the
20 performance required.

21 Q. Would a reburn zone have flue gas in it?

22 A. Yes. You would have a mix of combustion
23 products which we get lazy and call flue gas, but not
24 completely -- not completely combusted or completely
25 burned.

1 Q. So there would be -- in a reburn zone, there
2 would be flue gas, plus hydroxyls, and other gas phase
3 constituents?

4 A. And nitrogen oxide, which is the target to try
5 to reduce it, yes.

6 Q. Okay. So in a reburn zone, there would be NOx
7 flue gas and other gas phase constituents?

8 A. Yes.

9 Q. For those older setups that used reburn, the
10 reburn zone was within a combustion chamber?

11 A. It was above what I would think of as a
12 combustion chamber because you needed residence time to
13 get the reactions to do what you wanted to do.

14 Q. Have you heard of the term "overfire air"?

15 A. Yes.

16 Q. What is overfire air?

17 A. Overfire air was another method of controlling
18 nitrogen oxides. We found out that if you mixed fuel
19 and air and you didn't give the fuel all the air that it
20 wanted, it would set up a series of reactions around the
21 nitrogen that was bound in the coal, and because the
22 nitrogen couldn't find enough oxygen, it wouldn't form
23 NOx, it would intend -- instead form nitrogen species
24 like ammonia, and that sound really nasty like HCN,
25 hydrogen cyanide, but these nitrogen species would,

1 essentially, react with each other and go away in the
2 form of molecular nitrogen. So we -- and then -- but
3 you still had to finish burning the fuel out, so you had
4 to complete the air addition, and that was over the
5 burners, so some POSITA called it overfire air.

6 Q. Did overfire air contain coal?

7 A. No.

8 Q. So overfire air was another way to add air to a
9 combustion chamber without coal?

10 A. Correct.

11 Q. I believe you're also familiar with something
12 called the secondary air stream?

13 A. Yes.

14 Q. What is the secondary air stream?

15 A. Well, it's the second step of what you would --
16 asked about the primary combustion zone. Basically, the
17 primary combustion zone was retained by primary air and
18 fuel and really separated by 8 or 12 inches usually in a
19 concentric geometry, the secondary air would be brought
20 in, but within milliseconds, contacting the coal in the
21 primary combustion zone.

22 Q. Upstream of the combustion chamber, does coal
23 and the primary air stream contact the secondary air
24 stream?

25 A. Repeat that, please.

1 Q. Upstream of the combustion chamber, does coal
2 and the primary air stream contact the secondary air
3 stream?

4 A. Within the duct work of the power plant, the
5 answer to the question is no.

6 Q. Can you turn to the previous page, please, to
7 the figure?

8 A. Yes.

9 Q. And I want to ask you about the figure you
10 label as figure 1 in paragraph 31.

11 Do you see that?

12 A. Yes.

13 Q. What is the source of your figure 1 for
14 paragraph 31 of your declaration?

15 A. I can't remember. I probably used it in a
16 publication or technical paper, and I probably found it
17 searching a document. I might have a reference
18 someplace, but I didn't put it into this.

19 Q. Do you know whether this figure is
20 representative of coal plants before or after 2004 or
21 both?

22 A. It's representative of both. I would not have
23 used it if I didn't think it was.

24 Q. Okay. Do you see in your figure you have
25 something called air inlet?

1 A. Yes.

2 Q. Is that secondary air?

3 A. Given the nature of this chart, which is
4 general, it probably doesn't distinguish.

5 Q. But in a real coal plant, the primary air and
6 the secondary air would be separate ducts or pipes?

7 A. They are separate ducts or pipes, yes.

8 Q. Do you see how in your figure 1 there is
9 something called an SO₂ scrubber?

10 A. Yes.

11 Q. Is that sometimes just abbreviated as scrubber
12 without the SO₂ in front of it?

13 A. Yes.

14 Q. The purpose of a scrubber in a coal power plant
15 is to remove SO_x?

16 A. To remove sulfur dioxide.

17 Q. Sulfur dioxide is one type of SO_x?

18 A. Yes.

19 Q. Sulfur oxide is SO₂?

20 A. Correct.

21 Q. As of 2004, how expensive would it be to add
22 the scrubber to a power plant that did not have one?

23 A. Very.

24 Q. Hundreds of millions of dollars?

25 A. We think of it in terms of dollars per megawatt

1 of capacity or kilowatt of capacity, and scrubbers
2 typically could be anywhere from, at best, maybe \$250 a
3 kilowatt up to \$450 a kilowatt. So if you take a
4 500-megawatt power plant and multiply it 500 times 1,000
5 to put it into kilowatts and multiply that number again,
6 you get into millions.

7 Q. In fact, I think you would get into hundreds of
8 millions of dollars to add a scrubber?

9 A. Yes.

10 Q. As of 2004, what percentage of power plants in
11 the United States would you estimate had scrubbers?

12 A. Probably about 60 percent, but I could be
13 wrong, because it depend on how you -- well, a power
14 plant is a power plant, but I talked earlier about how
15 some people would scrub really, really, really deep and
16 not have to control on others, that would be -- well,
17 I'll stay -- I'll stay with about 60 percent.

18 Q. I think power plants often have multiple units
19 within them?

20 A. Yes.

21 Q. So a power plant can have anywhere from 1 to 4
22 or more coal units within it, right?

23 A. Yes.

24 Q. So that 60 percent estimate you gave me, is
25 that across power plants or across units?

1 A. Oh, I was thinking the national inventory. So
2 there used to be 15- or 1600 or more coal-fired power
3 plants in the U.S. We're down to about 450 now. And I
4 was thinking the national inventory.

5 Q. About 60 percent of those had scrubbers?

6 A. I think so. And -- yes, but I -- I -- it -- it
7 has changed and evolved.

8 Q. Are you familiar with the term called
9 "pyrolysis char"?

10 A. Yes.

11 Q. What is pyrolysis char?

12 A. Well, in the field of gasification where the
13 concept was to take coal and turn it into gas, what you
14 would do would be to expose coal to -- again, partially
15 burn it, starve it of oxygen, you would generate, among
16 others, carbon monoxide and hydrogen, which you would
17 come off and then use in a boiler and the residual
18 leftover would be carbon that you extracted and used in
19 a different manner. So what you extracted and used in a
20 different manner would be referred to as the pyrolysis
21 char.

22 Q. Have you ever heard of anyone mixing coal with
23 pyrolysis char?

24 A. I have not heard of it. I don't don't know why
25 it couldn't be done, but I have not heard of it.

1 Q. Does pyrolysis char inherently form inside a
2 combustion chamber?

3 A. It does depending on how unaware in the flame
4 zone and how the burner is designed.

5 Q. Are there coal -- is that process of pyrolysis
6 char formation been known since before 2004?

7 A. Yes.

8 Q. I want to take you to paragraph 13 of your
9 declaration, please.

10 Are you there?

11 A. Yes.

12 Q. Okay. And this is a section that's called
13 Legal Standards.

14 Do you see that?

15 A. Where the first -- where the next sentence
16 says, "I'm not a lawyer."

17 Q. Correct.

18 A. Okay. So I assume this is something that
19 someone drafted for you out of the legal standard
20 section.

21 A. Yes.

22 Q. And I'm certainly not going to ask you to give
23 legal opinions. I would like to ask you about some of
24 the standards you used in your analysis of this case.

25 A. Okay.

1 Q. And I want -- I'd look you to give me your best
2 answer, if you know. All right?

3 A. Okay.

4 Q. So paragraph 13, do you see how in the next to
5 last sentence that starts with "furthermore"?

6 Do you see that sentence?

7 A. Yes.

8 Q. You state that the inventors of the '114 and
9 '517 patents conceived the claimed inventions and
10 reduced it to practice before August 30th, 2004.

11 Do you see that?

12 A. I do.

13 Q. And that is -- is that an opinion you formed?

14 A. I had been described what reduced to practice
15 means, and I had reviewed the logbook and journals from
16 the EERC both, as reflected in Mr. Pavlish's
17 declaration, and going back to the source material
18 itself, convinced myself that the dates are correct, and
19 convinced myself that that the tests were taken and the
20 variables adjusted and the results written down so that
21 that statement was valid.

22 Q. Okay. Sometimes --

23 A. So the short answer is that is my conclusion,
24 no one else's, and I verified it.

25 Q. Got it.

1 And you understand that, in forming your
2 conclusions, there's a framework by which we're all
3 operating under, which are called the legal standards,
4 right?

5 A. Yes.

6 Q. And sometimes experts will include in their
7 declaration a section of what it means to reduce
8 something to practice or what it means to conceive of
9 something. That's a statement. I'm not asking you
10 that.

11 Did you include in your declaration a
12 statement of what the legal standard is to conceive of
13 an invention?

14 A. Let me look. The words in here that address
15 that were "I was informed by counsel."

16 Q. Okay. So what is the understanding you used in
17 performing your work in this case as to what it means to
18 conceive of a claimed invention?

19 A. Well, separate from anything an attorney told
20 me, I have been around the block a little bit and tried
21 to invent things myself and collaborated with people
22 that tried to invent things themselves [SIC].

23 So I have a sense for the fact that you
24 come up with an idea, you do a patent search, you write
25 down as best you can what you think the idea is going to

1 do, and if you have the ways and means to conduct an
2 experiment, you do so in a manner either proves you're
3 as clever as you thought you were or it shows perhaps
4 you're not.

5 So in this case, that was my internal
6 guideline on reading the declaration from John Pavlish
7 and looking through the logbook.

8 Q. Did counsel inform you of the legal definition
9 of what it means to conceive of an invention?

10 A. No.

11 Q. Okay. So in the analysis you applied, did you
12 consider -- withdrawn.

13 So conceive is a verb, right?

14 A. Yes.

15 Q. And the noun form is conception?

16 A. Yes.

17 Q. Okay. In the analysis you applied, did you
18 consider conception as another word for general goal or
19 research plan that the inventor is trying to pursue?

20 A. I have not used the term "conception" except in
21 church.

22 Q. In that -- now, you have used the word
23 "conceive," right?

24 A. I haven't thought -- correct.

25 Q. And I'm not asking about church.

1 A. Yeah.

2 Q. I'm asking about paragraph 13 of your
3 declaration. When you say that the inventors of the
4 '114 and '517 patents conceived the claimed invention,
5 I'd like to probe more what you mean by that "conceive."

6 A. I need to -- pardon me while I find the
7 sentence. So I'm reading, "Furthermore, the inventors
8 of the '114 and '517 patents conceived the claimed
9 invention and reduced it to practice before August 30th
10 of 2004."

11 Q. That's the sentence I was referencing.

12 A. Okay.

13 Q. And I want to focus -- do you understand that
14 "conceive" and "reduction to practice" are two separate
15 steps?

16 A. Yes.

17 Q. So I'd like to focus on the conceived step. We
18 call it conception as a noun.

19 In the analysis you applied, did you
20 consider conceiving an invention to mean to have a
21 general goal or research plan?

22 MR. COCHRANE: And I'll object as calling
23 for a legal conclusion.

24 But you can answer.

25 THE WITNESS: Could you repeat that again,

1 please? I'm not being difficult. I'm trying to think
2 through.

3 Q. BY MR. TOBIN: I'm not going to accuse you of
4 being difficult.

5 I'd like to focus on the conceive step. In
6 the analysis you applied, did you consider conceiving an
7 invention to mean having a general goal or a research
8 plan in mind?

9 A. Or just being observant. Let me tell you what
10 I saw that struck out at me.

11 John Pavlish was reviewing some material on
12 the composition of snow and ice in the Arctic, and he
13 found a publication that suggested that one of the
14 reasons why mercury -- and I think I'm getting this
15 correct -- mercury was found in snow and ice in the
16 Arctic in the oxidized state was due to the presence of
17 bromine in seawater.

18 I didn't talk to John about this. That
19 came up through some of the graphics decks in their
20 planning. And I thought that was impressive in terms of
21 being observant and then being able to run with that.

22 Q. So -- so the problem at hand was mercury
23 remediation, right?

24 A. Yes.

25 Q. And the analysis you applied, did you look for

1 a specific settled idea, a particular solution, to
2 remediate that mercury as part of the conception
3 inquiry?

4 A. I -- I simply read what they did and executed.
5 And I made sure it was to the standards that, if I were
6 in the lab, I would have executed, including, you know,
7 keeping the records in the logbook. And I thought it
8 certainly would stand -- I thought it would stand a test
9 of, essentially, being a valid concept. I don't think I
10 exactly answered your question, but --

11 Q. You did not.

12 A. Okay. Try again.

13 Q. So I'm really -- I'd like to separate these two
14 steps. There's conception and there's reduction to
15 practice.

16 You understand that, correct?

17 A. Yes.

18 Q. And then there's something called diligence in
19 reducing to practice. Is that something you're aware
20 of?

21 A. I wouldn't be -- yes, yes.

22 Q. So I'd like to focus on the conception first.

23 A. Okay.

24 Q. And the conception evidence that you talked
25 about is about bromine in seawater and mercury and snow?

1 A. Yes.

2 MR. COCHRANE: Object to form; misstates
3 testimony.

4 Q. BY MR. TOBIN: Did -- in doing your analysis,
5 did you ever take -- withdrawn.

6 You have the four patents in front of you,
7 right?

8 A. Yes.

9 Q. In determining conception, I want to focus on
10 that piece. Did you ever look to see what is the
11 evidence of conception and then map it against each of
12 the patent claims?

13 A. No.

14 Q. In -- I want to talk about reduction to
15 practice.

16 You understand -- I think that's a separate
17 step.

18 A. Yes.

19 Q. What is the standard you used -- the legal
20 standard -- withdrawn.

21 Again, I'm not asking you for a legal
22 opinion. I'm just asking for the framework you used to
23 conclude that reduction to practice had been shown, so
24 that's the context of my question.

25 A. Yes.

1 Q. My question is, what is the standard you used
2 in determining whether reduction to practice had been
3 met?

4 A. Well, as I described and as you pursued
5 earlier, much my life was involved in managing pilot
6 plant tests. You know, we didn't describe it, but three
7 years prior to that, I was the the guy in the lab
8 writing down the observations denoting the time and all
9 the details. So I certainly understand that, if you are
10 going to make a statement about anything that relates to
11 process chemistry or physical conditions or a mass
12 balance or energy balance, you -- you have to make the
13 right measurements. If you're conducting an experiment,
14 you have to identify and vary the right independent
15 parameters, separate those from the dependent
16 parameters, and make sure all the data support your
17 conclusion.

18 So that's a long-winded way of saying I
19 looked through their -- their logbooks, pretended I was
20 in a lab with them, and concluded that it met an
21 adequate standard to be -- or I thought it was reduced
22 practice that the data showed what they were claiming.

23 Q. And you have the ME2C patents in front of you,
24 the '114, '517, '225, and '430, correct?

25 A. Yes.

1 Q. In doing your work for this case, did you take
2 the four ME2C patents on one side, take the reduction to
3 practice on the other side, and try to map that
4 reduction to practice evidence to any of the patent
5 claims?

6 A. Not as you describe, but the key element of
7 adding bromine to the combustor and observing the impact
8 and having it be measured with -- with adequate and
9 reliable process equipment was what I focused on.

10 Q. But I do want to focus -- withdrawn.

11 In the last answer when you said "bromine,"
12 were you referring to Br₂ or just an ingredient that
13 contains BR?

14 A. In a compound or ingredient that contains
15 bromine, I -- you know, basically, they used the sodium
16 form.

17 Q. Okay. You saw that Pavlich and co-inventors
18 used sodium bromide, NaBr, correct?

19 A. Yes.

20 Q. And that's the only example of a Br form that
21 you saw them adding to coal is NaBr?

22 A. That is correct.

23 Q. So going back to my previous question, though,
24 did you -- withdrawn.

25 You're an inventor on patents right?

1 A. Yes.

2 Q. And you know that patents have patent claims in
3 them?

4 A. Yes.

5 Q. So did you make an effort to compare the
6 reduction to practice evidence to each limitation of the
7 patent claims of ME2C's patents?

8 A. I didn't go through each claim. I did not.

9 Q. Did you make an effort to compare the reduction
10 to practice evidence against any claim --

11 (Reporter requests clarification.)

12 Q. BY MR. TOBIN: Did you make an effort -- oh,
13 withdrawn.

14 Did you make an effort to compare the
15 reduction to practice evidence with any complete claim
16 in the ME2C patent?

17 A. Yes.

18 Q. Which specific claims?

19 A. The specific claims and language that addressed
20 the addition of a bromine compound, in this case sodium
21 bromide, to coal prior to entering the combustion
22 chamber.

23 Q. And I think you know that the patent claims in
24 ME2C's patents have more than just that one step of
25 adding the Br containing ingredient to coal --

1 A. Yes.

2 Q. -- correct?

3 A. Yes.

4 Q. Did you make any effort to map the reduction to
5 practice element -- withdrawn.

6 Did you make any effort to map the
7 reduction to practice evidence with each of the claimed
8 limitations beyond just the adding Br to coal
9 limitation?

10 A. Except for claims where a measurement was
11 required to provide information to adjust the sorbent
12 feed -- wait a minute. And I can't think if there are
13 any others. There might have been one or two more, but
14 I can't remember right now.

15 Q. Why do you except for limitation where it
16 required adjusting the feed?

17 A. Yeah, that wasn't a very clean answer. I think
18 the answer is no, with the exception of some of the
19 claims defined measuring mercury and using that
20 knowledge in the process control scheme to adjust the
21 amount that you're putting in. And, indeed, at that
22 test rig, they were measuring mercury, and it was not an
23 automated control system, it was manual, but you could
24 go through the log books and see where the mass rate of
25 addition of the sodium bromide was adjusted and the

1 corresponding change to mercury as measured in the flue
2 gas was denoted and detected.

3 Q. Okay. So somewhere in the evidence ME2C cites
4 for reduction to practice you found adding a
5 Br-containing ingredient to coal, correct?

6 A. Yes.

7 Q. And somewhere in the evidence that ME2C cites
8 reduction to practice, you found adjusting the sorbent
9 injection rate to as a response to a mercury?

10 A. Yes.

11 Q. And those are the two pieces you look for in
12 the documents?

13 A. Yes.

14 Q. Did you look for any other claim limitations in
15 the reduction to practice documents besides the two you
16 just cited?

17 A. Bear with me while I just scan one of the
18 patents.

19 Q. For the record, which patent are you looking at
20 now?

21 A. I am looking at '114.

22 Q. Thank you.

23 A. Yeah, there are a few more. I'm glad I did
24 this. For example, they call out a 70 percent
25 reduction. And, indeed, there are curves in the -- that

1 are presented in the DOE reports that show -- in the
2 Department of Energy, DOE, reports that are about that
3 report mercury removal, and you can go back and see
4 that, about how those levels were retained.

5 They also reported the mass of sodium
6 bromine added compared to the coal, and that comports
7 with the 1 to 30 grams.

8 Q. Now, does that 1 to 30 grams deal with the
9 ratio of sodium bromide to coal or another ratio?

10 A. This is the -- well, it's the -- it's the
11 amount of halogen promoter added to the coal, and that,
12 basically, is based on the -- I mean, they gave the
13 macerate of the material added and they gave the tons of
14 coal -- tons -- they gave the pounds of coal burned per
15 hour, and that's what the number comes out to Dr. Niksa
16 did the calculation to. So -- so there was the amount
17 of -- of sodium bromide that was added.

18 Q. At any point in your declaration, do you
19 actually -- do you -- withdrawn.

20 Do you know what a claim chart is?

21 A. No.

22 Q. A claim chart is where you write a claim
23 limitation from a patent claim, and then in connection
24 with that claim limitation, you say here is the evidence
25 that shows reduction to practice of this claim element.

1 Is that anything you did in your
2 declaration?

3 A. It's not what I did, no. And, you know, going
4 on, I -- we talked earlier about how I view a boiler
5 versus a combustion chamber and the like when it -- when
6 there's -- for example, there's -- claim 5 -- again,
7 having spent decades designing burners and burner system
8 combustion chambers, when I read claim 5, I'm
9 comfortable that that is valid that if you add the
10 material -- in my opinion, if you add the material to
11 the coal feed or you inject it into the root of the
12 flame, the answer will be the same. So 5 would be one
13 that I probably looked at and thought, Yeah, that makes
14 sense.

15 Q. Now, where in your declaration do you discuss
16 your opinions on claim 5?

17 A. I don't. I'm responding to your question.

18 Q. Oh, thank you.

19 Let me ask you a different question. At
20 anywhere in your declaration, do you say here is a claim
21 limitation in the patent and then here is the evidence
22 that supports reduction to practice of that claim
23 element?

24 MR. COCHRANE: Objection to form; the
25 document speaks for itself.

1 You can answer.

2 THE WITNESS: I did not conduct that
3 analysis in my declaration.

4 MR. TOBIN: Got it.

5 Richard, just -- I'm sure -- you've been
6 pretty good so far, but I'm sure you're aware of the
7 PTAB testimony guidelines. Things like document speaks
8 for itself, that's not one of the -- what you should be
9 doing.

10 MR. COCHRANE: Understood. Thank you.

11 MR. TOBIN: Okay.

12 Q. BY MR. TOBIN: Do you still have the '114
13 patent claim in front of you?

14 A. I do.

15 Q. I'd like you to turn to column 34, please,
16 which is Claim 1?

17 A. Column 34?

18 Q. Yes.

19 A. So that's the back end of Claim 1?

20 Q. Yes.

21 Do you see there's a claim limitation that
22 says, "Controlling in response to the monitor mercury
23 content of the claim gas an injection rate of injecting
24 the sorbent into the mercury-containing gas, the sorbent
25 composition, or a combination thereof so that the

1 mercury content of the cleaned gas is maintained at or
2 below a desired."

3 Do you see that?

4 A. I do.

5 Q. And I think you mentioned that, in the evidence
6 you saw, there was not a control scheme with a feedback
7 loop, correct?

8 A. Correct.

9 Q. It was more just a manual adjustment of some
10 tech adjusting a rate -- a sorbent injection rate?

11 A. Yes.

12 Q. And then -- and I think, as you see in this
13 claim, it presents two options as part of the control
14 scheme, either control an injection rate of injecting
15 the sorbent or controlling the sorbent composition.

16 Do you you see that?

17 A. Yes.

18 Q. And I think you testified that you saw evidence
19 somewhere in the exhibits of controlling an injection
20 rate of injecting the sorbent into the
21 mercury-containing gas?

22 A. Yes.

23 Q. Did you see evidence of controlling the sorbent
24 composition in response to the monitored mercury content
25 of the claimed gas?

1 A. No.

2 Q. Do you have an understanding of what diligence
3 in reduction to practice means?

4 A. No.

5 Q. Is that something you provided opinions on in
6 your declaration?

7 A. Does the word "diligence" show up in my
8 declaration? I don't think so.

9 Q. Well --

10 A. If so, I've forgotten.

11 Q. I think it shows up at the end of paragraph 14,
12 but then I don't think you say anything else about it,
13 but let me know if I'm wrong.

14 A. Well, okay. To me, diligence has a meaning of
15 its own in terms of evaluating investment background and
16 the like, but, to me, diligent is just the word of good
17 human practice. And so, I felt these guys exhibited
18 good human practice, but not in the context of -- of a
19 due diligence exercise.

20 Q. Did you check for delays in activity?

21 A. Pardon?

22 Q. Did you check for delays in research activity?

23 Excuse me. Let me ask a better question.

24 Did you check for gaps in activity where --
25 maybe for a month here, a month there they weren't

1 working on the project?

2 A. I did go through and see that there were
3 periods where -- that the particular test rig was not --
4 was not utilized for that purpose, but, again, having
5 been involved in this space, so to speak, for decades, I
6 understand that you cannot always dedicate a test rig
7 for all time for all your purpose. So I think I did see
8 that, but it didn't strike me as anything other than the
9 fact that somebody else needed the test rig.

10 Q. Okay. But is it fair to say you did not
11 investigate each of the gaps in activity and try to
12 figure out what the inventors were doing, then?

13 Is that a fair statement?

14 A. That's correct. Yes.

15 Q. Can you turn to paragraph 15 of your
16 declaration?

17 A. Yes.

18 Q. Midway down, there's a line that starts with,
19 "The credibility."

20 Do you see that?

21 A. "The credibility of inventor's story."

22 Q. Yes. I don't want to -- I want to ask you
23 about the next sentence. You state, "I understand that
24 factors bearing on the inventor's credibility and
25 whether the inventor's testimony has been adequately

1 corroborated include" and then you list seven factors.

2 A. Yes.

3 Q. Which of those factors did you find relevant in
4 forming a conclusion of reduction to practice?

5 A. Which of these did I find --

6 Q. Relevant in forming your opinions on reduction
7 to practice.

8 A. Well, you've already heard me share my opinion
9 of John Pavlish over decades, and to me, he's credible.

10 Q. Okay.

11 A. And despite the fact that he roots for the
12 wrong hockey team, I still like him. And if he -- when
13 I see work under his tutelage coming through the lab, I
14 believe it's -- it's straight up and -- and honest
15 and -- and he's not cutting corners on data.

16 Q. So which of the specific factors that you
17 discuss in paragraph 15 did you analyze for reduction to
18 practice?

19 A. Well, again, keep in mind this is under the
20 legal standard, and I am not a lawyer.

21 Q. Sure.

22 A. I looked at -- I looked at these. I, indeed,
23 thought about them. I -- certainly, I saw the
24 corroborating witnesses' familiarity. Other -- other
25 staff at EERC had similar declarations. And, again,

1 because I know -- I know Michael. I didn't do a deep
2 dive in any of these, but after reading through all of
3 this and the background material that was presented to
4 me and my knowledge of the EERC work, I -- I felt
5 comfortable with the fact that, if they've shown the
6 data, that its valid and that the concept is one that's
7 worth thinking about.

8 Q. So your conclusion, after reviewing the
9 materials, is that their data is valid and the concept
10 is one that's worth thinking about?

11 A. Well, I'm -- I'm -- Counsel, I -- I -- you
12 know, I don't -- there's six or seven items here, and I
13 certainly didn't -- didn't do any work other than than
14 reading these, reading the reports and thinking of a
15 multidecade reputation and being comfortable with --
16 with putting my name on this document saying I thought
17 they were -- they were diligent.

18 Q. So is it --

19 A. I have no more to say than that. I...

20 Q. So you did write up a technology background,
21 and let's put that aside. Other than the technology
22 background, did you view your role in the case as just
23 to, kind of, look at the documents you cite in your
24 report and just say, Yeah, those documents seem right?

25 MR. TOBIN: Object to form.

1 You can answer.

2 THE WITNESS: Well, I -- I -- to the extent
3 I had information available to me, as I said, I thought
4 of these, explored these, but I certainly -- I thought
5 of every one. I didn't have, in my -- in my presence,
6 the ability to go any deeper and I didn't think I needed
7 to.

8 Q. BY MR. TOBIN: So these factors you cite in
9 Exhibit 15, kind of, bears a legal background, but
10 anywhere in your declaration do you actually write
11 anything about any of these factors?

12 A. No.

13 Q. Let's turn to paragraph 16, please. And here,
14 we're getting into a little bit of a circular definition
15 I wanted to ask you about.

