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UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE PATENT TRIAL AND APPEAL BOARD  
BERKSHIRE HATHAWAY ENERGY COMPANY  
Petitioners  
v.  
BIRCHTECH CORP.  
Patent Owner

IPR2025-00274 (Patent No. 10,343,114 B2)  
IPR2025-00278 (Patent No. 10,343,114 B2)  
IPR2025-00280 (Patent No. 10,596,517 B2)  
IPR2025-00281 (Patent No. 10,596,517 B2)

\* \* \* \* \*

ORAL DEPOSITION OF STEPHEN NIKSA, PhD  
November 20, 2025

\* \* \* \* \*

ORAL DEPOSITION OF STEPHEN NIKSA, PhD, produced as a witness and duly sworn, was taken in the above-styled and numbered cause on November 20, 2025, from 9:10 a.m. until 1:33 p.m., before Suzanne Kelly, CSR Number 1260, in and for the State of Texas, reported by stenographic method at the offices of McDermott Will & Schulte, L.L.P., located at 2801 N. Harwood Street, Suite 2600, Dallas, Texas, pursuant to the Texas Rules of Civil Procedure and the provisions stated on the record, if any.

Reported by: Suzanne Kelly, CSR, RDR, CRR  
Job: 7752036

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22 ALSO PRESENT:  
23 Eric Horsley, via telephone  
24  
25

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1 PROCEEDINGS  
2 MR. NEMUNAITIS: My name is  
3 Justin Nemunaitis, representing the Patent  
4 Owner. I will be taking the deposition.  
5 MR. TOBIN: This is David Tobin  
6 here on behalf of Petitioner PacifiCorp, and  
7 also representing the witness, Dr. Stephen  
8 Niksa.  
9 Just so we are clear on the record,  
10 this deposition today is being conducted in  
11 parallel across four proceedings. Those four  
12 proceedings are:  
13 IPR2025-00274;  
14 IPR2025-00278;  
15 IPR 2025-00280;  
16 and IPR 2025-00281.  
17 THE COURT REPORTER: If you would  
18 please raise your right hand, I will administer  
19 the witness's oath to you.  
20 THE WITNESS: (Complies.)  
21 THE COURT REPORTER: Do you  
22 solemnly swear or affirm that the testimony  
23 which you will give in this case will be the  
24 truth, the whole truth, and nothing but the  
25 truth, so help you God?

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Page 3

1 THE WITNESS: I do.  
2 STEPHEN NIKSA, PhD,  
3 having sworn to testify the truth, the whole  
4 truth, and nothing but the truth testifies on  
5 the witness's oath as follows:  
6 THE COURT REPORTER: Thank you.  
7 EXAMINATION  
8 BY MR. NEMUNAITIS:  
9 Q. Could you please introduce yourself for  
10 the record?  
11 A. My name is Stephen Niksa.  
12 Q. And what's your title? Is it Mister,  
13 Doctor?  
14 A. Doctor.  
15 Q. Where do you live, Dr. Niksa?  
16 A. I live in Belmont, California.  
17 Q. Have you been retained by the  
18 Petitioners in these matters?  
19 A. Yes, I have.  
20 Q. Are you charging an hourly rate for  
21 your work on this case?  
22 A. Yes, I am.  
23 Q. What's your rate?  
24 A. My rate is \$365 per hour.  
25 Q. How many hours have you worked on this

Page 5

1 case?  
 2 A. I think it's only --  
 3 MR. TOBIN: I am going to lodge an  
 4 objection to form. But...  
 5 THE WITNESS: I think it's about  
 6 210 hours so far.  
 7 BY MR. NEMUNAITIS:  
 8 Q. What attorneys have you primarily  
 9 worked on this case with or these IPRs with?  
 10 A. I primarily worked with David Tobin.  
 11 Q. Any others that you can remember by  
 12 name?  
 13 A. There is another one named -- whose  
 14 first name is Sayed or Sayed. I don't know how  
 15 you pronounce that, but that's only for billing  
 16 purposes and administrative matters.  
 17 Q. How did you get your start in mercury  
 18 capture?  
 19 A. Well, I run a small consulting company,  
 20 and we specialize in air pollution control for  
 21 power plants burning solid fuels, could be  
 22 coals, petroleum cokes, biomass, any solid fuel.  
 23 And our focus, as I say, is on emissions.  
 24 So my company started, actually, I  
 25 don't want to bore you with what led up to this

1 the laboratory scale, whereas the activities in  
 2 the United States were almost exclusively  
 3 directed at testing full-scale utility borders.  
 4 As a scientist, or as a research  
 5 engineer, I can certainly learn more about the  
 6 underlying mechanisms involved in mercury  
 7 control from laboratory tests than we could from  
 8 full-scale tests.  
 9 So that was the information that  
 10 rapidly brought me into a position of -- at the  
 11 state-of-the-art, the mercury control, both in  
 12 the United States and certainly in Japan.  
 13 But there just were very, very few  
 14 people anywhere who were thinking about: What  
 15 is responsible?  
 16 How does this behave as a chemical  
 17 reaction system?  
 18 What's the relationship between the  
 19 knowledge base and what's happening in the  
 20 utility borders?  
 21 Q. You said that there were very few  
 22 people studying this issue. Are you referring  
 23 specifically to very few people studying mercury  
 24 capture?  
 25 A. No. I am referring to very few people