16 You say that the person of ordinary skill
17 in the art is a hypothetical person who is presumed to
18 have known the relative art at the time of the
19 invention. You then state that, by "relevant," I mean
20 relevant to the challenge claims of the ME2C patent,
21 right?

22 A. Yes.

23 Q. So what does "relevant art" mean in the context
24 of the ME2C patents?

25 MR. COCHRANE: Objection. Calls for a

1 legal conclusion.

2 THE WITNESS: The claims and the patents
3 come out of the test work at the EERC where they test
4 the combustor, a complete test rig. The staff that
5 conducted those tests know that equipment well. They
6 designed it. They tested it for years. They were very
7 familiar with how it worked. They've conducted
8 experiments, and how to separate a dependent variable
9 from an independent variable, and have all the staffing
10 to make the right measurements, and they understand the
11 process chemistry, and they understand how a coal-fired
12 power plant and all the associated environmental
13 controls were.

14 Q. BY MR. TOBIN: Is that what you meant by
15 "relevant art"?

16 A. Yes.

17 Q. Have you, personally, worked with any of the
18 EERC staff in your career?

19 A. No.

20 Q. Do you know who any of the EERC staff was that
21 ran the equipment?

22 A. You mean other than John and Michael?

23 Q. Correct.

24 A. John -- no.

25 Q. Do you know whether John Pavlish actually ran

1 the pilot test combustors versus had technicians do it
2 for him?

3 A. I believe -- and I don't know if this is just
4 an assumption, but I believe he probably ran the test
5 the way I did, where you had technicians doing the
6 hour-by-hour work, but at the end of the day or the end
7 of the week, you got a report, and the first thing you
8 looked at was does this make sense or not. And
9 sometimes there is abhorrent results and it's a bad
10 instrument that somebody missed, basically, the QA/QC.

11 Answer to the question is, I presumed he
12 was not on the floor every hour but that he had access
13 to the data and reviewed it for quality control at
14 frequent intervals.

15 Q. Did you make any attempt to investigate the
16 time difference or days difference between when data was
17 written in the logbook and when Mr. Pavlish was
18 presented with that data?

19 A. I can't recall if there was a description of
20 that in the DOE quarterly reports or not, but other
21 than -- the answer to the question is, no, except for
22 what might have been written in the DOE quarterly or
23 annual report.

24 Q. I want to go back to reduction of practice for
25 a little bit.

1 Would you agree that the goal of
2 Mr. Pavlish's DOE research that you're discussing in
3 your declaration was to remove mercury that was the big
4 picture goal?

5 A. Yes.

6 Q. And so, would you agree, if Mr. Pavlish
7 conducted an experiment and the mercury number did not
8 drop, that would be considered an unsuccessful test?

9 A. Not necessarily.

10 Q. Can you explain that?

11 A. Because even when we make mistakes in the lab,
12 we learn things. If the mercury did not drop but we had
13 a good reason why it did not drop, that would tell us
14 something about perhaps a correction to lower the
15 mercury or, better yet, something we could use in
16 another endeavor that you don't care about because it's
17 not in here.

18 But my point is, all test results, I
19 wouldn't consider them failures. I consider them
20 lessons to be learned and to talk the best and move on.

21 Q. Would you agree that the intended purpose of
22 Mr. Pavlish's test was to remove mercury and lower the
23 mercury emission's numbers?

24 A. Yes.

25 Q. Okay. And so, I'll use a different word than

1 "success."

2 Is it fair to say that, if a test is
3 consulted -- withdrawn.

4 If a test is conducted and it does not
5 lower the mercury emissions, that test would not be
6 achieving its intended purpose of the research, right?

7 A. Taking the short-term view, yes.

8 Q. Did you investigate the specific date at which
9 Mr. Pavlish or any of his co-inventors appreciated that
10 his invention would work for its intended purpose?

11 A. Well, I certainly looked at the dates and times
12 that were in the logbook and noted that those were, you
13 know, important, but I don't know at what point, you
14 know, they decided they had success or not.

15 Q. So sitting here today, do you know of a
16 specific date or, approximate, date at which Mr. Pavlish
17 or any of his co-inventors appreciated that their
18 inventions would work for their intended purpose?

19 MR. COCHRANE: Object to form.

20 THE WITNESS: I believe those tests were in
21 September of 2003.

22 Q. BY MR. TOBIN: And do you cite anything in your
23 declaration -- withdrawn.

24 Now, did -- you looked at the logbooks,
25 right?

1 A. Yes.

2 Q. Do you recall seeing actual mercury numbers in
3 the logbooks?

4 A. I believe the mercury results were in a chart
5 that was delivered separately in either the quarterly
6 daily report or the annual report.

7 Q. The mercury measurements were reported months
8 or sometimes over a year after the actual test was
9 conducted.

10 Do you recall seeing that?

11 A. I would ask you -- ask you to refine the word
12 "reported." I believe what you mean is the results were
13 released in the public domain through a department of
14 energy report. I believe that's what you mean. So --

15 Q. Yes.

16 A. Which is different than being reported.

17 Q. Did you do anything to investigate the specific
18 date at which Mr. Pavlish or any of his inventors knew
19 that adding MeBr to coal or activated carbon downstream
20 would achieve 70 percent mercury removal?

21 A. I did not pursue the data other than what was
22 in the logbook. And now that we're talking about it, I
23 think, you know, all these -- you know, again, my bias
24 here just with experience, all these similar CEMS when
25 you get -- I'm sorry, C-E-M-S, continuous emission

1 monitor system, all that comes out on -- certainly, back
2 then, I don't think a digital output, but a paper
3 output. And those are not able to be dumped into a
4 logbook, so I think I read someplace or maybe I just
5 assumed that they had the CEMS outputs at some point and
6 transferred those into -- into the report.

7 Q. And do you know when any of the inventors had
8 the CEMS output for the tests they conducted?

9 A. I can't confirm or approve that they had it at
10 the end of the test day, but if they didn't, they should
11 have fired the technicians.

12 Q. Okay. So if Mr. Pavlish testified that it
13 sometimes took him months to get the mercury data, would
14 you have any reason to dispute him?

15 A. I -- I don't -- I don't have a reason to
16 dispute what he's testified, but I would think he has --
17 I would think he would have it sooner, but now that you
18 mention it, there's a lot going on here.

19 I remember now he had CEMS data, plus they
20 also corroborated it with a batch process called Ontario
21 Hydro or something else, and that's maybe what took the
22 time was he probably had required time to get the
23 corroborating data and maybe that's why he didn't have
24 it at the end of the day.

25 Q. Okay. No. I appreciate you just answering my

1 questions, but none of this is in your declaration,
2 right?

3 A. Correct.

4 Q. So if you -- if you were to pinpoint --
5 withdrawn.

6 Do you discuss anywhere in your declaration
7 the specific date or month when the inventors knew that
8 this two-part process of NaBr on coal and activated
9 carbon downstream would be a successful mitigation
10 strategy for mercury?

11 MR. COCHRANE: Object to form.

12 THE WITNESS: No.

13 Q. BY MR. TOBIN: I do want to ask you, going back
14 to the person of ordinary skill in the art, can you go
15 back to paragraph 18, please, of your declaration. And
16 if you look at the first sentence, it states, "At the
17 time of invention, a POSITA would have a bachelor's
18 degree in mechanical engineering, chemical engineering,
19 chemistry, or a related field of technology, and at
20 least two years of experience dealing with power plant
21 operation and/or pollution control equipment."

22 When you state "at the time of the
23 invention," are you, again, referring to the 2003/2004
24 time frame?

25 A. Yes.

1 Q. Okay. And I want to focus on pollution control
2 equipment. At the 2003/2004 time frame, what kind of
3 pollution control equipment would a POSITA have at least
4 two years of experience in?

5 A. Ideally, it's the process equipment that's
6 shown in figure 1 in my discussion, so it would be a
7 scrubber -- a wet or dry scrubber for SO₂, some type of
8 particulate removal system, either a bag house or an
9 electrostatic precipitator, it would be the selective
10 catalytic reduction module. And, you know, all these --
11 all these work together with the power station.
12 Pollution controls aren't boxes that you put on a stack.
13 They're integrated into the power plant, so they would
14 have to know something about the power plant in terms of
15 fuel preparation and the like.

16 Q. Would a person of skill in the art in 2003/2004
17 have experience with spray dry absorbers?

18 A. That is what I referred to as the dry scrubber.

19 Q. So yes?

20 A. Yes.

21 Q. When was the first time you learned about
22 activated carbon injection?

23 A. Probably in the mid to late '90s when it became
24 clear that the EPA was going to consider mercury removal
25 and mercury limits as part of the Clean Air Act

1 amendments in 1990.

2 And the first thing that came out was the
3 reported, quote, success, unquote, of sorbent injection
4 in municipal waste combustors and how that would be one
5 -- one means by which to control mercury from coal-fired
6 power stations, so this is '95, '6, '7, something like
7 that, maybe '98, '99, certainly last century.

8 Q. So if -- and this activated carbon injection
9 that you were familiar within in '95 to 1999, was this
10 through some kind of proprietary information you had or
11 was this through some form of public knowledge?

12 A. Public knowledge.

13 Q. So if you learned about activated carbon
14 injection in 1995 to 1999, would a POSITA have had
15 experience with activated carbon injection by two --
16 almost a decade later by 2003, 2004?

17 A. Generally, yes.

18 Q. By 2003, 2004, a POSITA would have been
19 generally familiar with activated carbon injection?

20 A. Yes.

21 Q. Can we go to paragraph 16 of your
22 declaration -- excuse me, paragraph 17, and take a
23 moment to read and I'll ask you some questions about it.

24 A. Paragraph 16?

25 Q. 17, please.

1 A. Okay.

2 Q. So in paragraph 17, you list a number of
3 factors that go into defining the qualifications of the
4 person of skill in the art, right?

5 A. Yes.

6 Q. And did you consider all these factors when you
7 provided your definition of person of skill in the art
8 in paragraph 18?

9 A. Yes.

10 Q. I'd like to focus on one particular factor.
11 Do you see, you talk about the rapidity
12 with which innovations are made.

13 A. Yes.

14 Q. As of 2003/2004, can you describe for me the
15 rapidity with which innovation was being made in the
16 field of mercury mitigation of coal power plants?

17 A. Yeah, in terms of scrubbers, it was -- well,
18 let me back up. I'll start at the beginning.

19 The catalytic reactors we knew would
20 oxidize mercury, but we couldn't control them very much,
21 so people were experimenting with different catalysts.
22 With wet scrubbers, we were -- wet scrubbers actually
23 created mercury. They would take oxidized mercury and
24 drive it to an elemental state, so they actually
25 increased the mercury remissions. And there was a lot

1 of work going on with additives that prevented that from
2 happening.

3 With ESPs, it was trying to figure out if
4 one added a carbon-based sorbent, how it affected the
5 ash that was collected, because the carbon came out with
6 the ash and couldn't constrain what you were doing for a
7 byproduct. And with sorbents, it was -- it was,
8 basically, looking at high surface area contact. It was
9 creating sorbents from different fuels, lignite,
10 generating sorbents from lignites, generating sorbents
11 from other materials, noncarbon sorbents. So that was
12 the work going on, and there was -- it was progress from
13 time to time in each of those areas.

14 Q. In the 2003, was mercury mitigation a hot topic
15 in the scientific community?

16 A. It was an area of focus. Yes.

17 Q. Among power plant operators and affiliated
18 researchers, mercury was one area of concern in 2003
19 that people were trying to solve?

20 A. Yes.

21 Q. You see the factor sophistication of the
22 technology?

23 A. Is that in paragraph 17?

24 Q. Yes.

25 A. I see it. Yes.

1 Q. Describe for me the sophistication of sorbents
2 by 2003.

3 A. We understood that sorbent was a high surface
4 area device, the surface chemistry was important, and
5 you wanted to get as much surface area available as you
6 could for capturing -- capturing mercury.

7 Q. By "sorbent" just now, were you referring to
8 activated carbon sorbent?

9 A. There were different sorbents. There were some
10 people working on noncarbon sorbents because I described
11 earlier the issue of having carbon be retained in the
12 fly ash, and that affected its byproduct value, but if
13 there were some folks working on -- I forgot what they
14 were -- noncarbon materials, that if they presented the
15 same capability would substitute for carbon sorbent and
16 would not taint or compromise the ash once collected
17 from the ESP.

18 Q. So in 2003, people were considering --
19 withdrawn.

20 In 2003, activated carbon sorbent was
21 considered the conventional sorbent?

22 MR. COCHRANE: Object to form.

23 THE WITNESS: I think so. Yes.

24 MR. TOBIN: Let's go off record, briefly.

25 THE WITNESS: Okay.

1 (A recess was held from 12:01 p.m. to 12:42 p.m.)

2 MR TOBIN: Welcome back from lunch,
3 everybody.

4 Q. BY MR. TOBIN: Mr. Cichanowicz, I just wanted
5 to follow up on a few topics from before lunch. I'd
6 like to talk about the actual hardware that was used in
7 connection with activated carbon, and in particular, I
8 think we discussed how you first learned about activated
9 carbon in the mid-1990s; is that right?

10 A. Mid to late, yeah.

11 Q. And then certainly in 2003, activated carbon
12 was a conventional material, right?

13 A. Yes.

14 Q. Describe for me, as of 2003, how activated
15 carbon would have been introduced into a system.

16 A. It would have been pneumatically and --
17 pneumatically transported with transport air into a
18 series of injectors that would have disbursed the
19 material within the duct work of the power station, and
20 that location being dependent upon, basically, space and
21 time.

22 Q. But that location that you just described would
23 have been downstream of a combustion chamber?

24 A. Yes.

25 Q. That process you just described, have you also

1 heard it referred to activated carbon injection or ACI?

2 A. Yes. That is what I was referencing. Yeah.

3 Q. The process you described of activated carbon
4 injection, that was the routine way to deliver activated
5 carbon as of 2003?

6 A. Yes.

7 Q. Can you turn to paragraph 48 of your
8 declaration, please?

9 A. Yes.

10 Q. And take a moment to read it, if you need to.
11 I'll ask you a few questions about that paragraph.

12 A. Okay.

13 Q. I'd like to ask you about the last sentence in
14 the paragraph. You state, "That is particularly true
15 here, given that the conventional approach is titlewave
16 from the patented approach of combining precombustion
17 bromine additives with post-combustion activated carbon
18 injection."

19 Do you see that?

20 A. I do.

21 Q. The second piece there, you talk about
22 post-combustion activated carbon injection. That's the
23 process that you just described above with the pneumatic
24 injection downstream of a combustion chamber?

25 A. Yes.

1 Q. And that piece was certainly conventional by
2 2003, right?

3 A. That particular piece was, yes.

4 Q. And then you use what, to me, is a legal buzz
5 word, and I want to make sure we have the same
6 understanding of that. And that's the word "taught
7 away."

8 Do you see that?

9 A. Yes.

10 Q. What's your understanding -- withdrawn.

11 What was your intention by that term
12 "taught away"?

13 Did you mean actively discourage versus
14 just tried a different way versus something else?

15 A. I think it's more in the opinion of -- more in
16 the vein of actively discourage.

17 Q. Okay. Now, I think -- and then I read your
18 declaration, and I didn't see you cite anything for a
19 conventional approach that taught away from this
20 two-part process.

21 So is there certain document or person that
22 you have in mind that is doing the teaching away that
23 you have?

24 A. Well, the teaching away is mostly, basically,
25 picked up in the subsequent paragraph.

1 Q. Again, the subsequent paragraph, you don't cite
2 to anything?

3 Paragraph 49, that is, right, you don't
4 cite to any documents, do you?

5 A. I cite to, again, experience designing low-NOx
6 burners and how they induce corrosion. I do not have a
7 separate citation.

8 Q. Would you agree that, at least as of 2003,
9 there are certain coals -- withdrawn.

10 That there are coals in certain parts of
11 the world that have relatively high chlorine levels?

12 A. Yes.

13 Q. What are some examples of such coals with
14 relatively high chlorine levels?

15 A. Well, I think Illinois bituminous coal with
16 high sulfur tends to have high chloride levels as do
17 some coals in Kentucky.

18 Q. As of 2003, do you know if any coals had --
19 inherently had high bromine levels?

20 A. To my knowledge, bromine was not routinely
21 measured in coal composition until, actually, Vosteen
22 brought this to the party.

23 (Reporter clarification.)

24 THE WITNESS: Until 2003 and 2004 when this
25 topic came up. I said the word Vosteen as in his name,

1 V-O-S-T-E-E-N.

2 Q. BY MR. TOBIN: So let's break that up.

3 So I think -- so bromine was not routinely
4 measured in coal composition until 2003 or 2004?

5 A. I do not remember looking at coal composition
6 and seeing a lot of detailed bromine content. It just
7 wasn't -- it wasn't looked for.

8 Q. I think the person then you mentioned was
9 Vosteen, V-O-S-T-E-E-N?

10 A. That's correct.

11 Q. What did you mean by "Vosteen brought this to
12 the party"?

13 A. I was sitting in the third row of the mercury
14 control symposium in Washington, D.C. I forgot what
15 year. It might have been '03. And that was when he
16 came to the U.S. with his presentation, and I remember
17 the session, the session chair was Dr. -- the late,
18 unfortunately, Dr. George Offen, O-F-F-E-N, whom I used
19 to work for at EPRI.

20 And he had said, "We're going to talk about
21 bromine, and the reason why it's a surprise to many of
22 us is that we've never really looked at it before in
23 detail in coal composition." And I just remember -- I
24 just remember sitting there in the third row thinking,
25 yeah, that is unusual. So that's why -- that's the

1 genesis of that.

2 Q. Which specific conference are you thinking of
3 that was in 2003?

4 A. Well, there were -- there were four categories
5 of conferences. This one is -- it's got a funny name.
6 It's called the Megea, M-E-G-E-A, and that's simply
7 because three entities used to have separate
8 conferences, and then they said this is silly, let's
9 combine it into one. The three entities were EPRI,
10 E-P-R-I, the Environmental Protection Agency, and the
11 Department of Energy, /and so that was in '03, I think.

12 Q. Did you, personally, attend the Megea 2003
13 conference?

14 A. I attended every Megea conference from 1998
15 until they stopped having them in 2018.

16 Q. Do you recall the Megea 2003 conference was in
17 Washington, D.C.?

18 A. It was.

19 Q. And Dr. Vosteen attended the Megea 2003
20 conference?

21 A. That is my recollection.

22 Q. What did Dr. Vosteen discuss about bromine at
23 the Megea 2003 conference?

24 A. He presented, basically, the information that's
25 in this patent.

1 Q. Did Dr. Vosteen in the Megea 2003 conference
2 suggest that bromine would be a useful additive to
3 mitigate mercury?

4 A. I forgot the conclusions, but basically, it was
5 the same data and message that comes through in the
6 arguments in its patent. He, basically, presented the
7 same five examples that are in the patent.

8 Q. And do you recall, in the Megea 2003
9 conference, Dr. Vosteen discussing applying --
10 withdrawn.

11 And by "bromine," you just meant a
12 Br-containing ingredient, correct?

13 A. Yes.

14 Q. Do you recall Dr. Vosteen discussing at the
15 Megea 2003 conference applying a Br-containing
16 ingredient to coal?

17 A. Yes.

18 Q. Do you recall Dr. Vosteen -- withdrawn.

19 Do you recall what season the Megea 2003
20 conference took place in?

21 Summer? Winter? Fall?

22 A. Summer.

23 Q. Summer?

24 So in summer 2003, Dr. Vosteen presented to
25 you and others at the conference about applying a

1 Br-containing ingredient to coal to help remove mercury?

2 A. I'm off by a year. I think it was 2004. And
3 you can check that.

4 Q. Do you recall Vosteen attending conferences in
5 2003?

6 A. No.

7 Q. Okay. But -- so you think Dr. Vosteen
8 presented his proposal to remove mercury by putting Br
9 on coal in summer 2004?

10 A. Yes.

11 Q. Do you recall what month that was?

12 A. I know it was the summer because -- well, it
13 was the summer.

14 Q. What else -- do you recall what else Dr.
15 Vosteen presented at the Megea conference in connection
16 with Br and mercury?

17 A. It was the thesis -- it was, basically, the
18 same data and material that he has in his patent.

19 Q. And by "his patent," you're talking about the
20 patent that is being used in this case?

21 A. Yes.

22 Q. That Vosteen '589 patent?

23 A. Yes.

24 Q. At this conference -- withdrawn.

25 At the Megea conference in the summer of

1 2004, did Dr. Vosteen explain to the audience what kind
2 of Br should be applied to coal?

3 A. I don't recall.

4 Q. Were you surprised by Dr. Vosteen's
5 presentation?

6 A. As I said, George -- the late George often
7 introduced him. And he said, "Yeah, this is a bit
8 unusual," so it was something that was different. Yeah.

9 Q. Prior to Dr. Vosteen, had you heard of anybody
10 else applying Br to coal for purposes of mercury
11 mitigation?

12 A. No.

13 Q. Typically, do coals contain as much Br natively
14 as they do chlorine?

15 A. They have a lot less.

16 Q. At Dr. Vosteen's Megea presentation, did he
17 describe anything about how Br improves -- withdrawn.

18 At Dr. Vosteen's Megea presentation, did he
19 describe anything about the process by which Br is
20 effective at helping mitigate mercury?

21 A. Do you mean the chemical and physical means or
22 do you mean the applications?

23 Q. Why don't you answer each of those
24 individually, please.

25 A. I don't remember. I mean, it was 2004. I

1 don't remember if he had a mechanistic description, but
2 I remember being somewhat puzzled as to how we could
3 ever apply this in the U.S.

4 Q. Why were you puzzled?

5 A. None of the applications seemed relevant to
6 what we were working on at the time.

7 Q. None of the applications in this presentation,
8 right?

9 A. The applications he described in his
10 presentation, which were largely parallel to the
11 examples that he has in the patent.

12 Q. When was the mechanistic description of how Br
13 from a chemistry standpoint improves mercury remediation
14 with activated carbon, when did that become known in the
15 industry?

16 A. I don't know.

17 Q. Sometime after 2004?

18 A. Probably.

19 Q. In August 2004, was anyone in the industry
20 actually adding Br to coal in the combustion chamber?

21 A. Not that I know of.

22 Q. By August 2004, had anyone tested corrosion
23 issues when adding Br to coal or to a combustion
24 chamber?

25 A. Corrosion issues are always evaluated

1 independent of whether there's a suspect driving agent,
2 and it's typically been chlorine in the near-burner
3 region of low-NOx burners.

4 Q. What about the air preheater?

5 Were researchers looking to chlorine
6 corrosion at the air preheater?

7 A. I don't recall.

8 Q. Do you know when was the first time anyone
9 tested whether Br caused corrosion issues in the full
10 plant?

11 A. My recollection was down the road, I mean,
12 years later, there was a paper on bromine and air heater
13 corrosion, but I think it was '08 or something like
14 that.

15 Q. Are you thinking of a paper by EPRI about air
16 preheater corrosion in 2008?

17 A. Possibly.

18 Q. Are you familiar with a researcher named
19 Katherine Dombrowski?

20 A. I know of Catherine Dombrowski, yes.

21 Q. Do you know whether she was an author of that
22 paper in 2008?

23 A. I -- again, from memory, I couldn't tell you.

24 Q. Okay. But at least as far as you're aware, the
25 earliest anyone investigated the Br corrosion issues was

1 2008?

2 A. In the context of what we're describing around
3 the air heater, the answer to the question is yes.

4 Q. And the context of other parts of a power
5 plant, the first time anyone investigated Br corrosion
6 issues was 2008, as far as you're aware?

7 A. People invest -- to repeat myself, people
8 investigated corrosion in the near-burner region in a
9 furnace continuously. It was historically induced by
10 chlorides, and I don't know of anybody that's gone
11 through and tried to relate that to the role of bromine.

12 Q. What, if anything, did Mr. Pavlish and his
13 co-inventors do to solve any Br corrosion problems?

14 A. I don't know.

15 Q. Do you recall seeing anything in the DOE
16 reports in this case where Mr. Pavlish was expressing a
17 concern with corrosion from Br?

18 MR. COCHRANE: Object to form.

19 THE WITNESS: I don't recall.

20 Q. BY MR. TOBIN: Let's jump to paragraph 49 --
21 actually, not really.

22 Are you familiar with something called
23 brominated activated carbon?

24 A. Yes.

25 Q. Is that sometimes abbreviated as B-PAC?

1 A. It can be depending on the supplier, yes.

2 Q. B-PAC is a type brominated activated carbon?

3 A. Yes.

4 Q. In brominated activated carbon, that's where
5 the activated carbon sorbent had been promoted with a
6 halogen or halide outside of the system?

7 A. Yes.

8 Q. Is B-PAC more expensive than regular powdered
9 activated carbon?

10 A. My recollection is that it was more expensive.

11 Q. It was more expensive in 2003 and 2004,
12 correct?

13 A. I believe so. Yes.

14 Q. And so, do you agree that one consideration
15 that power plant operators would have used in 2003, 2004
16 when selecting the B-PAC versus conventional activated
17 carbon could be the cost?

18 A. Indeed, yes.

19 Q. In 2003 to 2004, were any power plants using
20 brominated powdered activated carbon sorbent?

21 (Reporter clarification.)

22 Q. BY MR. TOBIN: In 2003 to 2004, were any power
23 plants using brominated powdered activated carbon
24 sorbent?

25 A. There probably were some short-term tests, but

1 I can't recall of a commercial deployment that was years
2 long.

3 Q. In practice, would brominated powdered
4 activated carbon be injected at a similar point in the
5 system as conventional powdered activated carbon?

6 A. It depends. It could, it could not be
7 depending on the specifics.

8 Q. Whatever -- would anyone ever inject a halogen
9 or halide promoted carbon sorbent within a boiler?

10 A. Probably not.

11 Q. They would just get a fireball?

12 A. It depends where it goes. I mean, if it's
13 carbon, it's going to burn.

14 Q. If someone injected halogen or halide-injected
15 carbon sorbent within a boiler, it would no longer be
16 sorbent anymore, would it?

17 MR. COCHRANE: Object to form.

18 THE WITNESS: It would be a form of carbon
19 to be considered a means of maybe delivering bromine,
20 but, again, we would have to talk about where in the
21 boiler and at what temperature because that's -- that's,
22 kind of, key to the whole process.

23 Q. BY MR. TOBIN: Is that anything you've ever
24 seen anyone do?

25 A. No.

1 Q. Is injecting a brominated activated carbon
2 sorbent downstream of the combustion chamber part of the
3 invention of ME2C patents?

4 MR. COCHRANE: Object to form.

5 THE WITNESS: Yes.

6 Q. BY MR. TOBIN: So -- and, in fact, maybe if you
7 take -- do you have the '114 patent in front of you?

8 A. I do.

9 Q. Can you turn to Claim 14 of the '114 patent?

10 A. I'm sorry. Claim 14?

11 Q. Yes.

12 A. Okay.

13 Q. Let me know when you've had a chance to read
14 that.

15 A. The method of Claim 1 -- okay.

16 Q. So you agree that Mr. Pavlish and his
17 co-inventors thought that using brominated powdered
18 activated carbon sorbent or B-PAC was part of their
19 invention, right?

20 MR. COCHRANE: Object to form.

21 THE WITNESS: Let me read Claim 1 again to
22 refresh my memory.

23 Yes. Now, can you repeat the question?
24 It's been so long.

25 Q. BY MR. TOBIN: Would you agree that Mr. Pavlish

1 and his co-inventors thought that using brominated
2 active powdered sorbent or B-PAC was part of their
3 invention?

4 MR. COCHRANE: Object to form.

5 THE WITNESS: Yes.

6 Q. BY MR. TOBIN: So I need your help reconciling
7 something.

8 Can you turn to paragraph 49 of your
9 declaration.

10 A. Okay.

11 Q. Do you see towards the end of your first
12 sentence, you seem to be suggesting that injecting
13 brominated activated carbon was the conventional
14 approach as opposed to, say, Mr. Pavlish's invention?

15 MR. COCHRANE: Object to form; misstates
16 the testimony.

17 THE WITNESS: Well, the -- the two key
18 words are, in paragraph 49, post-combustion, which means
19 it could be right at the inlet of the electrostatic
20 precipitator and still be post-combustion. And the
21 words in Claim 1 on '114 says, "Downstream of the
22 combustion chamber," which doesn't limit it to anything,
23 so it could be in a different location. I don't -- I
24 don't view post-combustion the same as downstream of the
25 combustion chamber, because I viewed -- well, when I

1 crafted that sentence as the conventional approach, what
2 I had in my head was you were putting it in the duct
3 work right ahead of the particulate collector, and here
4 to me this is a more open statement.

5 Q. BY MR. TOBIN: By "here," you're pointing to
6 the '114 patent --

7 A. Yeah.

8 Q. -- in Claim 14?

9 A. I'm sorry. Yeah, the '114 patent. The
10 specific words are "Downstream of the combustion
11 chamber," which leaves a lot of space and time and
12 opportunity before what I deemed as the conventional
13 approach of post-combustion injection. I recognize the
14 words sound familiar, but in my head, that's what I
15 meant.

16 Q. But you would at least agree that Claim 14
17 would allow -- withdrawn.

18 Claim 14 -- you would at least agree that
19 Claim 14 would cover using pre-combustion addition of
20 bromine with post-combustion addition of brominated
21 powdered activated carbon?

22 A. One could do that.

23 Q. And that would be covered within what's recited
24 in Claims 14 in '114, right?

25 A. Yes.

1 Q. So the inventors were contemplating a system
2 where they added bromine in at least two places. They
3 would add bromine upstream at the combustion chamber or
4 be -- excuse me. Withdrawn.

5 The inventors were contemplating a system
6 where they added Br-containing ingredients in two
7 places. They added Br as part of the coal upstream of
8 the combustion chamber and then they added Br as part of
9 the activated carbon sorbent downstream of the
10 combustion chamber, correct?

11 A. It could be three.

12 Q. Or they added Br in even more places than two,
13 right?

14 A. The coal within the combustion chamber, that's
15 what the patent says, and then downstream of the
16 combustion chamber.

17 Q. So if we look at claims -- and you understand
18 dependent claims get read with the independent claim as
19 though it's a single claim?

20 A. Yes.

21 Q. So if we look at Claim 14, the inventors were
22 claiming a process where they added Br at at least two
23 locations in one process and possibly a third location,
24 as well, right?

25 A. That's what the issue patent says. Yes.

1 Q. And those places in Claim 14 is adding Br
2 upstream of the combustion chamber, adding Br to the
3 combustion chamber, and then adding Br as part of the
4 activated carbon downstream of the combustion chamber?

5 A. That's the possibility per this per '114.

6 Q. Claim 14, right?

7 A. Yes.

8 Q. So if corrosion were really a concern in 2004,
9 why would the inventor -- if Br corrosion was a concern,
10 why would the inventors add Br at three separate places
11 in the same process?

12 MR. COCHRANE: Object to form.

13 THE WITNESS: It's like anything else, the
14 devil is in the details, and you would have to look down
15 and see how you can modify the burner design or other
16 aspects. For example, we spoke before in the discussion
17 of a primary combustion zone in the secondary air
18 what -- what induced -- what induces corrosion on the
19 walls of the boiler in the -- may I call it the
20 near-burner region are chlorides that are drawn back in
21 with the flame kernel, K-E-R-N-A-L, that can damage the
22 boiler walls, and essentially one way possibly to
23 mitigate that is to change the burner design if -- if
24 you have the ways and means to continue to abide by
25 emissions of nitrogen oxides. If you change the burner

1 design, so you're not getting the same process
2 conditions that could affect the boiler. You're going
3 to have higher nitrogen oxides, and that has to be dealt
4 with.

5 Q. BY MR. TOBIN: Now, the answer you just gave --
6 I mean, you have 50 years of experience in the industry.

7 Is any of that discussed in the ME2C
8 patents about modifying the burner design?

9 A. No.

10 Q. So back to my original question. If -- and you
11 understand -- or withdrawn.

12 Do you understand that, when determining
13 whether something teaches a way or doesn't teach a way,
14 you need to put yourself in the mindset of 2004, not
15 today, right?

16 A. Yes.

17 Q. And you need to put yourself in the mindset of
18 a person with 2 years of experience and not 50 years of
19 experience, right?

20 A. Yes.

21 Q. Okay. So if -- again, if a person of skill in
22 the art would have thought that the Br would cause a
23 significant corrosion concern, back to my original
24 question, how does Claim 14 of the '114 patent recite
25 adding Br at three locations within the same plant?

1 MR. COCHRANE: Object to form.

2 THE WITNESS: As I said, it -- it would,
3 basically, be something that would have to be looked at.
4 I don't know that this patent -- I don't think this
5 patent, necessarily, addresses that, but if the incident
6 is there, it's possible people could find a way, a
7 workaround. And all I'm saying is that this wasn't, in
8 my opinion, conventional knowledge in 2003 and 2004.

9 Q. BY MR. TOBIN: You're saying Br to coal was not
10 conventional knowledge in 2003 to 2004?

11 A. No. I don't think I -- that's what I meant.
12 What I meant was that the steps to mitigate
13 bromine-induced corrosion were -- could be understood
14 only by a small sector of the industry, basically, the
15 people that spent a lot of time doing it, not
16 necessarily me, but people that have done nothing but
17 replace burners and boilers and rebuilt the tubing
18 around it.

19 And all I'm saying is that this was a
20 sufficient concern that most people would push away and
21 not want to do it, but I don't think it's out of the
22 question for the patent to have it, because it's -- it's
23 possible that mitigation could be developed.

24 Q. So I'm thinking of two alternatives. And let
25 me know if I'm off base.

1 A. Okay.

2 Q. It seems like -- again, withdrawn.

3 We're in the hypothetical world of 2004,
4 right?

5 A. Who was president then? I forgot.

6 Q. George Bush.

7 A. Thank you.

8 Q. So we're in the hypothetical world of 2004,
9 right, for this patent?

10 A. Yes.

11 Q. And so, it seems to be that either corrosion
12 caused by Br would not have been a significant concern
13 or it was a significant concern and the '114 patent
14 tells us nothing about how to fix that, address that
15 concern.

16 Is that -- is that a fair dichotomy?

17 A. Yes.

18 Q. I want it turn to paragraph 59, if you don't
19 mind.

20 You know what, I'll take that back. We'll
21 get there. Let's not skip -- let's go to paragraph 51,
22 please. Excuse me.

23 Do you see you have a sentence that starts
24 with
25 "after all"? It says, "After all, if a POSITA believed

1 that bromine additives could effectively oxidize the
2 mercury and that this oxidized mercury can be captured
3 in the scrubber, then there would be no reason to
4 undertake the additional expense and potential problems
5 of using activated carbon injection."

6 Do you see that?

7 A. Yes.

8 Q. So can you look at Claim 18 of the '114 patent.

9 A. Okay. Yes.

10 Q. And, again, I'll -- I'll represent this -- some
11 of this language is using the other patents, as well.
12 But would you agree that Claim 18 is a claim that
13 depends from Claim 1?

14 MR. COCHRANE: Object to form.

15 THE WITNESS: Well, that's certainly
16 what's -- what it looks like in the first four words.
17 Yes.

18 Q. BY MR. TOBIN: Okay. I'm not -- that wasn't a
19 trick question.

20 And so, in reading Claim 18 -- you read
21 Claim 18 and Claim 1 together?

22 A. Yes.

23 Q. So in Claim 18, the ME2C inventors claimed a
24 system that uses both activated carbon injection and a
25 scrubber.

1 Do you see that?

2 A. Yes.

3 Q. So I'm left with a similar quandary.

4 In paragraph 51 of your declaration, you
5 state that, if oxidized mercury can be captured in a
6 scrubber, then there would be no reason to undertake the
7 additional expense and potential problems of using
8 activated carbon injection.

9 You say that, right?

10 A. Yes.

11 Q. But at the same time, the ME2C inventors did
12 claim using both activated carbon injection and the
13 scrubber, yes?

14 A. Okay.

15 Q. Do you know why that is?

16 A. I do not.

17 Q. Do you know how you reconcile what you state in
18 paragraph 51 with what actually is in Claim 18?

19 A. I -- all I --

20 MR. COCHRANE: Object to form.

21 THE WITNESS: I don't have an answer. I
22 don't -- I don't have a reconciliation.

23 Q. BY MR. TOBIN: Okay. And then let's look at
24 the figure in your declaration, please. I'm trying to
25 find it. We'll get to it soon.

1 There we go. Page 32 of your declaration.

2 A. Page which?

3 Q. Excuse me. I'm sorry. Exhibit 2047, page 35.

4 A. Okay. I'm there.

5 Q. Here you're showing Figure 2 from the
6 provisional application?

7 A. Yes.

8 Q. And Figure 2 of the provisional application, do
9 you see an arrow that says "sorbent injection"?

10 A. I do.

11 Q. And then downstream of the sorbent injection do
12 you see a scrubber?

13 A. Yes.

14 Q. So, again, this ME2C is using sorbent injection
15 and a scrubber, yes?

16 A. Yes.

17 Q. But --

18 A. Or -- excuse me. Or -- well, there's no --
19 there's no choice? I mean, the gas is going to go
20 through the bag gas --

21 (Reporter clarification.)

22 THE WITNESS: There's no choice. The gas
23 is going to go through the bag gas and the scrubber.

24 Q. BY MR. TOBIN: Well, in Figure 2 of the
25 provisional, which is on page 35 of your declaration,

1 there is a plant shown that is using sorbent injection
2 when that plant already has a scrubber.

3 Is that a fair reading of that figure?

4 A. Yes.

5 Q. So, again, that seems a little inconsistent
6 with what you're saying in paragraph 51, which says,
7 basically, if oxidized mercury can be captured in a
8 scrubber, then there would be no reason to undertake the
9 additional expense and potential problems of using
10 activated carbon injection.

11 Do you see how that's a little
12 inconsistent?

13 MR. COCHRANE: Object to form.

14 THE WITNESS: It's just laying out options.
15 It's not a definitive design selection or criteria.
16 It's just -- Figure 2 -- I didn't make Figure 2. But
17 Figure 2, to me, is just a broad array of things that
18 you can do, some of which may or may not be desirable or
19 feasible. It's just an array of things that can be
20 done.

21 Q. BY MR. TOBIN: So some of the options in Figure
22 2 may not be desirable or feasible?

23 A. I -- well, if you look at the last box before
24 the stack, nobody has used a sorbent bed except
25 experiments where you, basically, have a fixed bed of

1 sorbent, but the gas goes through it. And then
2 eventually you -- the sorbent gets to capacity and you
3 got to change it out.

4 There were some experiments with that, but
5 nobody has done it. So, yeah, answer to your question
6 is, yes, there's things in here that people wouldn't do,
7 and that is an example of one.

8 Q. In an actual power plant, no one would use a
9 fixed bed of sorbent with activated carbon?

10 A. I do not know of any application that has done
11 that other than just in experiment. I think -- I think
12 one of the papers that was cited in this discussion
13 experimentally looked at that, but in terms of practical
14 application to meet the 2015, or whatever it turned out
15 to be, 2018 math rule, I don't know of anybody that's
16 taken this fixed bed approach.

17 Q. So -- and, again, I'm not so much interested in
18 today. I'm thinking back to 2004.

19 Was that what you intended with your
20 answer?

21 A. I think in 2004, it still might have been an
22 option. I think that one paper I'm thinking of was
23 after this, and it's not out of the question they could
24 have been successful. So --

25 Q. What -- so if someone were not using a fixed

1 bed sorbent of activated carbon, the other option would
2 have been activated carbon injection?

3 MR. COCHRANE: Object to form.

4 THE WITNESS: Unless you can get the
5 scrubber to take out the mercury that you want. Again,
6 these are -- I mean, Counsel, I wouldn't -- I wouldn't
7 interpret this as a mandate of things that people have
8 to do. It's a menu. And power plants are like people.

9 Q. BY MR. TOBIN: How?

10 A. How? Because they're all different in terms of
11 site conditions, fuel conditions, and how they operate.
12 So it's just a menu of options.

13 Q. When you say, "It's just a menu of options,"
14 you're referring to Figure 2 of the provision?

15 A. Yes.

16 Q. Thank you.

17 I see what you're looking at, but she can't
18 type that. That's why I'm asking.

19 A. Of course.

20 Q. So -- and, again, in Figure 2 of the 1040 --
21 withdrawn.

22 In Figure 2 of the provisional, you
23 interpret sorbent bed to be an activated carbon sorbent
24 bed?

25 A. Again, going back to 2003 and 2004, it could

1 have been a different material than activated carbon.
2 We've discussed there were alternatives that people were
3 looking at.

4 Q. But in terms of whether if a person of skill in
5 the art is going to use activated carbon in 2004,
6 whether they would use a fixed bed versus activated
7 carbon injection, the activated carbon injection would
8 have been the go-to choice?

9 MR. COCHRANE: Object to form.

10 THE WITNESS: Well, the -- the -- I think
11 it's -- Shostrom or somebody was -- had an experimental
12 device where they were looking at fixed beds. And it --
13 again, if that had been successful where you could get
14 mercury and change out the beds quick enough, that might
15 have been a competitor to activated carbon. So I don't,
16 necessarily, agree with your statement.

17 Q. BY MR. TOBIN: In an actual power plant, full
18 scale, in 2004, if a person of skill in the art were
19 going to use activated carbon, why would they use
20 injection over fixed bed?

21 A. I think that was the whole purpose of the -- of
22 the research. I mean, the simple answer is that
23 injections has to be cheaper in terms of capital, but
24 maybe you got more use of the sorbent. I mean, in -- in
25 today's world, the answer would be, no, you're not going

1 to use a fixed bed, absorbent bed.

2 But in '03 and '04, I think it was an open
3 question, and that's why that paper -- I think it was
4 Sharon who did it. That's why they launched that work.

5 Q. In today's world, why wouldn't someone use a
6 fixed bed sorbent for activated carbon?

7 A. I just think it's capital. It's just a big
8 device you've got. It's a big device you have to put
9 gas through.

10 Q. Do you have any reason to think that capital
11 would not have been a consideration of 2003 to 2004
12 also?

13 A. I think what was not known was the size of the
14 device. I mean, if you had a really powerful sorbent
15 and you didn't need a very big fixed bed and it lasted
16 eight months, that's not going to happen, but if it
17 lasted a long period of time, then -- then the capital
18 operating cost tradeoff could have been favorable to
19 that concept.

20 Q. Why don't we turn to paragraph 59, please.

21 MR. COCHRANE: We've been going for about
22 an hour. Do you want to take a break?

23 MR. TOBIN: Give me five minutes and then
24 I'll develop this line, or do you need a break now?

25 MR. COCHRANE: I'm okay.

1 THE WITNESS: What happens in five minutes?

2 MR. TOBIN: We can take a break in about
3 five minutes.

4 THE WITNESS: Okay. Yeah.

5 MR. TOBIN: Actually, let's take a break
6 now. I didn't ask a question.

7 MR. COCHRANE: Sure.

8 (A recess was held from 1:28 p.m. to 1:40 p.m.)

9 Q. BY MR. TOBIN: Mr. Cichanowicz, why don't you
10 take a look at paragraph 59 of your declaration. That's
11 where I left off before the break.

12 And apologies for asking this in advance.
13 But just to make sure we're all playing fair and square,
14 have there been any conversations with counsel during
15 breaks other than just food-type stuff?

16 A. No, no.

17 Q. Okay. Thank you -- thank you for that.

18 MR. TOBIN: And thank you, Counsel.

19 MR. COCHRANE: Of course.

20 Q. BY MR. TOBIN: Okay. So take a moment to read
21 paragraph 59, and I want to ask you some questions about
22 it.

23 A. Okay.

24 Q. And is, basically, the gist of paragraph 59 of
25 your declaration that, regardless of what form of Br is

1 added to coal for a combustion chamber, the flame
2 temperature is associated with these compounds and you
3 end up with similar results?

4 A. Yes.

5 Q. And I see you site the '114 patent, Figure 2
6 for that, yes?

7 A. Yes.

8 Q. And this statement that you just said about --
9 withdrawn.

10 So your opinions in paragraph 59, were
11 these known in 2004 about how regardless of what form of
12 Br is added to coal or combustion chamber, that
13 combustion flame will disassociate it to form bromine
14 atoms, then it forms HBr to reactivated carbon?

15 Was that process and reaction mechanism
16 known in 2004?

17 A. No.

18 Q. In fact, I think you said that, when you first
19 heard about Br on coal from Dr. Vosteen in 2004, that
20 was the first time you even thought about it, right?

21 A. I think that's fair. Yeah.

22 Q. So is it fair to say that, by 2004, it would
23 not have been known the process by which Br on coal
24 disassociates to form bromine atoms and then reactivated
25 carbon, that chemistry would not have been known in

1 2004, correct?

2 A. I'm not sure the question is relevant.

3 Q. Well, answer it anyways, please.

4 A. Okay. In terms of bromine, that might be a
5 fair statement, but I think those of us that have
6 designed burners and flame structure know that there are
7 few things that enter into the fuel and gas that by the
8 time -- by the time you get to 3,000 degrees,
9 particularly if it's something that's not going to burn
10 like carbon, if they -- what -- the form the stuff comes
11 in is really -- is rarely relevant.

12 Q. Okay. Then, again, I want -- I want to place
13 the proper mindset. It's not Mr. Cichanowicz with
14 50 years of experience, and it's not here in 2026.
15 We're talking about your person of skill in the art with
16 two years' experience and just one degree and in 2004.

17 You understand that, right?

18 MR. COCHRANE: Object to form.

19 THE WITNESS: I understand that. Yes.

20 Q. BY MR. TOBIN: Okay. So would that person of
21 skill in the art as of 2004 known that, whatever form of
22 Br goes on, the coal it will form bromine atoms and then
23 HBr?

24 A. I -- I don't know. I don't have an answer. I
25 mean, perhaps.

1 Q. And that -- would they have -- but you're not
2 sure, right?

3 A. I'm not sure.

4 Q. And would that person of skill in the art in
5 2004 have known that HBr reacts with activated carbon to
6 capture mercury?

7 A. They might have been able to piece it together
8 from other work, but, you know, this is a fairly
9 hypothetical question, and we're talking about a broad
10 specter of type of people. So -- and the answer -- I
11 can give you the answer.

12 You know, the answer is they may not know
13 that, but --

14 Q. And at least in summer of 2004, adding Br to a
15 coal combustion process, that's the first time you,
16 yourself, heard about it was summer of 2004, right?

17 A. In the coal combustion process, yes, but there
18 is a world of incineration and incinerators did all this
19 stuff, too, but we weren't thinking about it then.

20 Q. You, yourself, weren't thinking about Br in
21 coal combustion or incinerators prior to August 2004,
22 right?

23 A. Well, I certainly wasn't about coal, yeah. I
24 think, you know, as I said, we got into this because of
25 incinerators and that -- those -- that has different

1 chemistry and halogens were in there. So there was
2 probably something in my lexicon of information, but I
3 had not been thinking of it in terms of coal.

4 Q. I think you realize -- or I hope you realize
5 the '114 patent was filed in 2018. Is that something
6 you knew?

7 A. I know the -- the mechanics of this patent was
8 indeed filed at -- I know that filing date from this
9 patent. Yes.

10 Q. And the only document I cite to support your
11 opinions in paragraph 59 is the document that was filed
12 in 2018?

13 A. I don't believe so. All this goes back to the
14 provisional patent.

15 Q. Okay. So the only document you cite in
16 paragraph 59, though, is the '114 patent, correct?

17 A. Correct.

18 Q. And I do want to ask you -- withdrawn.

19 Are you aware of any documents from before
20 the provisional that describe what you're saying in
21 paragraph 59?

22 A. I can't think of any.

23 Q. Okay. So can you turn to paragraph 30 of your
24 declaration for me -- pardon me. I misdirected you.

25 Can you turn to Exhibit 2047, page 33.

1 There's a Figure 1 of Exhibit 1020. Do you see that?

2 A. I do. Yeah.

3 Q. Would you consider Figure 1 of Exhibit 1020 to
4 be from the -- wherever the spectrum of cartoon to
5 reaction chemistry model would you consider Figure 1 of
6 Exhibit 20?

7 A. Oh, it's fairly cartoony.

8 Q. What do you mean by "fairly cartoony"?

9 A. Well, it's -- they're just -- it's a proposed
10 mechanism with no quantitative analysis, which you
11 really can't do. And it's one means it could very well
12 be the likely means, but it is one means that you could
13 use to explain -- or that I've read people use to
14 explain how bromine promotes the absorption of mercury
15 by carbon.

16 Q. Okay. And let's go straight to the source, and
17 I want to ask you some follow-up questions about that.
18 So let me hand you Exhibit 1020, which is the
19 provisional.

20 And do you -- let me know when you find
21 that document in the provisional -- the cartoon of the
22 provisional.

23 A. Figure 1?

24 Q. Yes.

25 Did you find it?

1 A. Yes.

2 Q. Okay. I just -- I was going to ask you
3 questions, so I thought it only fair that you have the
4 original source in front of you.

5 What page are you on of Exhibit 1020?

6 A. Well, if you go to the very lower right-hand
7 corner, it says page 11.

8 Q. Very good. Thank you.

9 And, in fact, the figure calls this a
10 mechanistic model of the reactions resulting in
11 oxidation and capture of mercury, correct?

12 A. Correct.

13 Q. And mechanistic model is fancy scientific word
14 for, basically, a cartoon?

15 A. Yeah.

16 Q. Are you aware of whether the reaction model
17 shown in Figure 1 of Exhibit 20 actually does describe
18 what's going on with the interaction of mercury Br and
19 carbon?

20 A. It sounds plausible.

21 Q. Is -- now, you said "plausible." Is it proven?

22 Like, this is the actual chemical reaction
23 model?

24 A. In my opinion, it's not proven.

25 Q. And are you aware of others in the industry

1 criticizing this model and saying it's not actually
2 true?

3 A. I am not aware of such publications, but I'm
4 not surprised that intelligent scientists have different
5 opinions.

6 Q. So what does the first time you've seen this
7 cartoon or mechanistic model as shown in Exhibit 20,
8 Figure 1?

9 Is it part of your work in this case?

10 A. No. I'm sure I came across this or something
11 similar years ago in the work I was trying to do to help
12 sort out the feasibility and cost of various mercury
13 control techniques, but I will admit I probably didn't
14 put a lot of attention to it until I was asked to look
15 at this in detail.

16 Q. Are you aware of this mechanistic model being
17 known to a POSITA before 2004?

18 A. Could you repeat that, please?

19 Q. Are you aware of this mechanistic model or
20 cartoon being known to a POSITA before 2004?

21 A. No.

22 Q. By August 2004, was the chemistry of
23 Br-containing species in a coal combustor well-known?

24 A. To a POSITA, probably not.

25 Q. By August 2004, were the chemical reactions

1 between Br and activated carbon well-known?

2 A. Probably not.

3 Q. By August 2004, was the behavior of
4 Br-containing species in a combustion chamber
5 predictable?

6 A. I would think some people involved in the waste
7 incineration business would -- would think so because
8 they ran businesses incinerating halogens and had some
9 experience in doing the work.

10 Q. What did -- well, I guess 2004 was the behavior
11 of Br-containing species in a combustion chamber
12 predictable to a person of skill in the art as you
13 defined it?

14 A. It depends on the person, but probably not.

15 Q. Is it fair to say that, by August of 2004, the
16 nature of the reactions between Br and activated carbon
17 were still unproven and somewhat speculative?

18 A. Perhaps, yes.

19 Q. So if you have the provisional -- withdrawn.

20 So I know your background is mechanical
21 engineering, but you clearly have a strong experience in
22 chemistry. Do you understand that Figure 1 of Exhibit
23 1020 and what's being shown?

24 A. I've read the descriptions and I said -- I
25 think I said it's plausible.

1 Q. Okay. Do you see how in the -- actually, let
2 me get a different exhibit so we can label some things.
3 Give me one second, please.

4 So I actually think there's two versions of
5 the figure, and I want your help parsing it. So that's
6 where we're going.

7 A. Okay. I'll struggle to parse one.

8 Q. Well, do the best you can. If you don't know,
9 I'm sure you'll tell me.

10 Let me hand you a different document.
11 We've marked this one as Exhibit 1148.

12 MR. TOBIN: Richard, you can hold on to
13 that one. I don't know if you have it yet.

14 THE WITNESS: Thanks.

15 Q. BY MR. TOBIN: Exhibit 1148 is -- is
16 Publication Number 2009-0062119, which corresponds to
17 Application Number 12,201,595.

18 And do you have that in front of you,
19 Mr. Cichanowicz?

20 A. I do.

21 Q. Let me just orient you for a moment. If you
22 look on exhibit -- page 31 of Exhibit 2047, you have a
23 flow chart of the various patents.

24 A. Okay. Could you once again --

25 Q. Yes.

1 A. -- for the exhibit, what page?

2 Q. Exhibit 2047, page 31, you have a flow chart of
3 a bunch of the ME2C patents.

4 Do you see that?

5 A. I do.

6 Q. And --

7 A. It's the small numbers.

8 Q. If you look along the top row, there is an
9 octagon that's kind of wide.

10 Do you see that?

11 A. Yes.

12 Q. And do you see in the octagon it says
13 2009-0062119?

14 A. I do.

15 Q. And do you recognize -- and do you see in the
16 brackets below that it's Application 12,201,595?

17 A. I do.

18 Q. I call that the '595 application. Do you
19 understand that's what I'm talking about?

20 A. Yes.

21 Q. Okay. If you want to circle that, totally
22 fine.

23 So now talk a look of Exhibit 1148. And do
24 you recognize that as the '595 application?

25 A. The one you just handed out?

1 Q. Yes.

2 A. Yes, I do.

3 Q. Okay. Very good. So I'd like for you to keep,
4 please. Exhibit 1120 -- excuse me, 1020 in front of
5 you. That's the provisional, yes?