1 company, but we formally started in 1997.  
 2 And at that point, I had a long  
 3 track record in testing and simulations  
 4 associated with pollution control at these  
 5 utility power plants.  
 6 Once I started Niksa Energy  
 7 Associates, L.L.C., some of my first clients  
 8 were in Japan.  
 9 And in the United States, Mercury  
 10 Missions Control was rapidly moving up the  
 11 priority chain so that very quickly, soon after  
 12 we started, it was apparent that this was going  
 13 to be an area that we were working in.  
 14 And my Japanese clients wanted to  
 15 have me work as technology transfer agent. They  
 16 wanted me to keep pace of developments in the  
 17 United States and transfer what I knew to them  
 18 in Japan.  
 19 At the same time, they started  
 20 conducting tests. So really fortunate  
 21 circumstances from a business point of view was  
 22 that I got to see their data before anyone else  
 23 did.  
 24 And what makes that especially  
 25 important is that they were conducting tests at

1 trying to interpret the test results.  
 2 There was an army of researchers  
 3 that were conducting tests at full-scale utility  
 4 borders. That was the large effort.  
 5 But hardly anyone who was trying to  
 6 understand what those test results said about  
 7 the underlying chemistry and physics of the  
 8 process.  
 9 If I can just add, at that period,  
 10 when I made my presentations, I would talk about  
 11 the hypothetical height of all of the test  
 12 results that we had worked on.  
 13 These results were distributed in  
 14 these big reports, and I would encourage people  
 15 to think about how high that tower of reports  
 16 was getting without understanding.  
 17 You don't run tests to put figures  
 18 together. You run tests to learn something.  
 19 And the community was in such a  
 20 panic to meet impending regulations that they  
 21 were not devoting sufficient resources to the  
 22 interpretations.  
 23 Q. You have provided a tremendous amount  
 24 of information in response to these first few  
 25 questions. There is a lot of things I want to

|   |  |
|---|--|
| <p>1 follow up on.<br/> 2 I just want to say right now,<br/> 3 because I have a feeling I'm going to do this a<br/> 4 lot throughout the day, I am probably going to<br/> 5 take the things you say and repeat them back to<br/> 6 you to make sure that I understand and, also,<br/> 7 you said a lot of terms like "people,"<br/> 8 "community."<br/> 9 I'm not sure of the time period or<br/> 10 which particular people you are referring to.<br/> 11 A. Right.<br/> 12 Q. So to the extent we can clarify that, I<br/> 13 am going to be looking to do that. I just<br/> 14 wanted to give you a heads-up. I am not trying<br/> 15 to be rude or something. I just want to make<br/> 16 sure I understand all of these different things<br/> 17 you told me.<br/> 18 A. I am here to answer your questions.<br/> 19 Q. Okay. You said that there was an army<br/> 20 of researchers doing full-scale tests. Is that<br/> 21 right?<br/> 22 A. That's what I said.<br/> 23 Q. And are you referring to -- what time<br/> 24 period are you referring to when you say that?<br/> 25 A. I would say the ramp really started to</p> <p style="text-align: right;">Page 10</p>   | <p>1 systems, how different combustion methods, how<br/> 2 different coal types affected mercury emissions.<br/> 3 So that's really, I mean that's<br/> 4 when this took off. And in response to that,<br/> 5 the Department of Energy and its National Energy<br/> 6 Technology Laboratory started a three-phase<br/> 7 program to run field tests.<br/> 8 That's why I said the primary<br/> 9 preoccupation was on testing at full-scale<br/> 10 plants.<br/> 11 That imperative came out of NETL at<br/> 12 the Department of Energy.<br/> 13 Q. What is NETL at the Department of<br/> 14 Energy?<br/> 15 A. That's the National Energy Technology<br/> 16 Laboratory. And that's the arm of the<br/> 17 Department of Energy which is responsible for<br/> 18 developing control technologies at coal-fired<br/> 19 power plants.<br/> 20 Q. You mentioned the term "CR database"<br/> 21 that had data on field tests at power plants.<br/> 22 Is that right?<br/> 23 A. Yeah. It's actually the ICR database,<br/> 24 the Information Collection Request. It's an<br/> 25 awkward phrase, but that's what DOE called it.</p> <p style="text-align: right;">Page 12</p>         |
| <p>1 move around 1998, 1999.<br/> 2 Q. What caused there to be a ramp up in<br/> 3 research into mercury capture?<br/> 4 A. Well, the EPA through the early '90s,<br/> 5 the EPA -- I do have a section in the report,<br/> 6 but I am going to use rather vague terminology<br/> 7 at the start. If you want me to pursue it<br/> 8 further, I will open to those pages in my<br/> 9 report.<br/> 10 But the EPA had first identified<br/> 11 mercury as the most important air toxic for<br/> 12 control. And they also announced that coal<br/> 13 combustion was responsible for about a third of<br/> 14 the mercury emissions released into the air at<br/> 15 that time. This is mid- to late '90s.<br/> 16 And in 1998, they issued what was<br/> 17 called the "information collection request."<br/> 18 This was a demand to coal-fired utility<br/> 19 companies to measure mercury emissions and some<br/> 20 other supporting conditions along the way.<br/> 21 And by the year 2000, that ICR<br/> 22 database was released, and it had a lot of<br/> 23 interesting implications, obviously. But it was<br/> 24 really the first time that we got a chance to<br/> 25 see how different units and gas cleaning</p> <p style="text-align: right;">Page 11</p> | <p>1 Or EPA called it, I should say. The Information<br/> 2 Collection Request.<br/> 3 Q. And when was the ICR database released<br/> 4 to the public?<br/> 5 A. Early 2000.<br/> 6 Q. Why was research into mercury capture<br/> 7 necessary in the early 2000s? Why wasn't there<br/> 8 already a known solution for this?<br/> 9 A. Well, mercury is a neurotoxin that<br/> 10 is -- it affects neurological systems, brain<br/> 11 development in infants, and it also interferes<br/> 12 or it can interfere with pregnancies.<br/> 13 So the health sciences community<br/> 14 was raising alarms about toxic metals in air and<br/> 15 water. And mercury was examined and actually<br/> 16 the focus of those examinations because it's<br/> 17 particularly volatile.<br/> 18 If you burn something that contains<br/> 19 mercury, it will be released. It will<br/> 20 almost -- almost certainly be released in the<br/> 21 smokestack if you don't do anything to control<br/> 22 it.<br/> 23 Just by virtue of the fact that<br/> 24 coal contains mercury, we have an air pollution<br/> 25 issue associated with mercury.</p> <p style="text-align: right;">Page 13</p> |

1 Many, many, many -- the vast  
2 majority of other toxic metals are not  
3 necessarily released when they are burned, when  
4 the coal is burned.  
5 Coal can have a lot of arsenic, for  
6 instance, and it never makes it out of the  
7 smokestack. So that's why mercury became the  
8 focus.  
9 And, in fact, I cite one report  
10 which said that of all of the toxic metals in  
11 coal, mercury is the most important for control.  
12 Q. There were known pollution control  
13 methods that were already known in the industry  
14 before the early 2000s. Right?  
15 A. For -- I'm sorry. Could you be more  
16 specific? There certainly were pollution  
17 control methods.  
18 Q. My question is: Why were the known  
19 pollution control methods that were already  
20 available in the industry in the early 2000s,  
21 why were they unable to solve this problem of  
22 capturing mercury at coal-fired powered plants?  
23 MR. TOBIN: Objection. Form.  
24 THE WITNESS: I'm sorry.  
25 MR. TOBIN: Objection to form.

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1 Just means pause a second so if I  
2 need to object, I can. But you can answer if  
3 you know.  
4 THE WITNESS: Sorry. Sorry.  
5 The utility industry operates on  
6 regulations. Controls cost money. And when you  
7 are talking about commercial processes to scale  
8 of power plants, lots and lots of money is  
9 always involved in anything new.  
10 So the industry had no incentive to  
11 control mercury on its own. And it wasn't until  
12 EPA decided -- until EPA put mercury at the top  
13 of the list of air toxic control that all of the  
14 sudden -- and all of the sudden is literally  
15 true about the response of the industry to what  
16 EPA said was coming down the regulatory pathway.  
17 BY MR. NEMUNAITIS:  
18 Q. You said, all of the sudden, the  
19 industry was reacting to what the EPA said about  
20 mercury. What specific time period are you  
21 talking about there?  
22 A. I am talking there '99, 2000, 2001,  
23 2002, 2003, 2004. And at that point, it became  
24 clear that utilities had a sufficient number of  
25 potential solutions to evaluate for

Page 15

1 implementation.  
2 They were not regulated to  
3 implement those solutions. The research  
4 community always leads the implementation by  
5 several years.  
6 So this, you know, ferocious  
7 activity was in the research community because  
8 the industry didn't know what solutions were  
9 available to meet impending regulations, which  
10 is a very precarious position for them to be in.  
11 Q. Why couldn't power plants just take off  
12 the shelf already known pollution control  
13 systems in the early 2000s and say, okay. We  
14 already know about these. This will work for  
15 mercury capture?  
16 A. Well, if I may, let me first put a  
17 little different slant. Certain gas-cleaning  
18 configurations automatically controlled mercury,  
19 but nobody knew that because nobody ever  
20 monitored what was happening to mercury.  
21 So you suggested that there were  
22 off-the-shelf solutions available, and I am  
23 suggesting that certain power plants didn't need  
24 to do anything to comply with the impending  
25 regulations.

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1 And the ICR database was the first  
2 clear indication of where the dividing lines  
3 were, which plants were going to have the happy  
4 circumstance of not having to do anything, and  
5 which plants were going to have to struggle with  
6 inventing options and then implementing whatever  
7 options made the most sense for them.  
8 Q. What was it about some of these plants  
9 that allowed them to capture mercury without  
10 making any changes versus other plants that were  
11 going to have to make changes?  
12 A. There was three things:  
13 The first thing is they were  
14 burning coals that contained a lot of chlorine,  
15 "a lot" in a relative sense.  
16 The second thing is that their  
17 gas-cleaning system contained a selective  
18 catalytic reduction unit for NOx control.  
19 And the third thing is that the  
20 gas-cleaning system also contained a flue gas  
21 desulfurization unit.  
22 So if you had those three things:  
23 High chlorine coal, SCR and FGD, you were  
24 sitting pretty.  
25 Q. For power plants that were not burning

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1 high chlorine coal, did not have an SCR or did  
 2 not have an FGD, why was it necessary for there  
 3 to do research to figure out how those plants  
 4 could capture mercury?  
 5 MR. TOBIN: Objection. Form.  
 6 THE WITNESS: Well, the one  
 7 on-the-shelf solution that occurred very quickly  
 8 was activated carbon injection, and that  
 9 solution was off the shelf not in the sense that  
 10 it had been applied to coal-fired power plants  
 11 but that it had been used effectively to lower  
 12 mercury emissions from municipal waste  
 13 incinerators.  
 14 Incinerators generate a flue gas  
 15 that contains quite a bit more mercury than  
 16 coal-fired power plants.  
 17 So the thinking was if ACI,  
 18 activated carbon injection, works in  
 19 incinerators, then it's probably going to work  
 20 really well in coal-fired utility boilers. And  
 21 then there were also all sorts of schemes that  
 22 people came up with.  
 23 BY MR. NEMUNAITIS:  
 24 Q. If the industry knew about activated  
 25 carbon injection in the early 2000s, why was