6 A. Okay.

7 Q. You can put your declaration --

8 A. The provisional -- you want the provisional
9 chart?

10 Q. I do want the cartoon and the provisional.

11 A. So we're comparing three things?

12 Q. We're comparing two things.

13 A. Okay.

14 Q. Okay. Do you have Exhibit 1148, page 3 open,
15 and then Exhibit 1020 with a cartoon open.

16 Do you have both of those?

17 A. I do.

18 Q. Great. All right. And then one more document
19 I'd like to give you. So you can have everything on one
20 page, I took the two figures and put them on the same
21 page, so I'll hand you that. I created this document,
22 and you can compare and let me know that I did it
23 correctly.

24 So this will be marked as Exhibit 1149.

25 And if you look on the front page, there's the two

1 figures, and then on the second page, I added some
2 numbers so that we can now refer to some specific
3 pieces. So why don't you go to Exhibit 1149, please.
4 And we -- do you agree that what is shown on the left is
5 Figure 1 from Exhibit 1020, the provisional?

6 A. Yes.

7 Q. Do you agree that what is shown on the right is
8 Figure 2 from Exhibit 1148, which is the '595
9 application?

10 A. Yes.

11 Q. Okay. And I really just wanted you to be able
12 to see everything on one page. That's why we have
13 Exhibit 1149.

14 Fair?

15 A. Are you always this considerate?

16 Q. Depends who you ask.

17 So why don't you take a look at page 2 of
18 Exhibit 1149, please. And I'll represent you see
19 there's numbers 1 through 5 and letters, I think, A
20 through F. I added those letters and numbers so we can
21 refer to specific things --

22 A. Okay.

23 Q. -- okay?

24 And feel free to look at whatever page you
25 want, but I do want to ask you some specific questions

1 about the models.

2 So you can use Exhibit 11 -- Exhibit 1020,
3 Exhibit 1148, or Exhibit 1149 to answer. Okay?

4 A. Yes.

5 Q. Okay. So if you turn to -- and I'm going to
6 open up to page 2 of Exhibit 1149 so I can reference
7 specific items because, again, our court reporter can't
8 jot down here or there or see where I'm pointing.

9 A. Okay.

10 Q. All right. Very good. So to start off, would
11 you agree, at least, that there are differences between
12 the mechanistic model or cartoon shown in Exhibit 1020,
13 the provisional, and Figure 2 of Exhibit 1148?

14 A. Yes.

15 Q. Okay. What are the differences as you see it
16 between the two figures?

17 A. Well, the Exhibit 1148 appears to introduce
18 sulfur in the -- it's -- it has one more box or octagon,
19 and it appears to introduce the role of sulfur.

20 Q. Would you agree that Exhibit 1148 also
21 introduces HgBr₂?

22 A. I do see that. Yes.

23 Q. Did you see HgBr₂ in -- in the figure of
24 Exhibit 1020?

25 A. I do not.

1 Q. So is it fair to say between when the
2 provisional was filed in 2004 and when later
3 applications were filed, the inventors evolved or at
4 least changed their mechanistic model?

5 MR. COCHRANE: Object to form.

6 THE WITNESS: There's a difference.
7 Perhaps they understood -- you know, not getting in
8 their heads, perhaps what was Exhibit 1020 was just
9 simpler to convey and put in front of a patent attorney.

10 Q. BY MR. TOBIN: So let's talk about it. Between
11 the two figures shown in Exhibit 1149, do you know what
12 temperature these reactions are taking place at?

13 A. Well, if there is Br by itself and it's an ion,
14 it's -- it's certainly not low temperature because it
15 would probably combine with something by then, so I'd
16 say they are relatively elevated temperatures.

17 Q. Can you give me a best estimate of the
18 relatively elevated temperature?

19 A. Well, as I've said before, it could be in the
20 flame zone, 3,000, and as you cool down, somewhere Br
21 wants to become -- Br- wants to find a partner to dance
22 with and -- and -- and react with something, and I don't
23 know what that would be. I mean, 1,000, 800, I don't
24 know. I'd have to run -- run an ionic equilibrium
25 program.

1 Q. Are you referring to what I've labeled as Box 3
2 in Figure 1 of Exhibit 1020 with your previous answer?

3 A. Perhaps, yeah.

4 Q. Would Br- exist in the gas phase if it's 3-,
5 400 degrees?

6 A. By then, it should be partnered with something.

7 Q. So you expect that the only place you would see
8 Br- would be in the -- in the flame zone, right, if at
9 all?

10 A. Likely.

11 Q. What happens if you put activated carbon in the
12 flame zone?

13 A. It will burn.

14 Q. So is there any scenario in a coal combustion
15 process where as shown in Box 3 of Exhibit 1020 Br- could
16 react with activated carbon?

17 A. It could react with carbon.

18 Q. Remember -- remember, carbon is -- remember,
19 coal is carbon. And what I thought was very interesting
20 about some of the results were that, in my opinion,
21 there's no process flow sheet, but leaving a coal fired
22 flame zone, you still have unburned carbon. A basic
23 test of combustion efficiency is to take the ash and
24 measure the carbon in it. It's not negotiable. All ash
25 has carbon in it. So that mechanism could apply at

1 3,000 degrees with carbon that wasn't injected as
2 activated carbon but that is residual to the coal that
3 is injected.

4 Q. You think Figure 1 of Exhibit 1020 -- I mean,
5 it does say activated carbon, but do you think Figure 1
6 of Exhibit 1020 is discussing unburned carbon?

7 A. Well, I was answering the question you posed to
8 me. I don't know what the inventors had in mind when
9 they put this mechanism down. I mean, the -- the
10 provisional addresses putting bromine on coal and
11 perhaps that was in their head when they did that, but
12 my point is carbon is in a -- coal is carbon. It's not
13 negotiable. There's going to be carbon in the gases.
14 There might not be as much as you inject with activated
15 carbon, but there is carbon.

16 Q. Let me ask a more specific question. Let's
17 look at Box 1 in Exhibit 1020. Do you read Box 1 to be
18 referring to an activated carbon unsaturated site?

19 A. I do.

20 Q. Are you familiar with what a carbene,
21 C-A-R-B-E-N-E, species is?

22 A. I looked that --

23 MR. COCHRANE: Objection. Form; scope.

24 THE WITNESS: I looked that up, and I've
25 forgotten it.

1 Q. BY MR. TOBIN: Okay. If I told you it's an
2 unpaired electron in an activated carbon, did that jog
3 your memory?

4 A. That's what my AI friend told me.

5 Q. Okay. Prior to your AI friend, carbon is not a
6 term you've come across?

7 A. Well, for the -- for the -- no, it's not a term
8 I've come across.

9 Q. Okay. Fair point.

10 Do you see how in figure -- in Box 1 of
11 Exhibit 1149, there's a reference to an activated carbon
12 unsaturated site?

13 A. Yes.

14 Q. Do you know what happens to unsaturated sites
15 of activated carbon when they're exposed to ambient
16 conditions?

17 A. I suspect they get saturated.

18 Q. They get saturated with hydrogen or other
19 things in the air?

20 A. Yes.

21 Q. So in a real process, do you expect there to be
22 any activated carbon unsaturated sites?

23 A. I don't -- inside the flame zone, anything is
24 possible. I don't know.

25 Q. But, again, I asked specifically about

1 activated carbon, not unburned carbon.

2 You would not have activated carbon in a
3 flame zone, would you?

4 A. Let me refresh your memory that one way of
5 making activated carbon it is to take lignite or other
6 coals and process them in a matter, granted, a very
7 controlled matter, it's not a flame zone, but that's
8 where a lot of activated carbon comes from is a process
9 for coal. So sitting here today, I can't tell if that
10 is something that could be within a flame zone or not.

11 Q. Okay. Not sure?

12 A. I'm not sure.

13 Q. Okay. Turn to Box 2 of the model.

14 Do you know what the double arrows
15 represent?

16 A. I -- the equilibrium can go in either
17 direction, I guess.

18 Q. Okay. And then turn to Box 3. Do you see an
19 Hgo?

20 A. I do.

21 Q. Hgo is elemental mercury, correct?

22 A. Yes.

23 Q. So am I correct Box 3 is purporting to show the
24 process by which elemental mercury sticks to activated
25 carbon?

1 A. That's a fair interpretation.

2 Q. Does anything in Figure 1 of Exhibit 1020
3 address how oxidized mercury is captured by activated
4 carbon?

5 A. Can you repeat that, please?

6 Does anything in Figure 1 of?

7 Q. Exhibit 1020.

8 A. Oh, that's the --

9 Q. The left figure. Address how oxidized mercury
10 is captured by activated carbon.

11 A. Box 1 appears to be, perhaps, informative that
12 there's a site there, but there's no acknowledgement of
13 elemental mercury.

14 Q. Maybe you misspoke. You said there's no
15 acknowledgement of elemental mercury in Exhibit 1020.

16 A. Around Box 1.

17 Q. Did you mean there's no acknowledgement of
18 oxidized mercury in Exhibit 1020?

19 A. Okay. Let me take a breath here.

20 Exhibit 1020, the schematic on the left,
21 you asked me about Box 1, correct?

22 Q. Yes, starting with Box 1. Is there any
23 discussion -- let me take a step back and ask a
24 different question.

25 In the left figure shown in Exhibit 1149,

1 which corresponds to the figure from the provisional,
2 correct?

3 A. Yes.

4 Q. In the left figure shown in Exhibit 1149
5 corresponding to Figure 1 of the provisional, is there
6 any discussion of the reaction mechanism for how
7 oxidized mercury is captured by activated carbon?

8 MR. COCHRANE: Are you asking him about his
9 opinion in paragraph 58, or are you asking him about
10 just the figure on its own?

11 MR. TOBIN: I'm just asking a question.

12 MR. COCHRANE: Okay.

13 Q. BY MR. TOBIN: Do you need me to repeat the
14 question?

15 A. One more time, please. Yes.

16 Q. In the left figure shown in Exhibit 1149
17 corresponding to Figure 1 of the provisional, is there
18 any discussion of the reaction mechanism for how
19 oxidized mercury is captured by activated carbon?

20 A. Well, the way mercury is designated, there is
21 certainly no HG plus as a superscript. You do see HG
22 tied to carbon, and one of the mechanisms is that it
23 becomes plus because it gives up electrons. So I don't
24 know when whoever put this together what they were
25 thinking. I mean, they may have in their head thought,

1 as long as I'm showing mercury adjacent to carbon, in
2 their opinion, it's going to give up electrons.
3 Therefore, it becomes HG plus, but the brutal blunt
4 answer to your question is no.

5 Q. In fact, I now want to turn to the figure on
6 the right, which was filed about a year after the
7 provisional. So turning to Figure 2 of Exhibit 1148,
8 which is shown on the right of Exhibit 1149, that figure
9 does discuss how oxidized bromine is captured by --
10 withdrawn. Let me ask it different.

11 So turning to the figure on the right in
12 Exhibit 1149, which is Figure 2 of Exhibit 1148, that
13 figure does discuss how oxidized mercury is captured by
14 activated carbon, right?

15 A. You do see HBr₂ and you see HBr, so I believe
16 the answer to the question is yes.

17 Q. So one difference between Figure 1 of the
18 provisional and Figure 2 of the nonprovisional filed
19 about a year later in 2005 is that Figure 2 of this
20 nonprovisional, Exhibit 1148, does show HBr₂ being
21 captured by activated carbon?

22 A. Well, I don't know why going to Exhibit 1020,
23 Box 4, I don't know why one would dismiss what we've
24 already agreed to be a cartoon to not say the same
25 thing. I wonder if these differences are nomenclature

1 as much as anything else.

2 Q. You would agree, certainly, Box 4 of
3 Exhibit 1020 does not say HgBr₂, correct?

4 A. Agreed.

5 Q. And, in fact, nowhere in Figure 1 of
6 Exhibit 1020 does it reference HgBr₂, correct?

7 A. Correct.

8 Q. Another difference is that Figure 2 of the
9 nonprovisional application, Exhibit 1148, discusses
10 reactions with sulfate ions SO₄²⁻, but Exhibit 1 of the
11 provisional does not?

12 A. That is correct.

13 Q. And I think -- would you agree that sulfate
14 ions compete with mercury for active sites on activated
15 carbon?

16 A. Yes.

17 Q. And the nonprovisional application of
18 Exhibit 1148 accounts for that process in Figure 2, but
19 Figure 1 of the provisional does not account for the
20 competing sulfate reactions, correct?

21 MR. COCHRANE: Object to form.

22 THE WITNESS: I got lost. So we're on --
23 we're on 1020, the provisional.

24 Q. BY MR. TOBIN: Let me -- let me re-ask my
25 question. I'm sorry.

1 A. Okay.

2 Q. The nonprovisional application, Exhibit 1148,
3 accounts for the competition with sulfate ions for
4 activated carbon sites, yes?

5 A. Yes.

6 Q. The provisional, if you go to Exhibit 1020,
7 does not account for competition by sulfate ions for the
8 activated carbon sites, correct?

9 MR. COCHRANE: Object to form.

10 THE WITNESS: Correct.

11 Q. BY MR. TOBIN: So is it fair to say that --
12 withdrawn.

13 Do you understand the difference between a
14 heterogenous and a homogenous chemical reaction?

15 A. Yes.

16 Q. What's the difference?

17 A. Homogenous is gas face. Heterogenous is
18 something where a surface is prompting or engulfed in
19 the reaction.

20 Q. So would you agree that Figure 1 of
21 Exhibit 1020 shows a heterogenous reaction?

22 A. Yes.

23 Q. Figure 2 of Exhibit 1148, it shows a
24 heterogenous reaction?

25 A. Yes.

1 Q. Figure 1 of Exhibit 1020 does not show a
2 homogenous reaction?

3 A. Yes.

4 Q. Figure 2 of Exhibit 1148 does show a homogenous
5 reaction in that HBr₂ is formed?

6 A. Well, I see HBr₂. Am I to conclude that it's
7 formed from -- from the reaction that's presented?

8 Q. Are you?

9 A. I -- it's just -- I -- I see it there like
10 somebody wrote it down. I don't know.

11 Q. Is it fair to say that Exhibit 1148, Figure 2
12 is also a cartoon?

13 A. I think they're both general mechanistic, which
14 I described earlier.

15 Q. As a cartoon?

16 A. Yeah.

17 Q. Are you familiar in the context of chemistry
18 what the difference between a mass transfer limited
19 reaction and a kinetic limited reaction?

20 A. Yes.

21 Q. What's the difference?

22 A. Kinetic limited reaction is where everything is
23 uniformly and infinitely and conveniently mixed, and
24 the only rate at which the chemical reaction proceeds is
25 due to simply the rate constant between the two.

1 Mass transfer limited is the opposite in
2 which mixing is limited is the limiting step. If the
3 reactants were together amiably and intimately, the
4 reaction would go fast, but the mixing conditions limit
5 the ability and the ingredients to be amiably and
6 intimately mixed; therefore, the reaction rate is slowed
7 by mixing.

8 Q. I am impressed. That's very good.

9 So if I can simplify that, is it a mass
10 transfer limited reaction one in where the bottleneck is
11 getting the gases to the surface; whereas, a kinetic
12 limited reaction, it means the materials can easily get
13 to the surface; once they get to the surface, they're
14 limited in how quickly they react?

15 A. That would be another way of putting it, yes.

16 Q. Do either of the Figure 1 in Exhibit 1020 or
17 Figure 2 in Exhibit 1148 account for mass transfer
18 limitations or kinetic limitations?

19 A. I don't know that they were intended to be, but
20 the answer to your question is no.

21 Q. So that's another detail of the reaction
22 chemistry that either hadn't been worked out or these
23 had not been disclosed in these patent applications,
24 correct?

25 MR. COCHRANE: Object to form.

1 THE WITNESS: Yeah. Rate versus kinetic
2 limbations have not been discussed in any of these
3 patents.

4 Q. BY MR. TOBIN: And both of these, the cartoons
5 in both of these patent applications, Exhibit 1020 and
6 Exhibit 1148, seem to be suggesting that the main Br
7 constituent involved in these reactions is HBr; is that
8 right?

9 A. I don't know what the authors had in mind. I
10 think HBr, of course, is a key ingredient to all of
11 this, and it's probably -- if you count up the digits,
12 they probably mostly occupy the space. So, yeah, I'd
13 say it's mostly about HBr.

14 Q. And is that feature the the HBr would be the
15 key ingredient in the reactions with HG and activated
16 carbon, would that have been known in August 2004 other
17 than by looking at these patents?

18 A. Well, I mean, is this a POSITA or what are
19 we -- what's the context here?

20 Because, you know, I mean, rate -- these
21 rate limiting steps we've just discussed, everybody has
22 known about that for a century. So what -- what -- I
23 don't -- can you help me a little bit here?

24 Q. Let me ask a different question that's more
25 specific. I appreciate your clarification.

1 That HBr would be the key ingredient in
2 reactions between HG and activated carbon, would that
3 have been known to a person of skill in the art in
4 August 2004 other than by looking at these patents?

5 A. I'm sorry. One more time.

6 Q. Okay. So the context of my question is a
7 person of skill in the art in August 2004, fair?

8 A. They would know this?

9 Q. Yes.

10 A. Without seeing the patent?

11 Q. Correct.

12 A. Perhaps not.

13 Q. And, in fact, it looks like this reaction model
14 was continuing to develop from 2004 until later patent
15 applications in 2005.

16 Can we agree?

17 A. I don't know. Perhaps it was in their head,
18 and depending on how the patent application process
19 went, the different details were released. I've had
20 experience with patent examiners, and some of them are
21 really, really, really, really good; some of them less
22 so. And I think, perhaps, they started simple and got
23 more -- and the mechanism didn't change, but the
24 description did. But I'm speculating, and I shouldn't
25 do that. So --

1 Q. And you and I can't know what was in the
2 inventor's head, right?

3 A. Correct.

4 Q. So all we can know is what we see in these
5 patent applications, fair?

6 A. Correct.

7 Q. So at least what we see in these patent
8 applications from the provisional file in August 2004 in
9 Exhibit 1020 to later applications, the inventors were
10 disclosing more specifics about the reaction model in
11 their later applications compared to their provisional,
12 right?

13 A. I accept that. Yes.

14 Q. If I ask you a similar question on
15 Exhibit 1020, but I want to now ask you about Figure 2
16 of Exhibit 1148. Figure 2 of Exhibit 1148 is a more
17 detailed reaction model than if you go 1 of
18 Exhibit 1020.

19 Can we agree on that?

20 A. Yes.

21 Q. Using the more detailed reaction model in
22 Exhibit 1148 Figure 2, does that reaction model describe
23 the truth of the chemistry that actually occurs in real
24 life between activated carbon Br and mercury?

25 MR. COCHRANE: Object to form.

1 THE WITNESS: It might.

2 Q. BY MR. TOBIN: Does it?

3 A. I don't know. I mean, it -- it -- to -- to
4 confirm what this model says, you actually have to go
5 and do some really serious surface science measurements
6 on things that are really, really, really hard to
7 measure, and I don't know that anybody has done that.

8 In my opinion, you didn't ask this, but I'm
9 going to say it, as long as the mechanism is plausible
10 with what's observed in the field, that's good. If the
11 details change, I don't know if that makes that big of a
12 difference. So that's why, in my opinion, this is
13 interesting, but I just don't know how this affects
14 anything. I know it might affect your perspective on
15 things.

16 But in answer to your question, I'm not --
17 this could be right, there could be another evolution
18 depending on how important it is and what people want to
19 measure.

20 Q. In August 2004, did -- do you know whether EERC
21 had the ability to distinguish between Br₂ versus HBr
22 presence in a combustion gas?

23 A. I don't know that answer.

24 Q. Do you know if anyone had that ability in 2004?

25 A. Not that -- not that I know of.

1 Q. Now I want you to go a lull to cooler
2 temperatures downstream of the combustion chamber. Did
3 anyone in 2004 have the ability to distinguish Br₂ in
4 mercury-containing gas versus HBr in mercury-containing
5 gas?

6 A. Not that I'm aware of.

7 Q. So in 2004, for example, would there be any way
8 to know, experimentally, whether mercury-containing gas
9 contains Br₂?

10 A. Not that I know of.

11 Q. Would there be any way to determine
12 experimentally in August 2004 whether mercury-containing
13 gas contains Br⁻ ions?

14 A. I don't know how you could measure that. I
15 think a clever person could design an experiment to pull
16 those out, but in terms of instrumentation, I don't
17 know.

18 Q. So do you have any reason to think that the
19 ME2C inventors, as of August 2004, tested and determined
20 the presence of Br⁻ in mercury-containing gas?

21 MR. COCHRANE: Object to form.

22 THE WITNESS: I don't -- I don't have a
23 reason to think that that measurement could be made.

24 Q. BY MR. TOBIN: Do you have any reason to think
25 that the ME2C inventors as of August 2004 tested and

1 determined the presence of HBr in mercury-containing
2 gas?

3 A. No.

4 Q. Do you have any reason to think that the ME2C
5 inventors, as of August 2004, tested and determined the
6 presence of Br₂ in mercury-containing gas?

7 A. No.

8 MR. TOBIN: Let's take a break.

9 (A recess was held from 2:29 p.m. to 2:39 p.m.)

10 Q. BY MR. TOBIN: I wan to follow up. We have a
11 few questions, Mr. Cichanowicz.

12 In -- I was going to ask you several
13 questions about the presence of various species of
14 mercury-containing gas. Do you recall?

15 A. Yes.

16 Q. Do you recall -- withdrawn.

17 In August 2004 -- withdrawn.

18 Did you see any evidence that, by
19 August 2004, the ME2C inventors had measured the
20 presence in Br₂ inside the combustion chamber?

21 A. No.

22 Q. Did you see any evidence that, by August 2004,
23 the ME2C inventors had measured the presence of Br-
24 inside the combustion chamber?

25 A. No.

1 Q. Did you see any evidence that by August 2004,
2 the ME2C inventors had simulated the presence of Br₂ in a
3 combustion chamber?

4 A. No.

5 Q. Did you see any evidence that, by August 2004,
6 the ME2C inventors had simulated the presence of Br-
7 inside the combustion chamber?

8 A. No.

9 Q. Did you see any evidence that, by August 2004,
10 the ME2C inventors had simulated the presence of Br₂ in
11 mercury-containing gas?

12 A. No.

13 Q. Did you see any evidence that, by August 2004,
14 the ME2C inventors had simulated the presence of Br- in
15 mercury-containing gas?

16 A. You didn't ask me that already?

17 Did I miss that?

18 Q. I don't think I did.

19 A. Anyway, the answer to the question is no.

20 MR. TOBIN: You've been very patient with
21 me today, so thank you for your time. And I'll pass the
22 witness, subject to recross.

23 THE WITNESS: Okay. Thank you.

24 Q. EXAMINATION BY MR. COCHRANE: Mr. Cichanowicz,
25 thanks again for sitting in today. I'll just have a

1 couple of questions on redirect.

2 Do you recall Mr. Tobin asking you
3 questions as to whether or not you did any evaluation of
4 conception reduction of practice, including creating a
5 claim chart?

6 A. I remember that question, yes.

7 Q. Okay. In connection with this case, did you
8 review the declaration of Mr. John Pavlish at Exhibit
9 No. 2046?

10 A. Yes.

11 Q. And can you pull up on the computer in front of
12 you Exhibit 2046?

13 A. I need a password. Oh. 2046?

14 Q. Yes, sir.

15 MR. TOBIN: Counsel, you want to clarify
16 for me what exhibit you're going to be talking about?

17 MR. COCHRANE: I'm going to be referring to
18 Exhibit 2046, and the first four IPRs.

19 MR. TOBIN: Okay.

20 MR. COCHRANE: 274 through 281. I don't
21 want a free Adobe trial.

22 MR. TOBIN: X that?

23 THE WITNESS: This right here.

24 MR. TOBIN: Counsel, it's not clear in the
25 record what you're pointing to on the computer and I

1 can't see.

2 MR. COCHRANE: Oh, I'm just trying to get
3 him to clear the screen of extraneous --

4 THE WITNESS: My AI friend is following me.

5 MR. COCHRANE: It's on Acrobat, the
6 extraneous windows, that's what I was pointing at, for
7 the record. Apologies.

8 THE WITNESS: Okay. There we go. So what
9 page number?

10 Q. BY MR. COCHRANE: Do you recognize this
11 document?

12 A. I do.

13 Q. What is it?

14 A. This is the declaration of inventor John
15 Pavlish.

16 Q. And, as you said, you reviewed this declaration
17 in connection with your opinions rendered in this case,
18 correct?

19 A. That is correct.

20 Q. And specifically, you not only reviewed this
21 Exhibit 2046, but Mr. Pavlish's other declaration that
22 applied to the other four IPRs in this case, correct?

23 MR. TOBIN: Objection. Leading.

24 THE WITNESS: Correct.

25 Q. BY MR. COCHRANE: Did you review every page of

1 this document?

2 A. I did.

3 Q. Okay. And if I could just refresh your
4 recollection, if you reviewed the material, could --
5 strike that.

6 Could you look at the material that comes
7 after Mr. Pavlish's signature page?

8 A. Can you -- can you give me a hand what page
9 it's on?

10 Q. Sure. I realized I'm trying to do this in the
11 abstract without looking at the document, myself. So
12 let me look at the document.

13 MR. TOBIN: Counsel, would it help you to
14 have a paper copy of 2046?

15 MR. COCHRANE: Thank you for offering. I
16 have the electronic version, though.

17 THE WITNESS: Right.

18 Q. BY MR. COCHRANE: Can you go to page 33 of
19 Exhibit 2046. And do you recognize this to be the
20 signature page of Exhibit 2046?

21 A. I do. Yes.

22 Q. And can you read paragraph 58 of this document,
23 please?

24 A. "A claim chart comparing these documents to the
25 claims of the '430 and '225 patents is attached to this

1 declaration."

2 Q. And based on the fact that it's referring to
3 the '430 and '225 patents, are you looking at the
4 Exhibit 2046 as it applies to the final four IPRs that
5 we're talking about in this case, which are IPRs
6 202500422 through 425?

7 A. Yes.

8 Q. So did you review the claim charts?

9 A. I did.

10 Q. That were in --

11 A. I did review the claim charts.

12 Q. And did you also review the claim charts that
13 were in Exhibit 2046 for the other four IPRs regarding
14 US Patent numbers ending in '114 and '517?

15 A. Yes.

16 Q. So you reviewed all the claim charts that
17 Mr. Pavlish included in his declarations?

18 A. I did.

19 MR. COCHRANE: I pass the witness.

20 MR. TOBIN: I'll ask a few follow-up
21 questions on that, please.

22 Q. EXAMINATION BY MR. TOBIN: Can you open
23 Exhibit 2046 that -- from the '114 and '517 petitions,
24 please?

25 MR. COCHRANE: You might need to pass that

1 over to him if you've got an extra one.