Page 18

1 grossly dissimilar. Not at all the same.  
 2 And all of that affects mercury in  
 3 ways that were unknown at this time period.  
 4 So that's where the big testing  
 5 campaign came out and said, we are going to  
 6 figure out how this thing works.  
 7 Q. If activated carbon was this known  
 8 technology in the early 2000s, why was anyone  
 9 trying out anything else? Why not just test  
 10 that to see if it works and then go from there?  
 11 A. Well, managers at utility companies  
 12 were currently sitting in a position where they  
 13 spent zero dollars on mercury. So you might  
 14 say, by definition, the cost of activated carbon  
 15 was too expensive.  
 16 If you are comparing the cost of  
 17 anything to zero, it's way, way, way, way too  
 18 expensive.  
 19 And, you know, the immediate  
 20 imperative was to reduce the cost, and that was  
 21 actually built into the imperatives to the goals  
 22 and milestones of the testing program out of the  
 23 National Energy Technology Laboratory.  
 24 Q. What do you mean by that?  
 25 A. They specify that the objectives of the

Page 20

1 there a need for any further research at that  
 2 point?  
 3 A. Oh, knowing that something has the  
 4 potential to control an emission is not the same  
 5 as demonstrating that your plant can be operated  
 6 with emissions that fall below a regulated  
 7 level.  
 8 The amount of time involved in  
 9 meeting the regulations -- and I mean the  
 10 averaging of what's measured at the smokestack  
 11 to comply with the regulation introduces all  
 12 kinds of complications.  
 13 Power plants are not laboratory  
 14 test facilities. They have to swing all sorts  
 15 of operating conditions in the course of every  
 16 day.  
 17 So, you know, what worked in an  
 18 incinerator would be something worth trying.  
 19 But to actually find out how it performed,  
 20 plants are not by any stretch of the imagination  
 21 cookie cutter or duplicates of some master  
 22 design. So you have tremendous variability in  
 23 plant configuration.  
 24 And the big kicker is that in the  
 25 United States, plants burn coals that are

Page 19

1 phases of their programs were to reduce the  
 2 costs of eliminating a stated percentage of  
 3 mercury for some cost less than the current  
 4 value of activated carbon injection.  
 5 They used ACI as a ruler on costs.  
 6 And they didn't want to pay. They didn't want  
 7 their program to end up at 100 percent of those  
 8 costs.  
 9 At some point, the cost, the  
 10 fractional value was 75 percent of current ACI  
 11 costs. And at a later phase, it went down to 50  
 12 percent.  
 13 So, you know, they made it real  
 14 clear that the reason for this program is to  
 15 lower the cost compared to activated carbon  
 16 injection.  
 17 Q. Is what you are describing, did that  
 18 occur before -- I think it was 2004 that you  
 19 said work was going to happen?  
 20 A. This was all -- those three phases in  
 21 the NETL program, the testing programs were  
 22 rolled out from about 2000 to about 2004, 2005.  
 23 Q. Do you know approximately what  
 24 percentage of mercury, NETL used as the goal to  
 25 be removed from power plant emissions?

Page 21

1 MR. TOBIN: Objection to form.  
 2 THE WITNESS: The regulations on  
 3 the table bounced around as the presidential  
 4 administrations changed, but the one consistent  
 5 number that comes to mind is 70 percent.  
 6 There were a few different proposed  
 7 regulations that went after 70 percent.  
 8 BY MR. NEMUNAITIS:  
 9 Q. Did that number ultimately increase to  
 10 90 percent?  
 11 A. No. It's -- there are certain  
 12 combinations of firing conditions and coal type  
 13 that are regulated to 90 percent. But it's not  
 14 fair to say that the industry level was  
 15 increased from 70 percent to 90 percent.  
 16 The regulations, as they exist  
 17 today, are broken down by the type of furnace  
 18 and the type of coal.  
 19 Q. So what you are describing is that NETL  
 20 estimated how much it would cost to use  
 21 activated carbon at a power plant to reduce  
 22 emissions by 70 percent, and it was the goal  
 23 during that 2000 to 2004, 2005 time period to  
 24 reduce that cost as much as possible? Is that  
 25 fair?

Page 22

1 A. That's fair. And I've been speaking in  
 2 terms of NETL, but companies spent a lot of  
 3 their own money to go beyond NETL for their  
 4 particular company.  
 5 Q. At the end of this process in 2004,  
 6 2005, did NETL or anyone put out like the final  
 7 list of cost estimates or mercury capture  
 8 approaches that it said, these are the things  
 9 that, you know, will accomplish the goal?  
 10 A. NETL hired contractors who specialized  
 11 in process economics and, also, solicited  
 12 information from the commercial suppliers of the  
 13 technology to keep track of the cost.  
 14 And where that information ended  
 15 up, I am not familiar with. I don't recall. I  
 16 mean, I recall people from NETL claiming  
 17 victory, but that's not an area. That's not an  
 18 aspect of this process. The economics are not  
 19 an aspect of this process that I follow very  
 20 closely.  
 21 So I know I sat through  
 22 presentations on it, but I don't recall any  
 23 grand summary of how, you know, how they did it.  
 24 Q. If your understanding is that NETL  
 25 essentially declared victory on this goal of

Page 23

1 figuring out reduced costs for recapture  
 2 methods, do you know what the list of methods  
 3 are that ultimately could achieve that goal?  
 4 A. I could -- I could take a stab at  
 5 writing that list. But I don't know if that's  
 6 what you are asking.  
 7 Q. Yeah. I am asking for the list of  
 8 technologies that you understood to be the ones  
 9 that could achieve the goals NETL was trying to  
 10 achieve.  
 11 MR. TOBIN: Objection to form.  
 12 THE WITNESS: What has me pausing  
 13 is that NETL didn't set the regulations. They  
 14 came out of EPA. And at the end of the day, the  
 15 only thing that matters is for a company to  
 16 produce a signal of mercury concentration at the  
 17 smokestack that lies below the regulatory  
 18 threshold.  
 19 And there are all sorts of  
 20 different configurations and combinations that  
 21 different companies use to achieve that  
 22 compliance standard.  
 23 So it's not -- it's not -- there is  
 24 no -- well, I mean there are solutions that  
 25 would work everywhere, install an SCR and

Page 24

1 install an FGD.  
 2 The problem is, you know, you are  
 3 looking at the better part of a billion dollars  
 4 to do that. And once you open it up to the  
 5 economics, then there is a tremendous mix at  
 6 different plants.  
 7 BY MR. NEMUNAITIS:  
 8 Q. Let me try asking it this way. And  
 9 maybe there is no answer to this question  
 10 because each power plant is unique in its own  
 11 way.  
 12 But is there just an understanding  
 13 in the industry that here, say, the top five  
 14 approaches that power plants undertook to meet  
 15 the mercury regulations?  
 16 A. One of the citations I make is to the  
 17 report from the Massachusetts Environmental  
 18 Protection Agency, and that was issued in 2002.  
 19 So I think that's a good example of what you are  
 20 asking for, but you have to realize that it's a  
 21 moving target. Right?  
 22 I mean, what Mass EPA said in 2002  
 23 as the best top five would probably not look  
 24 very much like what somebody would say today.  
 25 Q. And I am trying to focus on the time

Page 25

1 period, because 2002, that's right in the middle  
2 of the research period you described. Isn't it?  
3 A. Yes.  
4 Q. So if we focus on once the -- sort of  
5 the intense research period was coming to a  
6 close in the 2004, 2005 time period, what was  
7 the understanding in the industry as to the top  
8 five approaches for mercury capture?  
9 MR. TOBIN: Objection. Form.  
10 THE WITNESS: Well, the -- that  
11 transition meant that it was no longer a  
12 research topic, that it was turned over to  
13 vendors.  
14 And the answer to your question is  
15 in what kinds of control the vendors were  
16 offering at a price. So when you say, "best,"  
17 it wasn't best from the research standpoint. It  
18 was the best from the cost standpoint.  
19 And that happened -- I mean, 2002  
20 is too early because the regulations weren't  
21 really implemented until 2015. But it left the  
22 research community and moved into commerce.  
23 And frankly, at that point, I did  
24 not follow things as closely as I had when I was  
25 in the research part of it.

1 gas-cleaning system contains, then you ought to  
2 look at this, that, and the other thing.  
3 But to say, you know, these are the  
4 best solutions, it just doesn't mean anything.  
5 Q. Were you working for your Niksa  
6 consulting firm during that entire 2000 to 2005  
7 time period?  
8 A. I was.  
9 Q. And what were you -- how were you  
10 related to the research during that time period?  
11 Were you hired by companies to do research? Or  
12 were you getting grants from the government?  
13 A. I got a few smaller grants from the  
14 government. But the large bulk of our funding  
15 in mercury control work came from individual  
16 utility companies, with the notable exception of  
17 the Electric Power Research Institute.  
18 EPRI is a research organization  
19 that is sponsored by contributions from member  
20 utility companies.  
21 So their -- that work is also  
22 directly connected, the money that I was given  
23 by -- from EPRI ultimately came from utility  
24 companies.  
25 Q. When utility companies were retaining

1 BY MR. NEMUNAITIS:  
2 Q. What was your understanding of the best  
3 options for mercury capture based on the  
4 research community's work in the 2004/2005 time  
5 period?  
6 A. You know, I am trying not to go in  
7 circles, but there is no single best. It  
8 depends on the coal type, it depends on the  
9 firing configuration, it depends on what units  
10 are present in the gas-cleaning system.  
11 Q. Is there not even like a list of top  
12 five most expected to perform well or anything  
13 like that?  
14 A. Does your cleaning system contain an  
15 FGD?  
16 Does your cleaning system contain  
17 an SCR but not an FGD?  
18 Does your cleaning system contain a  
19 fabric filter?  
20 Does your cleaning system contain  
21 an ESP upstream of the air pre-heater?  
22 These -- that -- you know, if you  
23 put a configuration on the table, then your  
24 question can be answered. And Mass EPA has the  
25 table like that. You know, if this is what your

1 your services in that 2000/2005 time period,  
2 what were they asking you to do?  
3 A. Well, at the very beginning, I  
4 mentioned that we assumed the distinctive  
5 posture of interpreting the field test data.  
6 And in the course of working for  
7 these companies, we developed a software product  
8 called "Mercurator." And Mercurator would  
9 accept data about what was in the gas-cleaning  
10 system, what kind of coal was being burned, all  
11 of the sorts of things that affected mercury  
12 emissions.  
13 And then it would simulate mercury  
14 chemistry along the gas-cleaning system.  
15 I would present our findings at  
16 research conferences and then companies would  
17 hire me to simulate their gas-cleaning systems.  
18 And it was the sort of thing where  
19 you could say: What if?  
20 Okay. You ran the test on their  
21 gas-cleaning system that only contained an  
22 electrostatic precipitator to collect  
23 particulates.  
24 What if we added an SCR? How much  
25 would the emissions change?