2 MR. TOBIN: Yeah.

3 THE WITNESS: Thank you.

4 Q. BY MR. TOBIN: Excuse me. I misspoke.

5 Can you open up your declaration from the
6 '114 and '517?

7 A. I have it.

8 Q. Do you have it?

9 A. I do.

10 Q. Okay. You signed your declaration
11 December 15th, 2025, in the '114 and '517 patent
12 proceedings, correct?

13 A. Yes.

14 MR. COCHRANE: Objection. Asked and
15 answered.

16 MR. TOBIN: Okay. Counsel, that one is
17 definitely not in the PTAB website of approved
18 objections.

19 Q. BY MR. TOBIN: Do you need me to repeat the
20 question?

21 A. Please.

22 Q. You signed your declaration December 15th,
23 2025, for the '114 and '517 patents, correct?

24 A. Yes.

25 Q. And I think you mentioned because you like to

1 be -- do a good job, you actually finished your
2 declaration the day before you signed it December 14th?

3 A. Yes.

4 Q. And they gave you a little extra time for a
5 final read?

6 A. Yes.

7 Q. Got it.

8 Now, Mr. Pavlish signed his declaration
9 that you relied on on December 12th, 2025, correct?

10 A. I can't remember.

11 Q. Here's Exhibit 2046 for the '114 and '517
12 patents from Mr. Pavlish. He signed his declaration
13 December 12, 2025?

14 A. Yes.

15 Q. And his declaration is 123 pages long?

16 A. Yes.

17 Q. Mr. Pavlish's declaration is detailed claim
18 charts?

19 A. Yes.

20 Q. And so, you reviewed those sometime between
21 when he signed on December 12th, 2025, and when you
22 finished your declaration on December 14th, two days
23 later, right?

24 A. Yes.

25 MR. COCHRANE: Object to form.

1 Q. BY MR. TOBIN: Okay. I'd like for you to turn
2 to your declaration on Exhibit 12047 for the '430 and
3 '225 patent.

4 Do you have that handy?

5 A. I do.

6 MR. COCHRANE: And I'll object to any of
7 these questions going outside the scope of my redirect.

8 Q. BY MR. TOBIN: So you have Exhibit 2047 that --
9 which is your declaration from the '430, '225 patents,
10 yes?

11 A. Yes.

12 Q. You signed your declaration January 16th, 2025?

13 A. Yes.

14 Q. So is it fair to think you would have finished
15 your review and analysis by January 15th, 2025?

16 MR. COCHRANE: Object to form.

17 THE WITNESS: Yes.

18 Q. BY MR. TOBIN: Okay. And in this Exhibit 2047,
19 you also reference a John Pavlish declaration with claim
20 charts that you reviewed, correct?

21 A. Yes.

22 Q. In fact, I think if -- and you're referencing
23 John Pavlish's declaration for the '430 and '225
24 patents, the same patents that you're reviewing, right?

25 A. Yes.

1 Q. Okay. Do you know where in Exhibit 10 -- 2047
2 you reference Mr. Pavlish's declaration?

3 A. I do not know where.

4 Q. And it's Exhibit 2046. Give me one second.
5 Let me see if I can find it for you.

6 Okay. Why don't you turn back to paragraph
7 62 of Exhibit 2047, which is your declaration for the
8 '430 and '225 patent?

9 A. Yes.

10 Q. Okay. And there you state that reduction to
11 practice is confirmed by testimony from all three
12 inventors, and one of the documents you cite is
13 Exhibit 2046.

14 Do you see that?

15 A. Yes.

16 Q. Okay. So -- and counsel asked you about claim
17 charts that you reviewed?

18 A. Yes.

19 Q. So in forming your opinions for your
20 declaration in the '430 and '225 patents, you reviewed
21 declaration with claim charts from Mr. Pavlish?

22 A. Yes.

23 Q. And that's the declaration you reference as
24 Exhibit 2046 in exhibit -- in paragraph 62 of your '430
25 and '225 declaration?

1 A. Yes.

2 Q. Okay. Do you have Exhibit 2046 from the '430
3 and '225 patents open on the computer screen?

4 A. Which patents?

5 Q. The '430 and '225.

6 A. No, I don't.

7 MR. COCHRANE: I believe it was the one
8 that you had open in the first instance.

9 THE WITNESS: I haven't changed it, so that
10 would be it.

11 MR. COCHRANE: I think that's the right
12 one, yes.

13 THE WITNESS: All right. '430 claim -- if
14 it's the only one you've opened up, that's it.

15 Q. BY MR. TOBIN: Okay. Let's make sure you're
16 looking at the right exhibit.

17 Do you see paragraph -- can you read
18 paragraph 2 into the record, please, of the Exhibit 2046
19 you have open?

20 A. "I make this declaration" -- I'm sorry, I'm in
21 the Apple family. All this stuff doesn't...

22 "I make this declaration to describe the
23 conception and reduction to practice of invention U.S.
24 Patent Number 10,668,430 (the '430 patent) and US Patent
25 Number 10,589,225 (the '225 patent)."

1 Q. Okay. So we're in the right document?

2 A. Is that the right one?

3 Q. That is.

4 So can you turn to page 33 of Exhibit 2046
5 for the '430 and '225 patents?

6 A. Which page?

7 Q. 33 of Exhibit 2046 in the '430 and '225 patent
8 IPR.

9 A. Okay.

10 Q. Mr. Pavlish signed his declaration
11 January 20th, 2026, correct?

12 A. That's what it says there. Yes.

13 Q. And this is the declaration you reviewed in
14 forming your opinions?

15 A. Perhaps a draft.

16 Q. This or a draft of is what you reviewed in
17 forming your opinions?

18 A. Yeah, I am 100 percent positive I've worked
19 through this chart before. That's all I know.

20 Q. Now, the chart you worked through is dated
21 January 20th, 2026, in what -- the copy we received,
22 correct?

23 Mr. Pavlish's claim charts are dated
24 January 20th, 2026?

25 A. Well, I'm looking at the signature page of the

1 document you asked me to pull up. And so, the answer is
2 yes.

3 Q. And the declaration you signed on the same
4 patents, Exhibit 2047, is dated January 16th 2025, four
5 days earlier?

6 A. Okay. Yes.

7 Q. Yes?

8 A. Yeah.

9 Q. Okay.

10 MR. TOBIN: I'll pass the witness.

11 MR. COCHRANE: No further questions. Thank
12 you.

13 THE REPORTER: And I know we have a rough.
14 Do you need one, as well?

15 MR. COCHRANE: Yes, please. Yeah, I do.

16 (Whereupon proceedings concluded at 2:56 p.m.)

17

18

19

20

21

22

23

24

25

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 PATENT TRIAL AND APPEAL BOARD

3 BERKSHIRE HATHAWAY ENERGY §
COMPANY, §
4 § IPR2025-00274
Petitioners, §
5 § (U.S. PATENT NO.
VS. § 10,343,114
6 §
BIRCHTECH CORP., §
7 §
Patent Owner, §
8 §

9 REPORTER'S CERTIFICATION

10 ORAL DEPOSITION OF EDWARD CICHANOWICZ, Ph.D.

11 MARCH 5, 2026

12
13 I, Nicole A. Hatler, Certified Shorthand
14 Reporter No. 11275 in and for the State of Texas, hereby
15 certify to the following:

16 That the witness, EDWARD CICHANOWICZ, Ph.D.,
17 was duly sworn by the officer and that the transcript of
18 the oral deposition is a true record of the testimony
19 given by the witness;

20 That the original deposition transcript was
21 delivered to _____;

22 That the copy of this certificate was served
23 on all parties and/or the witness shown herein on
24 _____;

25 I further certify that pursuant to FRCP Rule

1 30(f)(1) that the signature of the deponent:

2 _____ was requested by the deponent or a part
3 before the completion of the deposition and that the
4 signature is to be before any notary public and returned
5 within 30 days from the date of receipt of the
6 transcript. If returned, the attached Changes and
7 Signature Page contains any changes and the reasons
8 therefore:

9 ____X__ was not requested by the deponent or a
10 part before the completion of the deposition.

11 I further certify I am neither counsel for,
12 related to, nor employed by any of the parties or
13 attorneys in the action in which this proceeding was
14 taken, and further that I am not financially or
15 otherwise interested in the outcome of the action.

16 Certified to by me this 10th day of March,
17 2026.

18 
19

20 Nicole A. Hatler Texas CSR 11275
21 Expiration Date: 11/30/26
22 California CSR 13730, EXP 6/30/26
23 New Mexico CCR 588, EXP 12/31/26
24 NHatler@Ymail.com
25 Lexitas
Firm Registration No. 11253
435 Devon Park Drive, Suite 102
Wayne, Pennsylvania 19087
Phone: 215-494-7650

\$		
\$250 62:2	11 15:8 39:25 40:13 134:7 141:2	1980 50:11
\$450 62:3	1120 139:4	1990 53:2 94:1
\$475 13:6	11275 1:20 4:6	1993 49:15
-	114 8:20 9:25 10:4,18,24 11:20 65:8 68:4,8 72:24 76:21 79:12 112:7,9 113:21 114:6,9,24 116:5 117:24 119:13 120:8 129:5 132:5,16 164:14, 23 165:6,11,23 166:11	1995 94:14
---ooo--- 1:25	1148 137:11,15 138:23 139:14 140:8 141:3,13,17,20 149:7,12,20 150:9,18 151:2,23 152:4,11 153:17 154:6 156:16,22	1998 103:14
0	1149 139:24 140:3,13,18 141:3,6 142:11 145:11 147:25 148:4,16 149:8,12	1999 94:9,14
0 27:8 51:20	12 59:18 166:13	19th 49:14
02 29:8	12,201,595 137:17 138:16	1:28 128:8
03 102:15 103:11 127:2	1200 1:22 2:8	1:40 128:8
03/04 48:3 49:24	12047 167:2	1st 14:9 49:14
04 127:2	123 166:15	
08 108:13	12:01 98:1	2
1	12:42 98:1	2 117:18 122:5,8,24 123:16,17,22 125:14,20,22 129:5 140:8,17 141:6, 13 146:13 149:7,12,18,19 150:8,18 151:23 152:4,11 153:17 156:15,16,22 169:18
1 33:6 60:10,13 61:8 62:21 77:7,8 79:16,19 93:6 112:15,21 113:21 120:13,21 133:1,3,5,23 134:17 135:8 136:22 140:5,19 143:2 144:4,5,17 145:10 147:2,6,11,16,21,22 148:5,17 149:17 150:5,10,19 151:20 152:1 153:16 156:17	12th 19:22 166:9,21	20 133:6 134:17 135:7
1,000 62:4 142:23	13 64:8 65:4 68:2	2003 89:21 94:16,18 96:14,18 97:2, 18,20 98:11,14 99:5 100:2 101:8,18, 24 102:4 103:3,12,16,19,23 104:1,8, 15,19,24 105:5 110:11,15,19,22 118:8,10 125:25 127:11
10 15:8 168:1	14 39:24 40:17,21,24 41:2 81:11 112:9,10 114:8,16,18,19,24 115:21 116:1,6 117:24	2003/2004 48:8 49:22 92:23 93:2,16 95:14
10,343,114 1:5 4:23 8:18	14th 20:17,21 22:17 166:2,22	2004 43:12 44:5,11,15 60:20 61:21 62:10 64:6 65:10 68:10 94:16,18 101:24 102:4 105:2,9 106:1,25 107:17,19,22 110:11,15,19,22 116:8 117:14 118:8,10 119:3,8 124:18,21 125:25 126:5,18 127:11 129:11,16, 19,22 130:1,16,21 131:5,14,16,21 135:17,20,22,25 136:3,10,15 142:2 154:16 155:4,7,14 156:8 157:20,24 158:3,7,12,19,25 159:5,17,19,22 160:1,5,9,13
10,589,225 5:3 9:11 169:25	15 82:15 83:17 85:9	2005 149:19 155:15
10,596,517 4:25 8:24	15- 63:2	2008 108:16,22 109:1,6
10,668,430 5:2 9:5 169:24	15th 6:16,20 7:8 10:18 11:9 15:1,4 20:20 22:15 165:11,22 167:15	2009-0062119 137:16 138:13
100 170:18	16 54:25 85:13 94:21,24	2015 124:14
1001 8:17	1600 63:2	2018 103:15 124:15 132:5,12
1020 133:1,3,18 134:5 136:23 139:4, 15 140:5 141:2,12,24 142:8 143:2,15 144:4,6,17 147:2,7,15,18,20 149:22 150:3,6,23 151:6,21 152:1 153:16 154:5 156:9,15,18	164 3:6	2024 14:14
1040 125:20	16th 7:1 10:20 11:10 167:12 171:4	2025 6:16 7:1 14:16,18,21 18:4 19:22 165:11,23 166:9,13,21 167:12,15 171:4
10:36 54:23	17 94:22,25 95:2 96:23	
10:50 54:23	18 17:15 92:15 95:8 120:8,12,20,21, 23 121:18	
	18th 49:14	
	1975 25:4	
	1978 49:14	

2025-00274 4:22 2025-00278 4:22 2025-00280 4:24 2025-00281 4:24 2025-00422 5:1 7:15 2025-00423 5:1 2025-00424 5:2 2025-00425 5:3 2025-274278280 7:9 202500422 164:6 2026 1:12,18 130:14 170:11,21,24 2046 19:13 21:6,15 161:9,12,13,18 162:21 163:14,19,20 164:4,13,23 166:11 168:4,13,24 169:2,18 170:4,7 2047 6:15,20,25 39:9,19,24 40:22,25 41:11,16,23 44:5 47:9 48:21 54:25 122:3 132:25 137:22 138:2 167:8,18 168:1,7 171:4 2047A 7:12 14:25 39:10 40:25 41:18 2047B 7:4,15 20s 24:20 20th 170:11,21,24 2121 1:22 214 210-2793 2:5 214 888-4854 2:9 225 9:13 10:1,5,21 11:2 41:10 72:24 163:25 164:3 167:3,9,23 168:8,20,25 169:3,5,25 170:5,7 23 47:9 235 11:5 24 20:7,8 25 20:4,6,8 26 20:10 2600 2:4 274 161:20 2801 2:4 281 7:9 161:20 2:29 159:9 2:39 159:9 2:56 1:19 171:16	3 3 139:14 143:1,15 146:18,23 3,000 130:8 142:20 144:1 3- 143:4 30 41:3,12 42:4 43:18,22 44:1,4,9 45:3,5,8,16 46:11,19 47:4 77:7,8 132:23 30th 65:10 68:9 31 60:10,14 137:22 138:2 32 122:1 33 54:25 132:25 163:18 170:4,7 34 79:15,17 35 122:3,25 350 13:17 375 13:17 4 4 62:21 149:23 150:2 40 22:21 400 143:5 423 7:16 424 7:16 425 7:16 164:6 430 9:7 10:1,5,21 11:2,5 41:10 72:24 163:25 164:3 167:2,9,23 168:8,20,24 169:2,5,13,24 170:5,7 450 63:3 47 41:3,12 43:22 44:1,5,9 45:5,8 47:4 48 99:7 49 101:3 109:20 113:8,18 4th 22:6 5 5 1:12,18 40:7 48:21 78:6,8,12,16 140:19 50 43:8 47:8,21 48:4,10,16 117:6,18 130:14 500 62:4 500-megawatt 62:4	51 119:21 121:4,18 123:6 517 9:1,25 10:5,18,24 11:21 65:9 68:4,8 72:24 164:14,23 165:6,11,23 166:11 58 148:9 163:22 589 105:22 59 119:18 127:20 128:10,21,24 129:10 132:11,16,21 595 138:18,24 140:8 5th 14:22 15:15 18:4 22:16 42:14 6 6 48:18,20,21 50:5 94:6 60 62:12,17,24 63:5 600 13:19 61 19:17 20:3,6 62 168:7,24 6th 14:22 15:15 18:4 22:6,16 42:15 7 7 32:3 94:6 70 76:24 90:20 75201 1:23 2:4,9 76 11:6 79 10:24 8 8 59:18 800 142:23 80s 47:1 9 90s 47:1 93:23 93 50:12 95 94:6,9 98 94:7 99 94:7 9:26 1:19
---	--	---

A		
a.m. 1:19 54:23 abbreviated 50:22,25 61:11 109:25 abhorrent 87:9 abide 116:24 ability 85:6 153:5 157:21,24 158:3 above-styled 1:18 absorbent 127:1 absorbers 93:17 absorption 133:14 abstract 163:11 accept 156:13 accepting 30:25 access 87:12 accident 25:10 account 150:19 151:7 153:17 accounts 150:18 151:3 accurate 5:14,18 accuse 69:3 achieve 90:20 achieving 89:6 ACI 99:1 acid 31:9 39:1,4 acknowledgement 147:12,15,17 Acrobat 162:5 acronyms 42:12 act 51:15 52:10 53:3 93:25 activate 30:20 activated 31:5,14,20 53:17,24 90:19 92:8 93:22 94:8,13,15,19 97:8,20 98:7,8,11,14 99:1,3,4,17,22 107:14 109:23 110:2,4,5,9,16,20,23 111:4,5 112:1,18 113:13 114:21 115:9 116:4 120:5,24 121:8,12 123:10 124:9 125:1,2,23 126:1,5,6,7,15,19 127:6 131:5 136:1,16 143:11,16 144:2,5,14, 18 145:2,11,15,22 146:1,2,5,8,24 147:3,10 148:7,19 149:14,21 150:14 151:4,8 154:15 155:2 156:24 active 53:20 113:2 150:14	actively 100:13,16 activities 45:20 activity 81:20,22,24 82:11 actual 90:2,8 98:6 124:8 126:17 134:22 add 59:8 61:21 62:8 78:9,10 115:3 116:10 added 77:6,11,13,17 96:4 115:2,6,7, 8,12,22 129:1,12 140:1,20 adding 73:7,21 74:25 75:8 76:4 90:19 107:20,23 116:1,2,3 117:25 131:14 addition 59:4 74:20 75:25 114:19,20 additional 120:4 121:7 123:9 additive 104:2 additives 96:1 99:17 120:1 address 66:14 119:14 147:3,9 addressed 74:19 addresses 118:5 144:10 adequate 72:21 73:8 adequately 82:25 adjacent 149:1 adjust 75:11,20 adjusted 65:20 75:25 adjusting 75:16 76:8 80:10 adjustment 80:9 admit 135:13 Adobe 161:21 adopting 50:15 advance 15:14 21:18 128:12 affect 117:2 157:14 affected 96:4 97:12 affects 157:13 affiliated 96:17 Agency 103:10 agent 108:1 agree 11:8 32:25 33:12 46:10 88:1,6, 21 101:8 110:14 112:16,25 114:16,18 120:12 126:16 140:4,7 141:11,20 150:2,13 151:20 155:16 156:19 agreed 4:19 44:20 149:24 150:4	agreement 15:12 ahead 25:9 114:3 AI 145:4,5 162:4 air 24:22 52:10 55:24 56:18 58:14,16, 17,19 59:4,5,6,8,12,14,17,19,23 60:2, 25 61:2,5,6 93:25 98:17 108:4,6,12, 15 109:3 116:17 145:19 aligned 55:15 alkaline 51:9 allowed 53:3 alternatives 118:24 126:2 ambient 145:15 amendments 52:10 53:3 94:1 amiably 153:3,5 ammonia 58:24 amount 75:21 77:11,16 analogous 39:3 analysis 64:24 67:11,17 68:19 69:6, 25 71:4 79:3 133:10 167:15 analyze 83:17 and/or 92:21 annual 87:23 90:6 answering 91:25 144:7 anymore 47:15 111:16 apologies 45:14 128:12 162:7 Appalachian 51:8,12 APPEAL 1:2 APPEARANCES 2:1 Appearances..... 2 3:3 appears 141:17,19 147:11 Apple 169:21 applicable 10:9 application 53:21 122:6,8 124:10,14 137:17 138:16,18,24 140:9 150:9,17 151:2 155:18 applications 52:12 106:22 107:5,7,9 142:3 153:23 154:5 155:15 156:5,8,9, 11 applied 67:11,17 68:19 69:6,25 106:2 162:22

applies 164:4 apply 107:3 143:25 applying 104:9,15,25 106:10 appreciated 89:9,17 approach 99:15,16 100:19 113:14 114:1,13 124:16 approve 91:9 approved 165:17 approximate 89:16 approximately 12:21 14:25 aqueous 36:5,8 Arctic 69:12,16 area 55:2 96:8,16,18 97:4,5 areas 22:1 96:13 argue 49:12 arguments 104:6 array 123:17,19 arrow 122:9 arrows 146:14 arsenic 52:15 53:18 art 42:10,18 43:11,16,19,24 44:3,8, 14,24 45:4,6,17 47:6 48:9,13 85:17, 18,23 86:15 92:14 93:16 95:4,7 117:22 126:5,18 130:15,21 131:4 136:12 155:3,7 ash 96:5,6 97:12,16 143:23,24 aspect 48:14 aspects 22:1 116:16 assign 38:3 assigned 20:16 assume 23:5,8 64:18 assumed 91:5 assumption 87:4 astatine 32:13 atom 25:15,17,19 26:1,4,7 28:3,6,9, 12 35:3 45:21 atomic 27:14,20,25 atoms 27:23 28:18,21,22,24 29:10 36:16,18 37:20 129:14,24 130:22 attached 163:25	attempt 87:15 attend 103:12 attended 103:14,19 attending 16:8 17:2 105:4 attention 49:5 135:14 attorney 22:2 66:19 142:9 audience 106:1 August 65:10 68:9 107:19,22 131:21 135:22,25 136:3,15 154:16 155:4,7 156:8 157:20 158:12,19,25 159:5,17, 19,22 160:1,5,9,13 author 108:21 authors 154:9 automated 75:23 avid 17:10 aware 19:20,23 42:5 43:19,25 44:3,9 45:4,15,17,18,20,22,24 46:11,12,18 48:12,17 70:19 79:6 108:24 109:6 132:19 134:16,25 135:3,16,19 158:6 B B-PAC 109:25 110:2,8,16 112:18 113:2 bachelor's 23:2 92:17 back 7:19 15:10 17:17 42:16 43:11 44:11,15 65:17 73:23 77:3 79:19 87:24 91:1 92:13,15 95:18 98:2 116:20 117:10,23 119:20 124:18 125:25 132:13 147:23 168:6 background 19:2 39:9,14 41:3,11, 15,22 42:24 46:7 47:4 81:15 84:3,20, 22 85:9 136:20 bad 87:9 bag 93:8 122:20,23 balance 72:12 base 31:8 118:25 based 46:20 77:12 164:2 basic 25:12 45:9 47:5 48:14 143:22 basically 24:12 48:17 52:11 53:14, 19 54:1,8 59:16 73:15 77:12 87:10 96:8 98:20 100:24 103:24 104:4,6 105:17 118:3,14 123:7,25 128:24 134:14 Basin 51:13	basis 54:9 batch 91:20 Bear 76:17 bearing 82:24 bears 85:9 bed 123:24,25 124:9,16 125:1,23,24 126:6,20 127:1,6,15 beds 126:12,14 beginning 95:18 behalf 4:12,15 behavior 136:3,10 believed 119:25 benefit 49:4 Berkeley 24:24 26:21 BERKSHIRE 1:3 bet 46:4 bias 49:10 90:23 big 88:3 127:7,8,15 157:11 Birchtech 1:6 4:15 bit 51:22 66:20 85:14 87:25 106:7 154:23 bituminous 51:11 54:12,14,17 101:15 block 53:14 66:20 blocked 53:18 blunt 149:3 BOARD 1:2 boiler 55:3,5,8,13 56:2,7 57:17 63:17 78:4 111:9,15,21 116:19,22 117:2 boilers 118:17 boiling 45:25 46:6 bonded 28:19 38:14 bonding 31:4 36:18 bonds 28:25 book 24:4 books 75:24 bookworm 44:24 border 17:16 born 54:10
---	---	--

bottleneck 153:10 bottom 19:18 39:17 40:12 bottom-right 6:15 40:16,21 bought 49:25 59:19 bound 30:20 58:21 box 123:23 141:18 143:1,15 144:17 145:10 146:13,18,23 147:11,16,21,22 149:23 150:2 boxes 93:12 Br 27:14,17,20,23,25 28:12 33:9,19 34:22,23 36:18,22,23 38:14 73:13,20 74:25 75:8 105:8,16 106:2,10,13,17, 19 107:12,20,23 108:9,25 109:5,13, 17 115:7,8,12,22 116:1,2,3,9,10 117:22,25 118:9 119:12 128:25 129:12,19,23 130:22 131:14,20 134:18 136:1,16 142:13,20 154:6 156:24 Br- 28:13 34:24 35:6,9,12,17 142:21 143:4,8,15 158:13,20 159:23 160:6, 14 Br-containing 76:5 104:12,15 105:1 115:6 135:23 136:4,11 Br2 29:11 33:22,24 34:2,4,6,11,14 36:16,18,20,22 37:8,11,15,17,21 38:20 73:12 157:21 158:3,9 159:6,20 160:2,10 brackets 138:16 break 54:19 102:2 127:22,24 128:2, 5,11 159:8 breaks 5:25 6:2 128:15 breath 147:19 breathe 34:16 briefly 97:24 broad 123:17 131:9 bromide 28:10,13 30:2 32:23 33:5,6, 9,10,13 34:21,22,23 35:1,3,6 37:3,5, 17,25 46:1 73:18 74:21 75:25 77:9,17 brominated 109:23 110:2,4,20,23 111:3 112:1,17 113:1,13 114:20 bromine 28:9,12 32:11,23,25 33:12, 17,18,21,24 34:16,20 35:3 36:16 37:15 69:17 70:25 73:7,11,15 74:20 77:6 99:17 101:19,20 102:3,6,21 103:22 104:2,11 108:12 109:11 111:19 114:20 115:2,3 120:1 129:13, 24 130:4,22 133:14 144:10 149:9	bromine-induced 118:13 brought 101:22 102:11 brutal 149:3 building 43:2 bulk 21:14,25 24:23 49:1 51:7 55:25 bullet 48:4,10,15 bunch 138:3 burn 57:11 63:15 111:13 130:9 143:13 burned 56:23 57:9,25 77:14 burner 64:4 78:7 116:15,23,25 117:8 burners 59:5 78:7 101:6 108:3 118:17 130:6 burning 56:19 57:12 59:3 Bush 119:6 business 136:7 businesses 136:8 busy 22:10 buzz 100:4 byproduct 96:7 97:12 C C-A-R-B-E-N-E 144:21 C-E-M-S 90:25 cadence 40:2 calculation 77:16 Caldwell 1:21 2:8 4:14 call 7:4 15:17 30:2,5 51:2 57:23 68:18 76:24 116:19 138:18 called 27:5 37:15 54:14 56:25 59:5, 12 60:25 61:9 63:8 64:12 66:3 70:18 91:20 103:6 109:22 calling 68:22 calls 42:20 44:17 85:25 134:9 Canada 13:22 14:1 Canadian 17:16 capability 97:15 capacity 62:1 124:2 capital 50:25 51:20 126:23 127:7,10, 17	capture 131:6 134:11 captured 120:2 121:5 123:7 147:3, 10 148:7,19 149:9,13,21 capturing 97:6 carbene 144:20 carbon 30:20,24 31:5,8,15,20 53:17, 24 54:1 63:16,18 90:19 92:9 93:22 94:8,13,15,19 96:5 97:8,11,15,20 98:7,9,11,15 99:1,3,5,17,22 107:14 109:23 110:2,4,5,9,17,20,23 111:4,5, 9,13,15,18 112:1,18 113:13 114:21 115:9 116:4 120:5,24 121:8,12 123:10 124:9 125:1,2,23 126:1,5,7, 15,19 127:6 129:14,25 130:10 131:5 133:15 134:19 136:1,16 143:11,16, 17,18,19,22,24,25 144:1,2,5,6,12,13, 15,18 145:2,5,11,15,22 146:1,2,5,8, 25 147:4,10 148:7,19,22 149:1,14,21 150:15 151:4,8 154:16 155:2 156:24 carbon-based 96:4 care 8:5 88:16 career 86:18 carries 35:1 cars 25:2 cartoon 133:4,21 134:14 135:7,20 139:10,15 141:12 149:24 152:12,15 cartoons 154:4 cartoony 133:7,8 case 7:24 10:15 18:2,11 25:20 27:17 32:22 43:7 44:15 51:20 53:18 64:24 66:17 67:5 73:1 74:20 84:22 105:20 109:16 135:9 161:7 162:17,22 164:5 Cassady 1:22 2:8 4:14 catalatic 93:10 catalyst 52:16 53:13,17 catalysts 51:16 95:21 catalytic 50:16,21 95:19 categories 103:4 Catherine 108:20 caused 108:9 119:12 caution 20:24 CEMS 90:24 91:5,8,19 center 40:12 century 94:7 154:22
---	--	---