1 What if we blended the coal you are  
 2 using today with this other coal? How much  
 3 would the emissions change?  
 4 We had, you know, a long list of  
 5 factors that could be played with at the  
 6 simulation level.  
 7 So companies hired us to run the  
 8 simulations, or we licensed the package to them  
 9 so they could run their simulations and so  
 10 forth.  
 11 Q. So these companies that you worked for,  
 12 they would have testing data from field tests  
 13 that they would do themselves or hire others to  
 14 do, and then they would hire you to take that  
 15 data, interpret it and provide recommendations  
 16 or analysis, that sort of thing?  
 17 A. That's it.  
 18 Q. Okay. I believe you also mentioned  
 19 that based on your work, you were analyzing the  
 20 data from utilities, that you would publish some  
 21 of that work and talk about it in conferences?  
 22 A. Yeah. That's right. We analyzed  
 23 some -- there's over 200 different field tests  
 24 at full-scale utility power plants.  
 25 And all of that work was compiled

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1 in reports that we issued to EPRI.  
 2 And the bulk of that data was  
 3 sponsored by NETL. And then when we worked  
 4 directly with companies, we would use the NETL  
 5 data from their plants to kind of calibrate our  
 6 calculations and then they would present other  
 7 gas-cleaning conditions, other locations, other  
 8 coal types.  
 9 You know, that's where we played.  
 10 That's where we performed parametric studies.  
 11 Q. If you were being hired by the  
 12 utilities to analyze their data, why were they  
 13 okay allowing that to be published or presented  
 14 in conferences? Why not keep that confidential?  
 15 A. Well, they -- no. No. I'm sorry. I  
 16 guess I wasn't clear. When we worked with the  
 17 NETL data, the NETL data was in the public  
 18 domain to begin with. Okay? So that's the  
 19 stuff that we published.  
 20 The private data was all done under  
 21 non-disclosure agreements, and that was only  
 22 reported back to the client.  
 23 Q. When you say, "NETL data," is that data  
 24 collected in field tests at power plants that  
 25 was paid for or sponsored by NETL?

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1 A. Yeah. They had lots and lots of  
 2 cautionary relationships with different  
 3 utility companies.  
 4 So it's not fair to say that NETL  
 5 sponsored all of the costs of these field tests.  
 6 But they were a major contributor,  
 7 and one of the stipulations was that that data  
 8 was in the public domain.  
 9 Q. Once we get to the 2005 and past that  
 10 time period, were you still consulting with  
 11 power plants in evaluating data for them?  
 12 A. Yeah. The fever had subsided in the  
 13 research community, as I mentioned earlier, but  
 14 companies were still not regulated. And that  
 15 was mostly due to the George W. Bush  
 16 administration basically walking back from the  
 17 regulations that the industry had expected under  
 18 the Clean Air -- CAMR, whatever CAMR was.  
 19 So, you know, we had thought that  
 20 we were going to sell lots and lots of copies,  
 21 but -- of our software, but the regulations  
 22 didn't provide enough incentive.  
 23 Q. When did things change that, you know,  
 24 the EPA became more serious about imposing  
 25 mercury regulations?

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1 A. The name of the regulations is MATS,  
 2 Mercury and Air Toxics Control Technology  
 3 Standards. I don't recall. Somewhere in my  
 4 report, I have the schedule of how MATS was  
 5 ultimately implemented around -- around 2015,  
 6 2016.  
 7 There were extensions that were  
 8 provided, so even the ultimate implementation  
 9 was not in a fixed date, but it occurred over  
 10 several years.  
 11 Q. And I am kind of trying to place your  
 12 involvement in this at this point. What -- if  
 13 interest in the regulations died down in 2005,  
 14 were you still consulting or doing mercury  
 15 capture after that point?  
 16 A. Yeah. Yeah. For one reason, the  
 17 regulations in Japan were lagging those in the  
 18 United States. So the research activity in  
 19 Japan was still very active.  
 20 We were transferring what we  
 21 learned in the United States back to the  
 22 Japanese, and they were supporting the  
 23 development of our software, and we were doing  
 24 the sorts of work for Japanese utility companies  
 25 that we had been doing for American utility

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1 companies.  
 2 And we had a few jobs with European  
 3 utilities. I am trying to remember where else.  
 4 We worked with a utility in Taiwan.  
 5 We did some calculations for a  
 6 company in Hong Kong. So we were -- we were  
 7 still busy on mercury.  
 8 But the American -- it wasn't  
 9 primarily from the American industry at that  
 10 point.  
 11 Q. For power plants in the U.S. that were  
 12 ultimately going to need to make some change to  
 13 their system to capture mercury, did you ever  
 14 work with power plants like that to help them  
 15 figure out what changes to make?  
 16 A. Yes, we did.  
 17 Q. And what types of changes did they tell  
 18 you they were considering or did you recommend  
 19 under those circumstances?  
 20 A. Well, it's fair to say that they were  
 21 considering anything that could be changed that  
 22 would affect mercury emissions.  
 23 Q. Can you give me some examples?  
 24 A. Coal quality in the form of blending.  
 25 Additives in the form of halogens

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1 and what we call "base metals," materials like  
 2 lime and limestone.  
 3 And then more drastic changes would  
 4 be adding new units in the gas-cleaning system.  
 5 Q. What do you mean by "new units"?  
 6 A. Well, if the current gas-cleaning  
 7 system contained only an ESP, then you would  
 8 wonder, okay, if I converted from an ESP to a  
 9 fabric filter, how much mercury am I going to  
 10 retain?  
 11 Or even if I have to add an SCR in  
 12 a few years, tell me what that's going to do to  
 13 my mercury emissions so I won't spend too much  
 14 money between now and two years on mercury.  
 15 There are all sorts of scenarios  
 16 that they wanted to examine. And companies  
 17 don't run one power plant. Right? These are  
 18 populations of boilers in many different power  
 19 stations.  
 20 So there are a lot of -- a lot of  
 21 options.  
 22 Q. And I just want to be clear about the  
 23 terminology. When you say, "new units in the  
 24 gas-cleaning system," you are referring to some  
 25 sort of major piece of equipment?

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1 A. Right.  
 2 Q. Like an FGD or SCR? You are not  
 3 referring to like a new boiler or something like  
 4 that?  
 5 A. That's right, yeah. That's right.  
 6 And, of course, activated carbon injection was  
 7 always on the table.  
 8 Q. So for power plants in the United  
 9 States that were facing the EPA's new mercury  
 10 regulations, what were the main decision factors  
 11 going in to decide whether or not to use  
 12 activated carbon injection?  
 13 MR. TOBIN: Objection. Form.  
 14 THE WITNESS: What kind of coal are  
 15 they burning?  
 16 There are a minority of companies  
 17 that use the spot market to purchase their  
 18 coals, so the coal quality varies a lot.  
 19 And then on the other extreme,  
 20 there are plants that are built in an actual  
 21 mine, and essentially all of the coal that they  
 22 burn comes from one mine. So that's the kind of  
 23 bandwidth that we have.  
 24 BY MR. NEMUNAITIS:  
 25 Q. Any other major decision factors?

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1 A. What other pollutants are the  
 2 regulations becoming tighter for?  
 3 What's happening with NOx? What's  
 4 happening with sulfur?  
 5 You know, we -- this discussion,  
 6 this -- so far, we have only talked about  
 7 federal regulations. But state regulations, in  
 8 some cases, were years ahead of the federal  
 9 regulations and, still today, are more stringent  
 10 than the federal regulations.  
 11 Q. Any other decision factors?  
 12 A. I'm sure there are many more, but none  
 13 that I can think of off hand.  
 14 Q. For companies that were considering  
 15 using halogen additives to meet the new mercury  
 16 regulations, what were the major decision  
 17 factors for them?  
 18 MR. TOBIN: Objection. Form.  
 19 THE WITNESS: Coal quality is  
 20 the -- is the first and foremost.  
 21 And then whether an SCR was present  
 22 and whether an FGD was present.  
 23 BY MR. NEMUNAITIS:  
 24 Q. What is the difference between -- I'm  
 25 sorry. Strike that.

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1 What is the difference between coal  
2 quality and coal type?  
3 A. Coal type, we don't -- we don't use the  
4 term "type." We call it "rank," but it means  
5 "type." Coal rank is the way people talk about  
6 coal type, and that has several very broad  
7 categories.  
8 So to refine the properties of a  
9 particular coal, we use the term "coal quality."  
10 That points to a handful -- or better yet, one  
11 type, you know, one coal sample has a certain  
12 set of properties.  
13 Collectively, that's the coal  
14 quality we're talking about.  
15 Coal rank, bituminous coals can  
16 have properties that cover very broad ranges.  
17 Q. Are halogen additives more likely to be  
18 used with lower-ranked coals versus  
19 higher-ranked coals?  
20 A. Yes, they are.  
21 Q. And are halogen additives more likely  
22 to be used for power plants that don't have an  
23 SCR or don't have an FGD?  
24 A. Certainly for plants that don't have an  
25 FGD, yeah.

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1 But the SCR, the reason that I  
2 hesitate is that it may -- circumstances may  
3 arise where a halogen additive will increase the  
4 amount of mercury that's trapped by an FGD, even  
5 without an SCR. It's pretty rare, but it  
6 happens.  
7 Q. Are you familiar with halogenated or  
8 brominated activated carbon?  
9 A. I am.  
10 Q. What are the decision factors that go  
11 into whether or not a power plant will choose to  
12 use halogen or bromine additives versus halogen  
13 or brominated carbon?  
14 MR. TOBIN: Objection to form.  
15 THE WITNESS: So to clarify your  
16 question, there is a product called "B-PAC,"  
17 which is brominated-activated carbon.  
18 And what you are asking me is how a  
19 company decides between B-PAC on the one hand  
20 and between adding bromine somewhere in the  
21 system with conventional activated carbon?  
22 BY MR. NEMUNAITIS:  
23 Q. Yeah. And I will re-ask the question  
24 for a clear Q and A on the record.  
25 A. Okay.

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1 Q. How does a company choose between using  
2 brominated carbon or B-PAC versus using bromine  
3 on the coal and conventional activated carbon?  
4 MR. TOBIN: Objection to form.  
5 THE WITNESS: Cost. B-PAC is  
6 expensive, for one thing.  
7 But in addition, bromine additive  
8 does not just affect mercury capture on the  
9 carbon, itself.  
10 BY MR. NEMUNAITIS:  
11 Q. What do you mean by that?  
12 A. Well, you might think that, okay. If I  
13 added bromine somewhere upstream of the  
14 activated carbon injection position, that by the  
15 time the carbon sees the mercury, it really  
16 behaves like B-PAC.  
17 But what actually happens is the  
18 type of mercury that arrives at the activated  
19 carbon injection position will be different with  
20 the additive than without.  
21 Q. And what's the significance of that?  
22 A. Well, bromine additives oxidize the  
23 mercury, which is to say they turn metallic  
24 mercury into ionic mercury.  
25 And ionic mercury has a stronger

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1 affinity for carbon than metallic mercury does.  
2 Q. And how does that affect whether or not  
3 a company would choose to use B-PAC versus a  
4 bromine additive?  
5 A. Well, the -- the economics are  
6 paramount. Right? Conventional activated  
7 carbon costs less than B-PAC. And the additive,  
8 depending upon where you put it and how you  
9 apply it, costs some money.  
10 So what -- which configuration is  
11 likely to give you better mercury control?  
12 And then another factor is that  
13 bromine and flue gas sometimes causes corrosion  
14 problems. You wouldn't have those corrosion  
15 problems with B-PAC, because the bromine is  
16 bound to the carbon.  
17 But with the additive, you may or  
18 may not have corrosion problems to consider,  
19 and that depends on the design of the air  
20 preheater in that particular gas-cleaning  
21 system.  
22 So, you know, again, it's  
23 always -- these are complicated systems with  
24 many different variations, so it's always a long  
25 list of things that have to be worked out.