Certificate.....172
3:10

Certified 4:5

chair 10:16 102:17

challenge 85:20

chamber 55:9,20 56:2 58:10,12
59:9,22 60:1 64:2 74:22 78:5 98:23
99:24 107:20,24 112:2 113:22,25
114:11 115:3,8,10,14,16 116:2,3,4
129:1,12 136:4,11 158:2 159:20,24
160:3,7

chambers 78:8

chance 112:13

Chang 49:16,18,19 50:2

Chang's 49:23

change 44:20 51:16 76:1 116:23,25
124:3 126:14 155:23 157:11

changed 63:7 142:4 169:9

char 63:9,11,21,23 64:1,6

charge 13:18 26:5,8 27:10 28:1 33:6
35:1

charged 30:7 36:22,23

chart 61:3 77:20,22 90:4 137:23
138:2 139:9 161:5 163:24 170:19,20

charts 164:8,11,12,16 166:18 167:20
168:17,21 170:23

chase 46:25

cheaper 126:23

check 10:15 81:20,22,24 105:3

chemical 19:6,11 22:24 25:17 26:22,
25 31:4,14 33:2,19 37:23 38:3 46:5
92:18 106:21 134:22 135:25 151:14
152:24

chemically 28:18 29:18

chemistry 23:9,12,16,19 24:10
25:12 42:25 57:8 72:11 86:11 92:19
97:4 107:13 129:25 132:1 133:5
135:22 136:22 152:17 153:22 156:23

chloride 26:15 28:3,6 101:16

chlorides 109:10 116:20

chlorine 32:9 101:11,14 106:14
108:2,5

choice 53:4 122:19,22 126:8

church 67:21,25

Cichanowicz 1:11,16 3:5 4:1 5:10,
11,13 98:4 128:9 130:13 137:19
159:11 160:24

circle 138:21

circular 85:14

citation 101:7

cite 8:2 12:1 19:13 84:23 85:8 89:22
100:18 101:1,4,5 132:10,15 168:12

cited 6:8 76:16 124:12

cites 76:3,7

Civil 1:24

CI 27:13,17,20,23,25 28:3,6

CI- 28:7

claim 74:8,10,15 76:14 77:20,22,23,
24,25 78:6,8,16,20,22 79:13,16,19,
21,23 80:13 112:9,10,15,21 113:21
114:8,16,18,19 115:18,19,21 116:1,6
117:24 120:8,12,13,20,21,23 121:12,
18 161:5 163:24 164:8,11,12,16
166:17 167:19 168:16,21 169:13
170:23

claimed 65:9 66:18 68:4,8 75:7
80:25 120:23

claiming 72:22 115:22

claims 71:12 73:5 74:2,7,18,19,23
75:10,19 85:20 86:2 114:24 115:17,
18 163:25

clarification 74:11 101:23 110:21
122:21 154:25

clarify 161:15

clarity 40:20

class 24:8

classes 24:1

clean 52:10 75:17 93:25

cleaned 80:1

Cleaner 53:3

clear 4:17 5:21 93:24 161:24 162:3

clever 67:3 158:15

client 13:8

close 9:22

co-inventors 73:17 89:9,17 109:13
112:17 113:1

coal 25:1,4 49:8 51:17 52:1,2,3,18
54:4,5,14,15 56:5,16,23 57:9,10,12

58:21 59:6,9,20,22 60:1,20 61:5,14
62:22 63:13,14,22 64:5 73:21 74:21,
25 75:8 76:5 77:6,9,11,14 78:11
90:19 92:8 95:16 101:15,21 102:4,5,
23 104:16 105:1,9 106:2,10 107:20,
23 115:7,14 118:9 129:1,12,19,23
130:22 131:15,17,21,23 132:3 135:23
143:14,19,21 144:2,10,12 146:9

coal-fired 16:8 63:2 86:11 94:5

coals 50:19,20 51:4,6,11,12,15,24
52:5,7,13,14,20,22 54:17 101:9,10,
13,17,18 106:13 146:6

Cochrane 2:7 4:13,19 5:4,5 8:14
11:16 17:1 19:7 20:22,24 35:10 37:9,
12 42:20 44:17 68:22 71:2 78:24
79:10 85:25 89:19 92:11 97:22
109:18 111:17 112:4,20 113:4,15
116:12 118:1 120:14 121:20 123:13
125:3 126:9 127:21,25 128:7,19
130:18 142:5 144:23 148:8,12 150:21
151:9 153:25 156:25 158:21 160:24
161:17,20 162:2,5,10,25 163:15,18
164:19,25 165:14 166:25 167:6,16
169:7,11 171:11,15

COCHRANE.....160 3:7

coffee 17:3

cold 15:17

collaborated 16:21,25 66:21

collaborative 49:5

collected 96:5 97:16

collectively 10:1,5

collector 114:3

college 17:10,17 46:25

colloquial 56:3

column 32:5,6 79:15,17

combination 79:25

combine 103:9 142:15

combined 29:18

combining 99:16

combusted 57:24

combustion 24:13,15,17 25:1 55:8,
20,25 56:2,12,14,20,21,22 57:10,22
58:10,12 59:9,16,17,21,22 60:1 64:2
74:21 78:5,8 98:23 99:24 107:20,23
112:2 113:22,25 114:10 115:3,8,10,
14,16 116:2,3,4,17 129:1,12,13
131:15,17,21 136:4,11 143:14,23

157:22 158:2 159:20,24 160:3,7 combustor 73:7 86:4 135:23 combustors 87:1 94:4 comfortable 78:9 84:5,15 commercial 111:1 commercialized 57:5 common 32:13 49:3 community 96:15 companies 49:4 COMPANY 1:3 compare 74:5,9,14 139:22 compared 52:4,5 77:6 156:11 comparing 139:11,12 163:24 compensated 13:2 compete 150:14 competing 150:20 competition 151:3,7 competitor 126:15 complete 5:14 59:4 74:15 86:4 completely 56:19 57:24 completing 56:20 compliance 54:14 components 55:3 comports 77:6 composed 29:17 composition 69:12 79:25 80:15,24 101:21 102:4,5,23 compound 26:17 29:16,20,22 30:4, 18 33:10 35:22 36:20 37:6,17 38:4,17 73:14 74:20 compounds 129:2 compromise 97:16 computer 161:11,25 169:3 conceive 66:8,12,18 67:9,13,23 68:5,14 69:5 conceived 65:9 68:4,8,17 conceiving 68:20 69:6 concentric 59:19 concept 63:13 70:9 84:6,9 127:19	conception 67:15,18,20 68:18 70:2, 14,22,24 71:9,11 161:4 169:23 concern 51:14 96:18 109:17 116:8,9 117:23 118:20 119:12,13,15 concerns 10:18,21 conclude 31:9 71:23 152:6 concluded 72:20 171:16 conclusion 42:21 44:18 65:23 68:23 72:17 83:4 84:8 86:1 conclusions 66:2 104:4 conditions 72:11 117:2 125:11 145:16 153:4 conduct 67:1 79:2 conducted 31:11,12,23 49:4 86:5,7 88:7 89:4 90:9 91:8 conducting 72:13 conference 103:2,13,14,16,20,23 104:1,9,15,20,25 105:15,24,25 conferences 17:2 103:5,8 105:4 confirm 91:9 157:4 confirmed 168:11 connection 15:25 77:23 98:7 105:15 161:7 162:17 considerate 140:15 consideration 110:14 127:11 considered 29:2 47:5 88:8 97:21 111:19 consistent 39:6 consists 25:19 consolidated 4:17 consortium 49:1 constant 152:25 constituent 154:7 constituents 57:14 58:3,7 constrain 96:6 consult 45:7 consulted 89:3 contact 59:23 60:2 96:8 contacted 15:15 contacting 59:20 contemplating 115:1,5	content 12:22 51:8,9 52:4,25 54:11 79:23 80:1,24 102:6 context 16:6 42:18 46:10,20 71:24 81:18 85:23 109:2,4 152:17 154:19 155:6 continue 57:11 116:24 continues 20:8 continuing 155:14 continuous 90:25 continuously 109:9 control 14:5 16:7 50:1,3,17 57:6 62:16 75:20,23 80:6,13,14 87:13 92:21 93:1,3 94:5 95:20 102:14 135:13 controlled 146:7 controlling 58:17 79:22 80:15,19,23 controls 86:13 93:12 conveniently 152:23 conventional 97:21 98:12 99:15 100:1,19 110:16 111:5 113:13 114:1, 12 118:8,10 conversations 128:14 convey 142:9 convinced 65:18,19 cool 142:20 cooler 158:1 copies 6:11 8:1,13 copy 8:4,5 47:11,19 163:14 170:21 corner 6:15 39:17 40:16,21 134:7 corners 83:15 Corp 1:6 4:15 Corporation 9:21 correct 4:18 6:13,17,22 7:2,6,10 11:3,11,18 12:2,3,13 14:19 15:1,2 18:5 23:4 25:15,24 26:3,18,22 27:11, 12,19,22 28:1,2 29:3 30:7 33:19 34:5, 24 36:9,15,16,21,25 37:6,17 38:8 41:1 43:9 44:5,7 51:1 55:4 59:10 61:20 64:17 65:18 67:24 69:15 70:16 72:24 73:18,22 75:2 76:5 80:7,8 82:14 86:23 92:3 102:10 104:12 110:12 115:10 130:1 132:16,17 134:11,12 146:21,23 147:21 148:2 150:3,6,7,12,20 151:8,10 153:24 155:11 156:3,6 162:18,19,22,24
---	--	---

165:12,23 166:9 167:20 170:11,22 correction 88:14 correctly 139:23 corresponds 39:24 137:16 148:1 corroborated 83:1 91:20 corroborating 83:24 91:23 corrosion 101:6 107:22,25 108:6,9, 13,16,25 109:5,8,13,17 116:8,9,18 117:23 118:13 119:11 cost 110:17 127:18 135:12 cost-effective 53:10 counsel 4:16 6:10 7:25 12:5,12 18:6 22:4 66:15 67:8 84:11 125:6 128:14, 18 161:15,24 163:13 165:16 168:16 count 22:9 154:11 country 49:2 52:10 couple 17:13 18:22 161:1 courses 23:16 24:10 court 10:14 141:7 covalent 28:25 covalently 36:18 38:14 cover 41:23 114:19 covered 24:7 114:23 crafted 114:1 CRC 46:4 47:11,13 create 53:16 57:6 created 95:23 139:21 creates 51:18 creating 96:9 161:4 credibility 82:19,21,24 credible 83:9 credits 53:7 criteria 123:15 criticizing 135:1 crossover 19:6 crystal 38:7 CSR 1:20 Curry 1:22 2:8 4:14 curves 76:25	customary 13:11 cutting 83:15 cyanide 58:25 cycle 23:23 cycles 23:25 D D.C. 102:14 103:17 D1 17:16 daily 90:6 Dakota 17:12 54:8 Dallas 1:23 2:4,9 damage 34:18 116:21 dance 142:21 dangerous 22:3 data 47:16 72:16,22 83:15 84:6,9 87:13,16,18 90:21 91:13,19,23 104:5 105:18 date 89:8,16 90:18 92:7 132:8 dated 170:20,23 171:4 dates 65:18 89:11 David 2:3 4:10 day 6:2 15:16 87:6 91:10,24 166:2 day-to-day 45:19 46:14 days 12:19,20,21 15:8 22:7,9,11,18 87:16 166:22 171:5 de 53:1 deal 77:8 dealing 92:20 dealt 117:3 decade 94:16 decades 46:21 78:7 82:5 83:9 December 6:16,20 7:8 10:18 11:9 14:9,18,21,22 15:1,4,15 18:4 19:22 20:18,20 22:6,15 42:14 165:11,22 166:2,9,13,21,22 decided 89:14 decks 69:19 declaration 6:14,24 7:8 10:17,20,23 11:1,5,9,10,20 12:23 13:1 14:25 15:7 19:14,21,24 20:14,19 21:6,7,14,15,	19,24 22:7,14 39:25 40:4 41:6,10,19 43:6 45:9 46:19 47:9 48:19 60:14 64:9 65:17 66:7,11 67:6 68:3 77:18 78:2,15,20 79:3 81:6,8 82:16 85:10 88:3 89:23 92:1,6,15 94:22 99:8 100:18 113:9 121:4,24 122:1,25 128:10,25 132:24 139:7 161:8 162:14,16,21 164:1 165:5,10,22 166:2,8,12,15,17,22 167:2,9,12,19,23 168:2,7,20,21,23,25 169:20,22 170:10,13 171:3 declarations 6:7,9,11,19 7:20 12:1 18:8 19:18 39:15 41:16,23 42:19 44:1 83:25 164:17 dedicate 82:6 deemed 114:12 deep 62:15 84:1 deeper 85:6 deeply 53:6 defending 13:25 defined 75:19 136:13 defining 95:3 definition 67:8 85:14 95:7 definitive 123:15 defuse 53:19 degree 23:2,17,20 42:25 92:18 130:16 degrees 130:8 143:5 144:1 delays 81:20,22 deleted 11:13 deliver 99:4 delivered 90:5 delivering 111:19 denoted 30:15 76:2 denoting 72:8 department 13:22,25 77:2 90:13 103:11 depend 30:23 62:13 dependent 72:15 86:8 98:20 115:18 depending 64:3 110:1 111:7 155:18 157:18 depends 13:12 30:24 35:14 111:6,12 120:13 136:14 140:16
--	--	---

deployed 52:11 deployment 111:1 deposition 1:10,15 4:6,17,18,21 5:17 6:1,6 8:7 12:10,15 18:21 depositions 4:7 18:17 describe 34:14 43:25 55:11 72:6 73:6 95:14 97:1 98:14 106:17,19 132:20 134:17 156:22 169:22 describing 26:16 109:2 description 87:19 107:1,12 155:24 descriptions 136:24 design 116:15,23 117:1,8 123:15 158:15 designated 28:6,7 148:20 designed 55:18 64:4 86:6 130:6 designing 78:7 101:5 desirable 123:18,22 desired 80:2 detail 21:20 102:23 135:15 153:21 detailed 21:16 102:6 156:17,21 166:17 details 14:3 55:18 72:9 116:14 155:19 157:11 detected 76:2 determine 158:11 determined 158:19 159:1,5 determining 71:9 72:2 117:12 develop 127:24 155:14 developed 118:23 developing 50:1 device 55:13 97:4 126:12 127:8,14 devil 116:14 devolving 56:17 diagram 33:16 diatomic 33:2 diatonic 34:2 dichotomy 119:16 difference 45:21 52:12 87:16 142:6 149:17 150:8 151:13,16 152:18,21 157:12 differences 55:11 141:11,15 149:25	differently 31:12 51:15 difficult 69:1,4 digital 91:2 digits 154:11 diligence 70:18 81:2,7,14,19 diligent 81:16 84:17 dioxide 51:21 61:16,17 directed 50:15 direction 146:17 disagree 31:3,19 disassociate 129:13 disassociated 36:14 disassociates 36:1 129:24 disbursed 98:18 disclose 12:25 disclosed 153:23 disclosing 156:10 discourage 100:13,16 discrete 28:19 discuss 78:15 83:17 92:6 103:22 149:9,13 discussed 35:21 98:8 117:7 126:2 154:2,21 discusses 150:9 discussing 55:3 88:2 104:9,14 144:6 discussion 93:6 116:16 124:12 147:23 148:6,18 discussions 17:24 18:6,7 dismiss 149:23 dispute 13:21 91:14,16 dissolved 35:6 36:10 dissolves 35:24 distinction 45:11 distinguish 61:4 157:21 158:3 dive 84:2 diversion 17:23 document 39:18 60:17 78:25 79:7 84:16 100:21 132:10,11,15 133:21 137:10 139:18,21 162:11 163:1,11, 12,22 170:1 171:1	documents 8:2 19:13 76:12,15 84:23,24 101:4 132:19 163:24 168:12 DOE 77:1,2 87:20,22 88:2 109:15 dollars 61:24,25 62:8 domain 90:13 Dombrowski 108:19,20 donating 30:25 double 37:2 146:14 downstream 90:19 92:9 98:23 99:24 112:2 113:21,24 114:10 115:9, 15 116:4 122:11 158:2 draft 19:25 20:14 21:23,25 22:3 170:15,16 drafted 64:19 drafts 21:16 drawn 116:20 drive 95:24 driving 108:1 drop 88:8,12,13 dry 93:7,17,18 DTOBIN@MWE.COM 2:5 duct 60:4 98:19 114:2 ducts 61:6,7 due 69:16 81:19 152:25 duly 1:17 dumped 91:3 E e-mail 8:6 E-P-R-I 103:10 earlier 22:23 35:22 44:23 62:14 72:5 78:4 97:11 152:14 171:5 earliest 108:25 early 14:9 18:25 24:20 easily 46:16 153:12 eastern 51:11 Ed 16:17,19 education 44:25 Edward 1:11,15 3:5 4:1 5:10
---	---	--

EERC 54:9 65:16 83:25 84:4 86:3,18, 20 157:20

effective 106:20

effectively 54:2 120:1

efficiency 143:23

effort 53:16 74:5,9,12,14 75:4,6

elaborate 13:13 35:15 52:6,24

electric 48:23 49:1

electrically 29:2,4

electron 27:18 35:4 145:2

electronic 8:1,5 163:16

electrons 25:20 26:2,4,7 27:15,21 30:25 148:23 149:2

electrostatic 93:9 113:19

element 25:17 28:22 33:2,19 73:6 75:5 77:25 78:23

elemental 27:5 30:11,21 33:21 95:24 146:21,24 147:13,15

elementary 27:10 30:14

elements 26:25 28:22 29:7,14,17 51:15

elevated 142:16,18

else's 65:24

emission 90:25

emission's 88:23

emissions 9:21 14:5 53:4 89:5 116:25

encountered 42:14

end 79:19 81:11 87:6 91:10,24 113:11 129:3

endeavor 88:16

ending 164:14

energy 1:3 72:12 77:2 90:14 103:11

engineer 15:21 19:3 23:5,8

engineering 22:25 23:3 42:24 45:9 46:5 92:18 136:21

English 53:15

engulfed 151:18

enter 130:7

entered 53:11

entering 74:21

entire 55:13

entities 103:7,9

envelope 55:22,23

environmental 16:7 86:12 103:10

EPA 93:24

EPRI 48:24 49:7,13,16,23 52:13 102:19 103:9 108:15

equilibrium 142:24 146:16

equipment 43:1 46:23 73:9 86:5,21 92:21 93:2,3,5

Eric 12:11

ESP 97:17

ESPS 96:3

essentially 46:25 57:14 59:1 70:9 116:22

estimate 12:14 14:20 22:12 62:11,24 142:17

evaluated 107:25

evaluating 81:15

evaluation 161:3

eventually 124:2

evidence 70:24 71:11 73:4 74:6,10, 15 75:7 76:3,7 77:24 78:21 80:5,18, 23 159:18,22 160:1,5,9,13

evolution 157:17

evolved 63:7 142:3

Examination 3:6,7 5:6 160:24 164:22

examiners 155:20

examples 27:3 101:13 104:7 107:11

exception 75:18

exchanger 55:17

exchangers 55:15

excuse 56:21 81:23 94:22 115:4 119:22 122:3,18 139:4 165:4

executed 70:4,6

Exemplary 32:7

exercise 81:19

exhibit 6:15,19,20,25 7:12,15,18 14:25 19:13 20:10 21:6,15 39:9,19,24 40:22,25 41:11,16 44:5 47:9 48:21 54:25 85:9 122:3 132:25 133:1,3,6,18

134:5,17 135:7 136:22 137:2,11,15, 22 138:1,2,23 139:4,14,15,24 140:3, 5,8,13,18 141:2,3,6,12,13,17,20,24 142:8,11 143:2,15 144:4,6,17 145:11 147:2,7,15,18,20,25 148:4,16 149:7, 8,12,20,22 150:3,6,9,10,18 151:2,6, 21,23 152:1,4,11 153:16,17 154:5,6 156:9,15,16,18,22 161:8,12,16,18 162:21 163:19,20 164:4,13,23 166:11 167:2,8,18 168:1,4,7,13,24 169:2,16, 18 170:4,7 171:4

exhibited 81:17

exhibits 8:12,16 10:14 80:19

exist 26:25 27:14,20,25 30:11 35:9, 13 38:7 143:4

exists 30:14 33:2,21 34:6 38:5

expect 38:11,23 143:7 145:21

expense 120:4 121:7 123:9

expensive 61:21 110:8,10,11

experience 43:8,14 44:25 46:13 50:17,20 51:7 90:24 92:20 93:4,17 94:15 101:5 117:6,18,19 130:14,16 136:9,21 155:20

experienced 19:3

experiment 31:11,12,22 67:2 72:13 88:7 124:11 158:15

experimental 126:11

experimentally 124:13 158:8,12

experimenting 95:21

experiments 86:8 123:25 124:4

expert 50:2

experts 12:25 31:3,10 66:6

explain 88:10 106:1 133:13,14

explained 42:5 43:20 44:4 45:5,17

explored 85:4

expose 63:14

exposed 57:14 145:15

expressing 109:16

extent 17:24 85:2

extra 165:1 166:4

extracted 63:18,19

extraneous 162:3,6

F		
F-U-R-N-A-C-E 55:16	figure 47:2 60:7,9,10,13,19,24 61:8 82:12 93:6 96:3 121:24 122:5,8,24 123:3,16,17,21 125:14,20,22 129:5 133:1,3,5,23 134:9,17 135:8 136:22 137:5 140:5,8 141:13,23 143:2 144:4, 5 145:10 147:2,6,9,25 148:1,4,5,10, 16,17 149:5,7,8,11,12,13,17,18,19 150:5,8,18,19 151:20,23 152:1,4,11 153:16,17 156:15,16,22	follow-up 133:17 164:20
face 151:17	figures 139:20 140:1 141:16 142:11	food-type 128:15
fact 23:18 24:3 46:20 62:7 66:23 82:9 83:11 84:5 112:6 129:18 134:9 149:5 150:5 155:13 164:2 167:22	file 156:8	forgiven 17:12
factor 95:10 96:21	filed 132:5,8,11 142:2,3 149:6,18	forgot 97:13 102:14 104:4 119:5
factors 82:24 83:1,3,16 85:8,11 95:3, 6	filing 132:8	forgotten 32:1 81:10 144:25
failed 57:19	final 19:24 20:14 164:4 166:5	form 11:16 17:1 19:7 20:22 27:14,20, 25 30:21,22 33:21 35:10 37:9,12 38:10 58:22,23 59:2 64:1 67:15 71:2 73:16,20 78:24 84:25 89:19 92:11 94:11 97:22 109:18 111:17,18 112:4, 20 113:4,15 116:12 118:1 120:14 121:20 123:13 125:3 126:9 128:25 129:11,13,24 130:10,18,21,22 142:5 144:23 150:21 151:9 153:25 156:25 158:21 166:25 167:16
failures 88:19	find 46:15 54:14 58:22 68:6 83:3,5 118:6 121:25 133:20,25 142:21 168:5	formal 21:2
fair 8:11 11:15 31:13 43:12 47:3 52:17 82:10,13 89:2 119:16 123:3 128:13 129:21,22 130:5 134:3 136:15 140:14 142:1 145:9 147:1 151:11 152:11 155:7 156:5 167:14	fine 8:5 138:22	formation 64:6
fairly 131:8 133:7,8	finish 59:3	formed 35:6 65:13 152:5,7
Fall 104:21	finished 166:1,22 167:14	forming 66:1 83:4,6 168:19 170:14, 17
familiar 12:22 25:14,23 26:20 28:15 46:22 48:9,14 56:11,25 59:11 63:8 86:7 94:9,19 108:18 109:22 114:14 144:20 152:17	finishing 20:17,20	forms 35:3 38:25 39:4 129:14
familiarity 83:24	fire 25:6,7	found 58:18 60:16 69:13,15 76:4,8
family 169:21	fireball 111:11	frame 44:16 48:3,8 49:22 53:11 92:24 93:2
fancy 134:13	fired 54:18 91:11 143:21	framework 66:2 71:22
fans 17:10	firm 4:11,14	free 10:10 11:22 140:24 161:21
fast 153:4	fix 119:14	frequent 87:14
favorable 127:18	fixed 29:18 123:25 124:9,16,25 126:6,12,20 127:1,6,15	friend 15:18 145:4,5 162:4
feasibility 135:12	flame 24:21,23,25 35:16,25 36:4,12 57:7 64:3 78:12 116:21 129:1,13 130:6 142:20 143:8,12,22 145:23 146:3,7,10	front 5:19 6:11,24 7:23 8:17,23 9:4, 10 41:7,19 61:12 71:6 72:23 79:13 112:7 134:4 137:18 139:4,25 142:9 161:11
feasible 123:19,22	floor 87:12	fuel 24:23 55:24 58:18,19 59:3,18 93:15 125:11 130:7
feature 154:14	flourine 32:7	fuels 25:4 50:18 51:8 96:9
Federal 1:23	flow 137:23 138:2 143:21	full 5:8 12:20,21 22:8,11 108:9 126:17
feed 75:12,16 78:11	flue 57:21,23 58:2,7 76:1	fuming 34:6
feedback 80:6	fluoride 26:13	fundamental 25:3 47:5
feel 10:10 11:22 140:24	flux 56:17	funded 49:1
fellow 15:20	fly 97:12	funny 103:5
felt 81:17 84:4	focus 24:24 45:15 68:13,17 69:5 70:22 71:9 73:10 93:1 95:10 96:16	furnace 55:5,15,21 56:5,8 109:9
field 31:3 50:3 63:12 92:19 95:16 157:10	focused 49:25 73:9	
fight 54:1	folks 97:13	
Fighting 17:6,7,9	follow 22:22 98:5 159:10	

G gain 53:7 gains 26:1,4 35:3 gaps 81:24 82:11 gas 24:1,2,12 36:14 38:5,12 39:3 57:13,21,23 58:2,7 63:13 76:2 79:23, 24 80:1,21,25 122:19,20,22,23 124:1 127:9 130:7 143:4 151:17 157:22 158:4,5,8,13,20 159:2,6,14 160:11,15 gases 144:13 153:11 gasification 63:12 gasoline 25:1 gave 62:24 77:12,13,14 117:5 166:4 geeky 42:12 general 23:9,11 55:2 61:4 67:18 68:21 69:7 152:13 generally 54:4 94:17,19 generate 63:15 generating 96:10 generation 14:6 genesis 103:1 geometry 59:19 George 102:18 106:6 119:6 Germany 50:18 51:4,6,24 52:5,8,20 53:2 gist 128:24 give 5:14 14:20 21:20 47:19 58:19 64:22 65:1 127:23 131:11 137:3 139:19 142:17 149:2 163:8 168:4 giving 5:16 46:7 glad 76:23 go-to 126:8 goal 67:18 68:21 69:7 88:1,4 gold 27:3 49:10 good 4:4,10 5:4 8:14 17:19 19:4 21:4 34:17 79:6 81:16,18 88:13 134:8 139:3 141:10 153:8 155:21 157:10 166:1 governing 4:7 graduate 24:9,11,12,24,25 grams 77:7,8	granted 146:6 graphics 69:19 great 4:20 5:25 7:14,23 9:4 53:16 139:18 group 32:3 guess 36:7 39:21 136:10 146:17 guideline 67:6 guidelines 79:7 guy 72:7 guys 81:17 H H-I-N-T-O-N 15:20 H-Y-D-R-O-X-Y-L 57:15 H2o 29:14 half 12:19 halide 110:6 111:9 halide-injected 111:14 hallway 17:3 halogen 31:24,25 32:9,11,14 77:11 110:6 111:8,14 halogens 32:3,7 132:1 136:8 hand 10:13 53:25 69:22 133:18 137:10 139:21 163:8 Handbook 46:4,5 handed 138:25 handing 8:12 hands-on 19:3 handy 167:4 happen 31:18 127:16 happening 96:2 hard 17:3 157:6 hardware 98:6 Harwood 2:4 HATHAWAY 1:3 Hatler 1:19 4:5 HBR 37:8,11,23 38:2,5,7,11,14,17, 20,23,25 46:6 129:14 130:23 131:5 149:15 154:7,10,13,14 155:1 157:21 158:4 159:1	HBR2 149:15,20 152:5,6 HCL 39:3 HCN 58:24 head 46:24 114:2,14 144:11 148:25 155:17 156:2 heads 142:8 heard 16:3 32:3,22,23 37:23 56:1 58:14 63:22,24,25 83:8 99:1 106:9 129:19 131:16 heat 55:14,17,18 56:15,17 heater 108:12 109:3 held 28:25 54:23 98:1 128:8 159:9 helping 106:20 helps 14:24 20:2 heterogenous 151:14,17,21,24 Hg 27:8 148:21 149:3 154:15 155:2 Hgbr2 29:25 30:2,5,7,9,18 141:21,23 150:3,6 Hgcl2 30:18 Hgo 30:15 146:19,21 high 14:4 47:16 52:8 96:8 97:3 101:11,14,16,19 high-sulfur 51:11,12 high-temperature 23:19 24:2 higher 13:14 52:1,13,18 54:8 117:3 highest 13:18,19 Hinton 15:20,21,23 16:1 hired 46:21 historically 109:9 hockey 17:11,16,18 83:12 hold 40:4 137:12 holds 47:15 Holmes 16:17,18,22 18:19 homogenous 151:14,17 152:2,4 honest 83:14 hood 34:12 hope 132:4 hot 96:14 hour 5:25 13:6 77:15 87:12 127:22 hour-by-hour 87:6
--	---	--

hourly 13:5 hours 13:17 22:12,21 house 93:8 human 52:15 81:17,18 hundreds 61:24 62:7 hybrid 22:24 Hydro 91:21 hydrobromic 38:25 hydrocarbon 25:3 hydrochloric 39:4 hydrogen 25:6,7,20 37:25 46:1 58:25 63:16 145:18 hydrohalide 38:2 hydroxyl 57:15 hydroxyls 58:2 hyphen 34:24 hypothetical 85:17 119:3,8 131:9 I i-d-e 26:10,12 ice 17:10,17 69:12,15 idea 66:24,25 70:1 ideally 42:24 93:5 identical 11:14 identify 48:10 72:14 Illinois 101:15 imagine 34:17 imbalance 53:4 impact 73:7 important 21:19 52:8 89:13 97:4 157:18 impressed 153:8 impressive 69:20 improves 106:17 107:13 inches 59:18 incident 118:5 incinerating 136:8 incineration 131:18 136:7	incinerators 131:18,21,25 include 27:3 66:6,11 83:1 included 164:17 including 12:16 70:6 161:4 inconsistent 123:5,12 increased 95:25 incredible 49:10 independent 13:23 72:14 86:9 108:1 115:18 INDEX 3:1 individual 55:14 individually 106:24 induce 101:6 induced 109:9 116:18 induces 116:18 industry 56:1 107:15,19 117:6 118:14 134:25 ineffective 53:20 infinitely 152:23 inform 67:8 information 20:25 47:2 49:7 75:11 85:3 94:10 103:24 132:2 informative 147:11 informed 66:15 ingredient 73:12,14 74:25 76:5 104:12,16 105:1 154:10,15 155:1 ingredients 53:20 115:6 153:5 inherently 64:1 101:19 initial 56:15 inject 35:25 78:11 111:8 144:14 injected 111:4,14 144:1,3 injecting 79:23 80:14,20 112:1 113:12 injection 76:9 79:23 80:10,14,19 93:22 94:3,8,14,15,19 99:1,4,18,22, 24 114:13 120:5,24 121:8,12 122:9, 11,14 123:1,10 125:2 126:7,20 injections 126:23 injectors 98:18 inlet 60:25 113:19 innovation 95:15	innovations 95:12 inquiry 70:3 inside 64:1 145:23 159:20,24 160:7 insight 19:4 inspecting 43:2 instance 1:17 169:8 Institute 48:24 instrument 87:10 instrumentation 158:16 integrated 93:13 intelligent 135:4 intend 41:22 58:23 intended 88:21 89:6,10,18 124:19 153:19 intent 39:13 intention 41:14 100:11 interaction 134:18 interchangeably 55:6,9 56:3 interested 24:21 25:5 124:17 interesting 24:22 143:19 157:13 internal 67:5 internet 47:1 interpret 49:9 125:7,23 interpretation 31:22 147:1 interpretations 31:2,7,10,18 intervals 87:14 intimately 153:3,6 introduce 7:19 141:17,19 introduced 98:15 106:7 introduces 141:21 invade 12:8 invent 66:21,22 invented 57:5 invention 47:22 48:1 66:13,18 67:9 68:4,9,20 69:7 85:19 89:10 92:17,23 112:3,19 113:3,14 169:23 inventions 65:9 89:18 inventor 67:19 73:25 116:9 162:14 inventor's 82:21,24,25 156:2
--	--	--

inventors 65:8 68:3,7 82:12 90:18 91:7 92:7 115:1,5,21 116:10 120:23 121:11 142:3 144:8 156:9 158:19,25 159:5,19,23 160:2,6,10,14 168:12 inventory 63:1,4 invest 109:7 investigate 82:11 87:15 89:8 90:17 investigated 108:25 109:5,8 investment 81:15 involved 72:5 82:5 136:6 154:7 iodine 32:18 ion 25:23 26:1,10 28:4,7,10,13 33:6 34:22,23 35:1,3 36:22,23 45:21 142:13 ionic 33:10 36:20 38:17 142:24 ions 35:20,23 36:4 150:10,14 151:3,7 158:13 IPR 4:22,24,25 5:1,2 7:9,15 170:8 IPR2025-00274 1:4 IPRS 161:18 162:22 164:4,5,13 issue 7:21 97:11 115:25 issues 21:17 43:7 107:23,25 108:9, 25 109:6 items 84:12 141:7	Justin 12:11 K K-E-R-N-A-L 116:21 K-E-R-N-E-L 55:23 Katherine 108:19 KBR 37:3 keeping 70:7 Kentucky 101:17 kernal 116:21 kernel 55:22,23 key 52:12 73:6 111:22 113:17 154:10,15 155:1 kilowatt 62:1,3 kilowatts 62:5 kind 8:6 12:8 13:20 15:12 84:23 85:9 93:2 94:10 106:1 111:22 138:9 kinds 54:5 kinetic 24:7 152:19,22 153:11,18 154:1 kinetics 24:13 knew 44:15 90:18 92:7 95:19 132:6 knowing 17:13 knowledge 45:9 46:8 75:20 84:4 94:11,12 101:20 118:8,10 L lab 43:2 70:6 72:7,20 83:13 88:11 label 7:3 60:10 137:2 labeled 6:14,25 8:16 143:1 lack 55:21 language 74:19 120:11 laptop 8:9 large 11:22 16:9 largely 11:14,19 107:10 lasted 127:15,17 late 93:23 98:10 102:17 106:6 launched 127:4 law 1:21 4:11,14	lawyer 64:16 83:20 lawyers 42:13 laying 123:14 lazy 57:23 Leading 162:23 learn 88:12 learned 88:20 93:21 94:13 98:8 leaves 114:11 leaving 143:21 left 50:13 121:3 128:11 140:4 147:9, 20,25 148:4,16 leftover 63:18 leg 38:7 legal 13:21 42:21 44:17 64:13,19,23 66:3,12 67:8 68:23 71:19,21 83:20 85:9 86:1 100:4 lengthy 19:14 lessons 88:20 letters 140:19,20 level 14:4 47:16 54:16 levels 46:12 77:4 101:11,14,16,19 Lewis 31:8,9 lexicon 132:2 life 16:7 72:5 156:24 lignite 51:24 52:1,3 54:4,12 96:9 146:5 lignites 54:7 96:10 limbations 154:2 limit 23:21 113:22 153:4 limitation 74:6 75:9,15 77:23,24 78:21 79:21 limitations 75:8 76:14 153:18 limited 152:18,19,22 153:1,2,10,12, 14 limiting 153:2 154:21 limits 54:16 93:25 liquid 34:7 56:18 list 83:1 95:2 LLP 2:3 location 98:20,22 113:23 115:23
J January 7:1 10:20 11:10 167:12,15 170:11,21,24 171:4 job 166:1 jog 145:2 John 16:13,21 17:5,10,11,24 18:10, 13,15,17,21 19:14 67:6 69:11,18 83:9 86:22,24,25 161:8 162:14 167:19,23 Joseph 5:10 jot 141:8 journals 65:15 Jr 5:10 judge 5:19 jump 109:20 June 49:14 Justice 13:22,25		

locations 115:23 117:25 log 75:24 logbook 65:15 67:7 70:7 87:17 89:12 90:22 91:4 logbooks 72:19 89:24 90:3 long 5:21 21:5 35:11 111:2 112:24 127:17 149:1 157:9 166:15 long-term 13:15 long-winded 72:18 longer 36:8,13 111:15 looked 18:3 21:8 51:7 72:19 78:13 83:22 87:8 89:11,24 102:7,22 118:3 124:13 144:22,24 loop 80:7 loses 26:2,7 lost 40:3 150:22 lot 21:19 22:10 46:21 51:7 52:11,12 53:15 54:9 91:18 95:25 102:6 106:15 114:11 118:15 135:14 146:8 lots 13:16 love 53:10 low 142:14 low-nox 101:5 108:3 lower 13:17 51:8,9,20 54:7 55:16 88:14,22 89:5 134:6 lower-end 52:2,3 lull 158:1 lunch 98:2,5 lung 34:18 M M-E-G-E-A 103:6 macerate 77:13 machine 1:21 made 24:23 70:5 95:12,15 158:23 main 154:6 maintained 80:1 make 21:9 25:12 32:20 72:10,12,16 74:5,9,12,14 75:4,6 86:10 87:8,15 88:11 100:5 123:16 128:13 169:15, 20,22	makes 27:23 78:13 157:11 making 33:15 146:5 manage 50:14 managing 50:6,9 72:5 mandate 125:7 manner 49:5 56:3 63:19,20 67:2 manual 75:23 80:9 map 71:11 73:3 75:4,6 MARCH 1:12,18 marked 137:11 139:24 mass 72:11 75:24 77:5 152:18 153:1, 9,17 material 6:8 51:9 65:17 69:11 77:13 78:10 84:3 98:12,19 105:18 126:1 163:4,6 materials 12:1 20:10 38:21 84:9 96:11 97:14 153:12 math 124:15 matrix 16:9 matter 13:3 14:8,18 16:4,23 22:9 37:14 146:6,7 Mcdermott 2:3 4:11 ME2C 9:16,17 10:1,5 12:12 14:8,17, 21 15:15 16:1,3,11,22 18:16 72:23 73:2 74:16 76:3,7 85:20,24 112:3 117:7 120:23 121:11 122:14 138:3 158:19,25 159:4,19,23 160:2,6,10,14 ME2C's 18:1,3 74:7,24 meaning 81:14 means 53:10 65:15 66:7,8,17 67:1,9 81:3 94:5 106:21 111:19 113:18 116:24 133:11,12 153:12 meant 32:5,6 86:14 104:11 114:15 118:11,12 measure 143:24 157:7,19 158:14 measured 73:8 76:1 101:21 102:4 159:19,23 measurement 75:10 158:23 measurements 72:13 86:10 90:7 157:5 measuring 75:19,22 Mebr 90:19 mechanical 19:5,11 22:25 23:2	92:18 136:20 mechanics 132:7 mechanism 31:19 129:15 133:10 143:25 144:9 148:6,18 155:23 157:9 mechanisms 148:22 mechanistic 107:1,12 134:10,13 135:7,16,19 141:12 142:4 152:13 mecuric 30:2 meet 12:9 124:14 meetings 12:4 16:9 meets 38:25 39:4 megawatt 61:25 Megea 103:6,12,14,16,19,23 104:1,8, 15,19 105:15,25 106:16,18 members 52:13 memory 11:17 108:23 112:22 145:3 146:4 mention 50:24 91:18 mentioned 11:25 22:23 44:23 52:4, 14 80:5 102:8 165:25 menu 125:8,12,13 mercury 27:3,5,6,10 29:22,24 30:9, 11,12,14,15,17,20,21 31:4,15,20 50:1,3 54:3 69:14,15,22 70:2,25 75:19,22 76:1,9 77:3 79:22 80:1,24 88:3,7,12,15,22,23 89:5 90:2,4,7,20 91:13 92:10 93:24,25 94:5 95:16,20, 23,25 96:14,18 97:6 102:13 104:3 105:1,8,16 106:10,20 107:13 120:2 121:5 123:7 125:5 126:14 131:6 133:14 134:11,18 135:12 146:21,24 147:3,9,13,15,18 148:7,19,20 149:1, 13 150:14 156:24 mercury-containing 79:24 80:21 158:4,8,12,20 159:1,6,14 160:11,15 message 53:9 104:5 met 16:19 72:3,20 metallic 27:5 method 58:17 112:15 Michael 16:18,22 18:19 84:1 86:22 mid 93:23 98:10 mid-1990s 98:9 Midway 82:18 Midwest 9:21
---	---	--

Mike 16:17 miles 17:15 millions 61:24 62:6,8 milliseconds 35:19 59:20 mind 46:15 69:8 83:19 100:22 119:19 144:8 154:9 mindset 43:10 44:10 117:14,17 130:13 minimum 53:1 minute 75:12 minutes 46:6 127:23 128:1,3 misdirected 132:24 missed 87:10 misspoke 147:14 165:4 misstates 71:2 113:15 mistakes 88:11 mitigate 104:3 106:20 116:23 118:12 mitigation 92:9 95:16 96:14 106:11 118:23 mix 19:8,9,11 22:24 55:24 57:22 mixed 24:23 58:18 152:23 153:6 mixing 63:22 153:2,4,7 model 133:5 134:10,13,16,23 135:1, 7,16,19 141:12 142:4 146:13 155:13 156:10,17,21,22 157:4 modeling 24:13 models 141:1 modify 116:15 modifying 117:8 module 93:10 molecular 33:24 34:16 37:15 59:2 molecule 28:16,18,21,24 29:7,10,13 33:3 34:2,4 37:18,20 38:18 Molecules 29:2 moment 94:23 99:10 128:20 137:21 monitor 47:16 79:22 91:1 monitored 80:24 monoxide 63:16 month 11:2 81:25 92:7 105:11 months 90:7 91:13 127:16	mood 17:19 morning 4:4,10 move 88:20 muffin 53:15 multidecade 84:15 multiple 62:18 multiply 62:4,5 municipal 94:4 mutual 15:18 N Nabr 73:18,21 92:8 Nacl 29:20 named 15:20 108:18 names 12:9 30:3 nanoseconds 35:18,19 nasty 58:24 national 63:1,4 nationally 54:16 natively 106:13 naturally 33:2 nature 27:1 30:11,14,17 33:21 35:9, 13,14 61:3 136:16 near-burner 108:2 109:8 116:20 necessarily 25:4 44:24 52:23 88:9 118:5,16 126:16 needed 45:7 47:2 52:9 53:1 58:12 82:9 85:6 negative 26:4,10 33:6 35:1 37:2 negatively 36:23 negotiable 143:24 144:13 neutral 29:2,4 30:7 33:1 34:4 neutrons 25:21 nice 32:1 niche 57:4 Nicole 1:19 4:5 Niksa 18:18 19:10 77:15 nitrogen 50:17,24 57:6,8,16 58:4,18, 21,22,23,25 59:2 116:25 117:3	nixing 56:18 nomenclature 149:25 noncarbon 96:11 97:10,14 nonprovisional 149:18,20 150:9,17 151:2 North 2:4 17:12 54:8 notation 32:20 noted 89:12 notes 8:6 notorious 52:15,16 noun 67:15 68:18 NOX 50:25 51:2 58:6,23 number 4:23,25 5:3 6:19 7:4 20:5 22:12 27:14 39:22 40:13 62:5 77:15 88:7 95:2 137:16,17 162:9 169:24,25 numbered 1:18 numbering 39:18 numbers 11:13,21 88:23 90:2 138:7 140:2,19,20 164:14 O O-F-F-E-N 102:18 object 11:16 17:1 19:7 20:22,24 35:10 37:9,12 68:22 71:2 84:25 89:19 92:11 97:22 109:18 111:17 112:4,20 113:4,15 116:12 118:1 120:14 121:20 123:13 125:3 126:9 130:18 142:5 150:21 151:9 153:25 156:25 158:21 166:25 167:6,16 Objection 42:20 44:17 78:24 85:25 144:23 162:23 165:14 objections 165:18 observant 69:9,21 observations 72:8 observed 157:10 observing 73:7 occupy 54:2 154:12 occurs 31:4 156:23 octagon 138:9,12 141:18 odd 27:14 Offen 102:18 offering 163:15
--	--	--

office 1:1 12:18 Offices 1:21 older 18:22 58:9 Olson 16:17,19 Olympics 17:20 Ontario 91:20 open 114:4 127:2 139:14,15 141:6 164:22 165:5 169:3,8,19 opened 169:14 operate 8:10 125:11 operating 66:3 127:18 operation 92:21 operators 96:17 110:15 opinion 65:13 71:22 78:10 83:8 100:15 118:8 134:24 143:20 148:9 149:2 157:8,12 opinions 64:23 78:16 81:5 83:6 129:10 132:11 135:5 162:17 168:19 170:14,17 opportunity 114:12 opposed 113:14 opposite 153:1 option 124:22 125:1 options 80:13 123:14,21 125:12,13 Oral 1:10,15 ordinary 13:11 43:15 85:16 92:14 orient 137:21 original 117:10,23 134:4 Otto 23:23 output 91:2,3,8 outputs 91:5 overfire 58:14,16,17 59:5,6,8 owner 1:7 2:6 4:15 9:23 oxidation 134:11 oxide 26:18 58:4 61:19 oxides 50:17,24 57:6,8,16 58:18 116:25 117:3 oxidize 95:20 120:1 oxidized 30:9,12,17,21 51:23 69:16 95:23 120:2 121:5 123:7 147:3,9,18 148:7,19 149:9,13	oxygen 58:22 63:15 P P.C. 1:22 2:8 p.m. 1:19 98:1 128:8 159:9 171:16 Pacificorp 4:12 pages 40:3 166:15 paper 8:4 47:11 60:16 91:2 108:12, 15,22 124:22 127:3 163:14 papers 31:1,6,7,17 124:12 paragraph 11:21 19:17 20:3,5,6 42:4 43:18 45:3,8,16 46:11,19 47:8, 21 48:4,10,15,18,20 50:5 54:25 60:10,14 64:8 65:4 68:2 81:11 82:15 83:17 85:13 92:15 94:21,22,24 95:2,8 96:23 99:7,11,14 100:25 101:1,3 109:20 113:8,18 119:18,21 121:4,18 123:6 127:20 128:10,21,24 129:10 132:11,16,21,23 148:9 163:22 168:6, 24 169:17,18 paragraphs 10:24 11:6,13,20 41:3, 12 43:22 44:1,4,9 45:5 47:4 parallel 107:10 parameters 72:15,16 pardon 14:12 24:16 68:6 81:21 132:24 parse 137:7 parsing 137:5 part 30:18 33:10 37:20 45:19 46:13 70:2 80:13 93:25 112:2,18 113:2 115:7,8 116:3 135:9 partially 63:14 particle 56:16,17 particulate 93:8 114:3 partner 142:21 partnered 143:6 parts 101:10 109:4 party 101:22 102:12 pass 160:21 164:19,25 171:10 password 161:13 patent 1:1,2,5,7 2:6 4:15,23,25 5:1,3 8:18,20,23 9:1,4,7,10,13,23 10:9,24 11:6,12,21 42:12 66:24 71:12 73:4 74:2,7,16,23 76:19 77:23 78:21 79:13	85:20 103:25 104:6,7 105:18,19,20, 22 107:11 112:7,9 114:6,9 115:15,25 117:24 118:4,5,22 119:9,13 120:8 129:5 132:5,7,9,14,16 142:9 153:23 154:5 155:10,14,18,20 156:5,7 164:14 165:11 167:3 168:8 169:24,25 170:7 patented 99:16 patents 7:19,21,23 10:1,4,5,6,18,21 11:2 16:16 18:1,4 41:11 65:9 68:4,8 71:6 72:23 73:2,25 74:2,7,24 76:18 85:24 86:2 112:3 117:8 120:11 137:23 138:3 154:3,17 155:4 163:25 164:3 165:23 166:12 167:9,24 168:20 169:3,4 170:5 171:4 patience 5:7 patient 160:20 Pavlich 73:17 Pavlish 16:13,21 18:10,13,16,17,21 19:14,25 67:6 69:11 83:9 86:25 87:17 88:6 89:9,16 90:18 91:12 109:12,16 112:16,25 161:8 162:15 164:17 166:8,12 167:19 168:21 170:10 Pavlish's 19:1 21:6,15 65:16 88:2,22 113:14 162:21 163:7 166:17 167:23 168:2 170:23 Pearl 1:22 2:8 pentoxide 53:21 people 16:11 17:13 18:16 31:19 34:15 46:21 53:16 62:15 66:21 95:21 96:19 97:10,18 109:7 118:6,15,16,20 124:6 125:7,8 126:2 131:10 133:13 136:6 157:18 percent 62:12,17,24 63:5 76:24 90:20 170:18 percentage 62:10 performance 57:20 performing 66:17 period 127:17 periodic 31:25 periods 35:11,17,18 82:3 Perry's 46:5 person 42:9,16,18,23 43:11,15,19,24 44:3,8,13,22,23 45:4,6,10,16 47:5 48:8,13 85:16,17 92:14 93:16 95:4,7 100:21 102:8 117:18,21 126:4,18 130:15,20 131:4 136:12,14 155:3,7 158:15
--	---	---

personally 86:17 103:12 perspective 43:5,7 157:14 pertain 14:4 petitioner 1:17 2:2 4:12 Petitioners 1:4 petitions 164:23 Ph.d. 1:11,16 3:5 49:21 phase 24:13 36:14 39:3 57:13 58:2,7 143:4 physical 72:11 106:21 physically 53:14,18 physics 42:25 picked 100:25 picture 16:15 40:6 88:4 piece 27:13 71:10 99:21 100:1,3 131:7 pieces 76:11 140:3 pilot 50:6,10,14 72:5 87:1 pinpoint 92:4 pipes 61:6,7 place 14:24 54:13 56:16 104:20 130:12 142:12 143:7 places 115:2,7,12 116:1,10 plan 67:19 68:21 69:8 planning 69:20 plant 13:16 56:5 60:4 61:5,14,22 62:4,14,21 72:6 86:12 92:20 93:13,14 96:17 108:10 109:5 110:15 117:25 123:1,2 124:8 126:17 plants 16:8 43:2 49:8 50:7,10,14 60:20 62:10,18,25 63:3 95:16 110:19, 23 125:8 plasma 35:12 platinum 49:10 plausible 134:20,21 136:25 157:9 play 17:16 playing 128:13 pneumatic 99:23 pneumatically 98:16,17 point 11:9 36:13 45:25 46:6 57:13 77:18 88:18 89:13 91:5 111:4 144:12 145:9	pointing 114:5 141:8 161:25 162:6 points 48:5,10,15 poison 51:16 52:15,16 53:12,24 54:2 political 26:21 politics 53:10 54:16 pollution 92:21 93:1,3,12 pool 49:2 popular 25:7 pore 53:15,19 pores 53:16 posed 144:7 POSITA 42:5,9 47:22 59:5 92:17 93:3 94:14,18 119:25 135:17,20,24 154:18 positive 26:7 170:18 positively 36:22 possibility 116:5 possibly 108:17 115:23 116:22 post-combustion 99:17,22 113:18, 20,24 114:13,20 potassium 33:10 37:3,5 potential 120:4 121:7 123:9 pounds 77:14 Powder 51:13 powdered 110:8,20,23 111:3,5 112:17 113:2 114:21 power 13:16,23 14:5 16:8 43:2 48:24 49:3,8 56:5 60:4 61:14,22 62:4,10,13, 14,18,21,25 63:2 86:12 92:20 93:11, 13,14 94:6 95:16 96:17 98:19 109:4 110:15,19,22 124:8 125:8 126:17 powerful 127:14 practical 44:25 124:13 practice 21:4 48:14 65:10,14 66:8 68:9,14 70:15,19 71:15,23 72:2,22 73:3,4 74:6,10,15 75:5,7 76:4,8,15 77:25 78:22 81:3,17,18 83:4,7,18 87:24 111:3 161:4 168:11 169:23 pre-combustion 114:19 precipitator 93:9 113:20 precise 5:21 precombustion 99:16	predictable 136:5,12 preheater 108:4,6,16 preparation 93:15 prepare 6:5 12:9 prepared 21:16 preparing 11:25 12:15 18:8 presence 69:16 85:5 157:22 158:20 159:1,6,13,20,23 160:2,6,10,14 presentation 102:16 106:5,16,18 107:7,10 presented 77:1 84:3 87:18 97:14 103:24 104:6,24 105:8,15 152:7 presents 80:13 president 119:5 presume 12:4 presumed 85:17 87:11 pretended 72:19 pretty 9:22 12:22 17:19 22:8 23:20 46:16 47:5,13 52:3 79:6 prevented 96:1 previous 40:9 60:6 73:23 143:2 primary 56:11,14,21,22 57:10 59:16, 17,21,23 60:2 61:5 116:17 print 39:22 prior 72:7 74:21 106:9 131:21 145:5 privilege 12:8 privileged 20:25 probe 68:5 problem 69:22 problems 49:6 51:17 109:13 120:4 121:7 123:9 Procedure 1:24 proceeding 21:3 proceedings 4:18,21 165:12 171:16 proceeds 152:24 process 43:1 46:23 55:25 56:20 64:5 72:11 73:9 75:20 86:11 91:20 92:8 93:5 98:25 99:3,23 100:20 106:19 111:22 115:22,23 116:11 117:1 129:15,23 131:15,17 143:15,21 145:21 146:6,8,24 150:18 155:18 processes 24:14,15,17
---	--	---

produced 1:16 producer 13:23 products 57:23 professionally 16:24 program 50:20 142:25 progress 96:12 project 82:1 promoted 110:5 111:9 promoter 77:11 promotes 133:14 prompting 151:18 proofread 21:1 proper 32:21 130:13 proportions 29:18 proposal 105:8 proposed 133:9 proprietary 94:10 Protection 103:10 protons 25:19 proven 134:21,24 proves 67:2 provide 47:4 48:4,15 57:19 75:11 provided 81:5 95:7 provision 125:14 provisional 122:6,8,25 125:22 132:14,20 133:19,21,22 136:19 139:5,8,10 140:5 141:13 142:2 144:10 148:1,5,17 149:7,18 150:11, 19,23 151:6 156:8,11 PTAB 79:7 165:17 public 13:22 46:8 90:13 94:11,12 publication 60:16 69:13 137:16 publications 135:3 pull 158:15 161:11 171:1 purporting 146:23 purpose 49:2 50:19 61:14 82:4,7 88:21 89:6,10,18 126:21 purposes 106:10 pursuant 1:23 4:7 pursue 67:19 90:21	pursued 72:4 push 118:20 put 7:23 10:15 22:10 30:3 35:24 43:10 51:10 53:8 60:18 62:5 84:21 93:12 117:14,17 127:8 135:14 139:7, 20 142:9 143:11 144:9 148:24 putting 44:10 75:21 84:16 105:8 114:2 144:10 153:15 puzzled 107:2,4 pyrolysis 63:9,11,20,23 64:1,5 Q QA/QC 87:10 qualifications 95:3 qualify 41:24 qualifying 10:8 quality 87:13 quandary 121:3 quantitative 133:10 quarter 23:6 quarterly 87:20,22 90:5 question 5:22 45:13 60:5 70:10 71:24 72:1 73:23 78:17,19 81:23 87:11,21 109:3 112:23 117:10,24 118:22 120:19 124:5,23 127:3 128:6 130:2 131:9 144:7,16 147:24 148:11, 14 149:4,16 150:25 153:20 154:24 155:6 156:14 157:16 160:19 161:6 165:20 questions 5:22 12:7 41:21 92:1 94:23 99:11 128:21 133:17 134:3 140:25 159:11,13 161:1,3 164:21 167:7 171:11 quick 126:14 quickly 153:14 quote 94:3 R radiation 55:19 radical 26:21 27:13 radicals 57:15,16 Ramsay 49:16	ran 16:10,12 86:21,25 87:4 136:8 rank 54:11 Rankine 23:23 rapidity 95:11,15 rarely 130:11 rate 13:5,7,11,18 51:16 75:24 76:9 79:23 80:10,14,20 152:24,25 153:6 154:1,20,21 ratio 77:9 raw 38:20 RCOCHRANE@CALDWELLCC.COM 2:10 re-ask 150:24 react 59:1 142:22 143:16,17 153:14 reactants 153:3 reaction 31:14,19 129:15 133:5 134:16,22 148:6,18 151:14,19,21,24 152:2,5,7,19,22,24 153:4,6,10,12,21 155:13 156:10,17,21,22 reactions 58:13,20 134:10 135:25 136:16 142:12 150:10,20 154:7,15 155:2 reactivated 129:14,24 reactive 27:23 reactors 95:19 reacts 131:5 read 30:23 31:1,6,7 70:4 78:8 91:4 94:23 99:10 100:17 112:13,21 115:18 120:20 128:20 133:13 136:24 144:17 163:22 166:5 169:17 reading 43:1 67:6 68:7 84:2,14 120:20 123:3 real 61:5 145:21 156:23 realize 132:4 realized 163:10 reason 5:13 24:20 88:13 91:14,15 102:21 120:3 121:6 123:8 127:10 158:18,23,24 159:4 reasons 69:14 rebuilt 118:17 reburn 56:25 57:3,4,11,18,21 58:1,6, 9,10 recall 16:11 19:15 20:1,3,13,15,18 21:5,23 24:8 87:19 90:2,10 103:16
---	---	--

104:8,14,18,19 105:4,11,14 106:3 108:7 109:15,19 111:1 159:14,16 161:2 receive 8:6 received 170:21 recently 18:25 recess 54:23 98:1 128:8 159:9 recite 117:24 recited 114:23 recognize 114:13 138:15,24 162:10 163:19 recollection 103:21 108:11 110:10 163:4 reconcile 121:17 reconciliation 121:22 reconciling 113:6 record 4:17,21 5:9 76:19 97:24 161:25 162:7 169:18 records 70:7 recross 160:22 reddish-brown 34:7 redirect 161:1 167:7 reduce 57:8,16 58:5 66:7 reduced 65:10,14 68:9 72:21 reducing 70:19 reduction 50:16,21 68:14 70:14 71:14,23 72:2 73:2,4 74:6,9,15 75:4,7 76:4,8,15,25 77:25 78:22 81:3 83:4,6, 17 87:24 93:10 161:4 168:10 169:23 refer 6:19 7:24 8:20 9:1,7,25 10:4 33:7,9 37:25 40:20 41:18 140:2,21 reference 6:8 9:16 11:22 45:7 60:17 141:6 145:11 150:6 167:19 168:2,23 referenced 15:18,19 referencing 11:19 68:11 99:2 167:22 referred 28:12,13 33:24 63:20 93:18 99:1 referring 7:11,14 24:19 43:21 73:12 92:23 97:7 125:14 143:1 144:18 161:17 164:2 refers 33:1,5 refine 90:11	reflected 65:16 refresh 112:22 146:4 163:3 region 55:16 108:3 109:8 116:20 regular 110:8 relate 109:11 related 92:19 relates 72:10 relative 85:18 release 56:15 released 90:13 155:19 relevance 42:18 relevant 44:14 83:3,6 85:19,20,23 86:15 107:5 130:2,11 reliable 47:13 49:7 73:9 relied 166:9 rely 20:11 remainder 42:6 43:20 remediate 70:2 remediation 69:23 107:13 remember 18:19,20 21:18 32:17 33:16 60:15 75:14 91:19 102:5,16,23, 24 106:25 107:1,2 143:18 161:6 166:10 remind 39:16 reminding 17:5 remissions 95:25 removal 77:3 90:20 93:8,24 remove 61:15,16 88:3,22 105:1,8 render 53:20 rendered 162:17 repeat 10:3 59:25 68:25 109:7 112:23 135:18 147:5 148:13 165:19 replace 118:17 report 20:3 77:3 84:24 87:7,23 90:6, 14 91:6 reported 1:20 4:7 77:5 90:7,12,16 94:3 reporter 4:4,5 10:14 74:11 101:23 110:21 122:21 141:7 171:13 Reporter's 3:10 reports 77:1,2 84:14 87:20 109:16	represent 120:10 140:18 146:15 representative 60:20,22 reputation 84:15 requests 74:11 required 57:20 75:11,16 91:22 research 48:24,25 67:19 68:21 69:7 81:22 88:2 89:6 126:22 researcher 108:18 researchers 96:18 108:5 reset 40:10 residence 58:12 residual 63:17 144:2 resolution 21:20 resources 49:3 respirator 34:12 responding 78:17 response 76:9 79:22 80:24 responsibilities 50:6 resulting 134:10 results 34:17 65:20 87:9 88:18 90:4, 12 129:3 143:20 retained 14:7,17,21 15:3,9,11 16:3, 23 18:11 22:5,13,14,16 59:17 77:4 97:11 reveal 20:25 review 18:20 19:24 161:8 162:25 164:8,11,12 167:15 reviewed 6:7,8 12:1 17:25 18:15,17, 19 20:13 65:15 87:13 162:16,20 163:4 164:16 166:20 167:20 168:17, 20 170:13,16 reviewing 21:5 31:17 69:11 84:8 167:24 Richard 2:7 4:13 8:13 12:11 79:5 137:12 rig 75:22 82:3,6,9 86:4 right-hand 134:6 River 51:13 road 108:11 role 49:23 84:22 109:11 141:19 room 34:6 38:5,8,10,12
--	--	--

root 78:11 roots 83:11 rough 171:13 roughly 11:1 routine 99:4 routinely 101:20 102:3 row 32:1,2,5 102:13,24 138:8 140:2 rule 124:15 rules 1:23 4:7 run 69:21 142:24 running 50:12 S S-I-O-U-X 17:6 sake 40:19 salt 35:6,20,24 36:3,7,8,12,13 salts 35:23 saturated 145:17,18 saved 24:9 scale 49:5 126:18 scan 76:17 scenario 143:14 schematic 147:20 scheme 75:20 80:6,14 school 17:15 24:9,11,12,24,25 Schulte 2:3 4:11 science 31:14,16 157:5 scientific 96:15 134:13 scientists 135:4 scope 144:23 167:7 Scott 15:20,21 SCR 50:22 screen 162:3 169:3 scrub 53:5 62:15 scrubber 52:18,22 53:1 54:18 61:9, 11,14,22 62:8 93:7,18 120:3,25 121:6,13 122:12,15,23 123:2,8 125:5 scrubbers 52:9,11 53:9 62:1,11 63:5 95:17,22	scrubbing 53:5 search 38:9 47:17 66:24 searching 60:17 season 104:19 seawater 69:17 70:25 secondary 59:12,14,19,23 60:2 61:2,6 116:17 section 39:14 40:7 42:6 43:20,21 64:12,20 66:7 sector 118:14 selecting 110:16 selection 123:15 selective 50:16,21 93:9 self-employed 15:24 semester 23:6,7 semesters 23:9,11,14 sense 26:22 66:23 78:14 87:8 sentence 64:15 65:5,6 68:7,11 82:23 92:16 99:13 113:12 114:1 119:23 separate 61:6,7 66:19 68:14 70:13 71:16 72:15 86:8 101:7 103:7 116:10 separated 59:18 separately 90:5 September 89:21 series 58:20 98:18 session 102:17 set 54:17 57:7 58:20 settled 31:13,16 70:1 setups 58:9 share 83:8 Sharon 127:4 sheet 143:21 shell 27:21 Shocking 53:12 short 35:17,18 48:25 65:23 short-term 89:7 110:25 shorter 45:13 shorthand 1:21 4:5 Shostrom 126:11	show 77:1 81:7 146:23 149:20 152:1, 4 showed 72:22 showing 122:5 149:1 shown 71:23 84:5 93:6 123:1 134:17 135:7 136:23 140:4,7 141:12 142:11 143:15 147:25 148:4,16 149:8 shows 67:3 77:25 81:11 151:21,23 SIC 66:22 side 73:2,3 signature 163:7,20 170:25 signed 6:16,20,25 7:8 10:17,20 15:1, 7,12 19:20 20:19 21:7 22:14 165:10, 22 166:2,8,12,21 167:12 170:10 171:3 significant 117:23 119:12,13 silly 103:8 similar 45:20 83:25 90:24 111:4 121:3 129:3 135:11 156:14 Similarly 28:9 simple 33:19 126:22 155:22 simpler 142:9 simplify 153:9 simply 70:4 103:6 152:25 simulated 160:2,6,10,14 single 25:17 115:19 Sioux 17:6,7,9 sir 5:7 6:5 14:7 54:24 161:14 sit 32:1 35:21 site 54:2 125:11 129:5 144:18 145:12 147:12 sites 145:14,22 150:14 151:4,8 sitting 46:1 89:15 102:13,24 146:9 160:25 size 127:13 skill 42:10,18 43:11,15,19,24 44:3,8, 14,24 45:4,6,10,16 47:6 48:8,13 85:16 92:14 93:16 95:4,7 117:21 126:4,18 130:15,21 131:4 136:12 155:3,7 skim 21:13 skimmed 21:11
---	---	--

skip 119:21 slowed 153:6 small 118:14 138:7 snow 69:12,15 70:25 SO2 51:22 52:9 53:7,24,25 54:16 61:9,12,19 93:7 SO3 51:23 53:25 SO42- 150:10 socially 16:25 sodium 73:15,18 74:20 75:25 77:5,9, 17 solid 35:20,23,24 36:3,7,8,12,13 38:7 solution 36:5,8 70:1 solve 96:19 109:13 solving 49:6 someplace 60:18 91:4 sooner 91:17 sophistication 96:21 97:1 sorbent 30:21 75:11 76:8 79:24 80:10,15,20,23 94:3 96:4 97:3,7,8,15, 20,21 110:5,20,24 111:9,15,16 112:2, 18 113:2 115:9 122:9,11,14 123:1,24 124:1,2,9 125:1,23 126:24 127:6,14 sorbents 96:7,9,10,11 97:1,9,10 sort 55:21 135:12 sound 58:24 114:14 sounds 134:20 source 47:13 49:7 52:18 60:13 65:17 133:16 134:4 SOX 51:18,20 61:15,17 space 82:5 98:20 114:11 154:12 spans 41:3,12 speak 18:13 82:5 speaking 40:1 speaks 78:25 79:7 species 58:23,25 135:23 136:4,11 144:21 159:13 specific 12:7 16:11 48:1 70:1 74:18, 19 83:16 89:8,16 90:17 92:7 103:2 114:10 140:2,21,25 141:7 144:16 154:25 specifically 12:8 56:8 145:25	162:20 specifics 111:7 156:10 specter 131:10 spectrum 133:4 speculating 155:24 speculative 136:17 spent 12:15 16:7 21:5 22:13 78:7 118:15 spoke 116:16 spoken 18:10 spray 93:17 square 128:13 stable 27:1 35:22 stack 93:12 123:24 staff 83:25 86:4,18,20 staffing 86:9 stand 70:8 standard 49:11 64:19 66:12 71:19, 20 72:1,21 83:20 standards 64:13,24 66:3 70:5 standpoint 107:13 Stanford 49:21 start 11:8 22:2 33:17 95:18 141:10 started 22:6 50:11 155:22 starting 10:23 11:9 40:24 41:2 147:22 starts 20:8 56:17,18 65:5 82:18 119:23 starve 63:15 state 1:20 4:8 5:8 26:1 27:1 42:4 43:18 44:8 45:3,16 50:5 54:10 65:8 69:16 82:23 85:19 92:22 95:24 99:14 121:5,17 168:10 statement 65:21 66:9,12 72:10 82:13 114:4 126:16 129:8 130:5 states 1:1 51:5 52:5,22 57:17 62:11 92:16 station 93:11 98:19 stations 94:6 stay 62:17 stenographically 4:6	step 7:19 59:15 68:17 69:5 71:17 74:24 147:23 153:2 stepping 26:24 steps 68:15 70:14 118:12 154:21 sticks 146:24 stopped 103:15 story 48:25 82:21 straight 83:14 133:16 strategy 57:6 92:10 stream 59:12,14,23,24 60:2,3 Street 1:22 2:4,8 strike 82:8 163:5 strong 136:21 struck 69:10 structural 38:10 structure 24:21 25:1 130:6 struggle 137:7 studied 21:11 studying 24:25 stuff 128:15 130:10 131:19 169:21 subcategory 37:8,11 subject 160:22 submitted 7:9,15,18,21 10:23 11:1 22:17 42:19 subsequent 100:25 101:1 subset 55:21 substance 29:17 substitute 97:15 success 89:1,14 94:3 successful 92:9 124:24 126:13 sufficient 118:20 suffix 26:11 suggest 104:2 suggested 69:13 suggesting 113:12 154:6 Suite 1:22 2:4,8 sulfate 150:10,13,20 151:3,7 Sulfide 26:13 sulfur 51:8,17,21,23 52:4,13,17,21,
---	---	--

25 54:4,7,9,11 61:16,17,19 101:16 141:18,19 summer 104:21,22,23,24 105:9,12, 13,25 131:14,16 superscript 27:8 34:24 148:21 supplier 110:1 support 72:16 132:10 supports 78:22 surface 30:24 54:1 96:8 97:3,4,5 151:18 153:11,13 157:5 surprise 22:1 102:21 surprised 106:4 135:4 suspect 108:1 145:17 swapped 11:12 sworn 1:17 4:2 5:16 symbol 27:8 37:3 symposium 16:9 102:14 system 23:6 75:23 78:7 91:1 93:8 98:15 110:6 111:5 115:1,5 120:24 T table 31:25 35:21 tables 47:14 taint 97:16 takes 21:9 23:5,8 56:15 Taking 89:7 talk 34:20,21 48:23 69:18 71:14 88:20 95:11 98:6 99:21 102:20 111:20 138:23 142:10 talked 10:14 31:8 62:14 70:24 78:4 talking 23:24 48:2 90:22 105:19 130:15 131:9 138:19 142:12 161:16 164:5 target 58:4 task 13:7 taught 100:6,12,19 teach 117:13 teaches 117:13 teaching 100:22,24 team 17:13 83:12	tech 80:10 technical 16:9 19:1 21:17 22:1 39:8 41:11 42:24 49:6 60:16 technicians 87:1,5 91:11 techniques 135:13 technologies 50:1 technology 14:4,5,6 16:8 19:4 39:13 41:2,14,22 42:5 43:6,20,25 44:4 45:5, 17 47:3 50:16,18 51:11 57:4,18 84:20,21 92:19 96:22 tells 119:14 temperature 34:6 38:5,8,10,12 111:21 129:2 142:12,14,18 temperatures 142:16 158:2 tend 54:7 term 9:16 26:21 29:4 32:23 46:11,18 55:5 56:2,11 58:14 63:8 67:20 100:11 145:6,7 terminology 25:13 39:7 terms 25:1,3 26:16 32:21 55:8 61:25 69:20 81:15 93:14 95:17 124:13 125:10 126:4,23 130:4 132:3 158:16 test 70:8 75:22 82:3,6,9 86:3,4 87:1,4 88:8,18,22 89:2,4,5 90:8 91:10 143:23 tested 86:6 107:22 108:9 158:19,25 159:5 testified 4:3 80:18 91:12,16 testifying 5:19 testimony 5:14,17 18:15 71:3 79:7 82:25 113:16 168:11 tests 50:6,9,14,15 65:19 72:6 86:5 89:20 91:8 110:25 Texas 1:20,23 4:5,8 54:6 text 46:25 textbooks 45:7 themselves 66:22 theory 24:7 thereof 79:25 thermal 55:19 thermodynamic 23:25 thermodynamics 23:18,19,22,23 24:1,2,3,8	thesis 105:17 thing 24:22 33:7 87:7 94:2 149:25 things 21:1 23:22 43:2 46:14 66:21, 22 79:7 88:12 123:17,19 124:6 125:7 130:7 137:2 139:11,12 140:21 145:19 157:6,15 thinking 63:1,4 84:7,10,14 102:24 103:2 108:15 118:24 124:18,22 131:19,20 132:3 148:25 thought 24:21 25:5,6 28:24 67:3,24 69:20 70:7,8 72:21 78:13 83:23 84:16 85:3,4 112:17 113:1 117:22 129:20 134:3 143:19 148:25 three-quarter 12:21 three-quarters 53:6 tie 53:19 tied 148:22 time 12:14,18 13:2 14:24 15:9 16:10 17:25 18:3 21:20 22:5,6,10,13,14 25:9 35:11,17 36:13 44:15 47:22 48:1,3,8 49:22 58:12 72:8 82:7 85:18 87:16 91:22 92:17,22,24 93:2,21 96:13 98:21 107:6 108:8 109:5 114:11 118:15 121:11 127:17 129:20 130:8 131:15 135:6 148:15 155:5 160:21 166:4 times 36:3 44:20 62:4 89:11 title 24:4 39:21 titlewave 99:15 Tobin 2:3 4:9,11,16,20 5:6 8:13,15, 16 10:13,17 11:19 17:4 19:10 21:4 35:12 37:11,14 40:1,4 43:4 44:21 54:24 69:3 71:4 74:12 79:4,11,12 84:25 85:8 86:14 89:22 92:13 97:24 98:2,4 102:2 109:20 110:22 111:23 112:6,25 113:6 114:5 117:5 118:9 120:18 121:23 122:24 123:21 125:9 126:17 127:23 128:2,5,9,18,20 130:20 137:12,15 142:10 145:1 148:11,13 150:24 151:11 154:4 157:2 158:24 159:8,10 160:20 161:2,15,19, 22,24 162:23 163:13 164:20,22 165:2,4,16,19 167:1,8,18 169:15 171:10 TOBIN.....5 3:6 today 5:14 6:6 7:11 9:15 11:25 44:9 46:1 89:15 117:15 124:18 146:9 160:21,25 today's 126:25 127:5
---	--	---

told 66:19 145:1,4 tons 77:13,14 top 46:15,23 138:8 topic 96:14 101:25 topics 98:5 totally 138:21 toxic 34:9 38:23 trace 51:14 track 40:3 trade 53:3 TRADEMARK 1:1 tradeoff 127:18 training 46:13 transfer 152:18 153:1,10,17 transferred 91:6 transport 98:17 transported 98:17 trial 1:2 18:15 161:21 trick 120:19 trioxide 51:23 true 99:14 135:2 truth 156:23 truthful 5:18 tubing 118:17 turn 29:16 47:8 48:18 54:24 60:6 63:13 79:15 82:15 85:13 99:7 112:9 113:8 119:18 127:20 132:23,25 141:5 146:13,18 149:5 167:1 168:6 170:4 turned 124:14 turning 27:13 149:7,11 tutelage 83:13 two-part 92:8 100:20 TX 2:4,9 type 31:22 37:17 46:22 61:17 93:7 110:2 125:18 131:10 typically 28:24 40:20 62:2 106:13 108:2 typing 22:7	U U.S 1:5 U.S. 50:16,20 51:15 63:3 102:16 107:3 169:23 U.S.A. 17:13 unaware 64:3 unburned 143:22 144:6 146:1 uncharged 29:5 33:1 34:4 undergraduate 17:15 23:13,17,20 24:5 underneath 39:18 understand 5:16,22 7:20,22 8:21 9:2,8,13,22 10:2,7 15:11 19:1 42:9 43:14 44:13 45:11 47:20 48:12 66:1 68:13 70:16 71:16 72:9 82:6,23 86:10,11 115:17 117:11,12 130:17,19 136:22 138:19 151:13 understanding 42:17 66:16 81:2 100:6,10 understood 21:10 46:22 79:10 97:3 118:13 142:7 undertake 120:4 121:6 123:8 UNEC 17:14 uniformally 152:23 unit 25:17 28:19 United 1:1 51:5 52:5,22 57:17 62:11 units 52:11 53:5,8 62:18,22,25 University 17:12 unpaired 27:18 145:2 unproven 136:17 unquote 94:3 unsaturated 144:18 145:12,14,22 unsuccessful 88:8 unusual 102:25 106:8 upstream 59:22 60:1 115:3,7 116:2 utilities 49:2 53:3 utility 53:4 utilized 82:4	V V-O-S-T-E-E-N 102:1,9 V2o5 53:23 valence 27:15,21 valid 65:21 70:9 78:9 84:6,9 vanadium 53:21 variable 86:8,9 variables 65:20 varies 54:6 vary 52:7 54:13 72:14 vein 100:16 Venn 33:15 vent 34:12 verb 67:13 verified 65:24 version 20:14 163:16 versions 137:4 versus 13:22 78:5 87:1 100:13,14 110:16 126:6 154:1 157:21 158:4 vertical 32:1 view 78:4 84:22 89:7 113:24 viewed 113:25 viewing 43:6 virtually 21:8 VNO5 53:22 Vosteen 101:21,25 102:9,11 103:19, 22 104:1,9,14,18,24 105:4,7,15,22 106:1,9 129:19 Vosteen's 106:4,16,18 W wait 75:12 walls 116:19,22 wan 159:10 wanted 58:13,20 85:15 97:5 98:4 140:11 Washington 102:14 103:17 waste 94:4 136:6
---	---	--

water 35:7,24 38:25 39:4**ways** 67:1 116:24**weak** 57:7**website** 165:17**week** 14:9,22 15:6 87:7**weekends** 22:9**weeks** 18:22**weigh** 53:7**well-known** 51:13 135:23 136:1**wet** 93:7 95:22**whichever** 11:22**wide** 138:9**wife** 47:20**windows** 162:6**Winter** 104:21**withdrawn** 29:23 34:22 56:21 67:12
71:5,20 73:10,24 74:13 75:5 77:19
89:3,23 92:5 97:19 100:10 101:9
104:10,18 105:24 106:17 114:17
115:4 117:11 119:2 125:21 129:9
132:18 136:19 149:10 151:12 159:16,
17**witnesses'** 83:24**word** 26:16 32:25 33:5 45:15 55:22
67:18,22 81:7,16 88:25 90:11 100:5,6
101:25 134:13**words** 38:3 66:14 113:18,21 114:10,
14 120:16**work** 13:14,15,20 15:23 46:14 48:14
49:3,13 60:4 66:17 73:1 83:13 84:4,
13 86:3 87:6 89:10,18 93:11 96:1,12
98:19 102:19 114:3 127:4 131:8
135:9,11 136:9**workaround** 118:7**worked** 22:18 38:20 46:21 86:7,17
153:22 170:18,20**working** 11:17 22:18 43:1 82:1
97:10,13 107:6**world** 24:22 101:11 119:3,8 126:25
127:5 131:18**worth** 84:7,10**write** 66:24 77:22 84:20 85:10**writing** 72:8**written** 21:14 30:4 34:22,23 65:20
87:17,22**wrong** 62:13 81:13 83:12**wrote** 6:21 7:5 152:10**Wyoming** 51:13

Y

year 14:11,13,15 48:1 90:8 102:15
105:2 149:6,19**years** 25:8 43:3,8 49:13 50:9 72:7
86:6 92:20 93:4 108:12 111:1 117:6,
18 130:14 135:11**years'** 130:16**yesterday** 12:16

Z

zone 35:16 56:12,14,22 57:1,3,7,10,
11,21 58:1,6,10 59:16,17,21 64:4
116:17 142:20 143:8,12,22 145:23
146:3,7,10**zones** 56:6,7