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11 (Pages 38 - 41)

1 Q. I understand your point about economics  
2 if the only thing that matters is the cost of  
3 the bromine additive versus the cost of the  
4 B-PAC versus the cost of the activated carbon.  
5 But how does this oxidation  
6 changing of the mercury issue factor into the  
7 decision between whether to use bromine  
8 additives versus B-PAC?  
9 A. Well, oxidized mercury has a better  
10 affinity for carbon than elemental mercury. So  
11 if more of my mercury is oxidized at the  
12 activated carbon injection position, I can use  
13 less carbon.  
14 I can get the same removal  
15 underneath the regulatory limit for less carbon,  
16 hence, less dollars.  
17 Q. Is that also true if you are using  
18 B-PAC?  
19 A. If you use -- no. No. If you use  
20 B-PAC, you didn't affect anything upstream of  
21 the activated carbon injection position. There  
22 was no additive present to oxidize the mercury.  
23 So that's why I say it's never  
24 apples. It's never, you know, one apple from  
25 one orange. It's always 16 fruits compared to

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1 14 fruits.  
2 Q. Can B-PAC out perform just using  
3 conventional activated carbon?  
4 A. It usually does.  
5 Q. Why is that?  
6 A. Because it's applied to coals that have  
7 very low native chlorine and bromine. So you  
8 get to add the bromine precisely where it's  
9 needed on the carbon.  
10 And in those cases, it's typical to  
11 see 90 percent capture with much less B-PAC than  
12 with an untreated conventional carbon.  
13 It's almost impossible to get to 90  
14 percent capture with a conventional carbon, but  
15 the B-PAC gets there, gets the 90 percent at a  
16 much lower injection concentration than the best  
17 result with the conventional carbon.  
18 Q. Is that because the B-PAC oxidizes the  
19 mercury?  
20 A. That's because the B-PAC adsorbs the  
21 mercury.  
22 Q. How does activated carbon react with  
23 mercury to help capture it?  
24 A. Activated carbon also absorbs mercury  
25 from the flue gas.

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1 Q. If B-PAC and conventional activated  
2 carbon both capture mercury through adsorption,  
3 why does B-PAC perform so much better than  
4 conventional carbon?  
5 A. Because if you are burning a coal that  
6 has very low native chlorine and bromine, the  
7 activated carbon has no place to put the  
8 mercury.  
9 The mercury binds to sites on the  
10 carbon that also contain the halogen. Mercury  
11 on clean activated carbon is slow.  
12 Mercury on carbon that contains  
13 halogens is much faster.  
14 And in these gas-cleaning systems,  
15 there is only several seconds available for the  
16 carbon to capture the mercury.  
17 MR. TOBIN: We are at an hour.  
18 When you are done with your line of questions,  
19 we should take a break.  
20 MR. NEMUNAITIS: Let me ask one  
21 thing to close out. I am struggling in my brain  
22 to figure out how to phrase this question. Why  
23 don't we just take a break?  
24 THE COURT REPORTER: Off of the  
25 record.

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1 (Recess taken.)  
2 THE COURT REPORTER: Back on the  
3 record.  
4 BY MR. NEMUNAITIS:  
5 Q. Would you say that you qualify as a  
6 person of ordinary skill in the art with respect  
7 to the patents at issue in these IPRs?  
8 A. I would.  
9 Q. Would you say you have experience that  
10 exceeds the level of ordinary skill in the art?  
11 A. I would.  
12 Q. During the 2000 to 2005 time frame, did  
13 you keep up to speed on the latest developments  
14 in mercury capture?  
15 A. I did.  
16 Q. And why is that?  
17 A. Because my company was working to  
18 develop a commercial software product. And we  
19 knew that the broader the database we were able  
20 to interpret, the more valuable the software  
21 would be for our clients.  
22 Q. Are you familiar with the EERC?  
23 A. I am.  
24 Q. What was the EERC's role related to  
25 mercury capture in the 2000s to 2005 time frame?

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1 MR. TOBIN: Objection to form.  
 2 THE WITNESS: The EERC had -- they  
 3 played several roles, several prominent roles in  
 4 mercury capture.  
 5 BY MR. NEMUNAITIS:  
 6 Q. What do you mean by that?  
 7 A. They had experts who were refining the  
 8 available detection systems to monitor mercury  
 9 at power plants.  
 10 They had testing teams that would  
 11 conduct field tests on mercury emissions along  
 12 utility gas-cleaning systems.  
 13 And they also eventually became the  
 14 host for a center on air toxic metals, which was  
 15 conducting more fundamental laboratory research  
 16 than research at pilot scale to clarify the  
 17 mechanisms associated with those emissions.  
 18 Q. Did you use or rely on EERC data or  
 19 publications for any of your work in mercury  
 20 capture?  
 21 A. I did.  
 22 Q. And why is that?  
 23 A. Because it was certainly relevant.  
 24 They ran field tests at companies that had  
 25 certain kinds of gas-cleaning systems, and I

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1 wanted to include those types of systems in our  
 2 database.  
 3 Q. Are you familiar with the inventors of  
 4 the patents at issue in these proceedings?  
 5 A. I know two of them: John Pavlish and  
 6 Ed Olson. I know their work. I am familiar  
 7 with their work.  
 8 Q. How are you familiar with their work?  
 9 A. Well, John Pavlish led some of those  
 10 testing teams that went to utility companies and  
 11 monitored mercury emissions, and his group would  
 12 issue reports and then I would take what I  
 13 needed from those reports and use -- incorporate  
 14 that into our database and interpret it.  
 15 He would also attend the kind of  
 16 conferences that I went to. And he would also  
 17 make presentations occasionally at those  
 18 conferences.  
 19 So I got to see him that way.  
 20 Q. And what's been your involvement with  
 21 Ed Olson?  
 22 A. Ed Olson is a university professor of  
 23 chemistry, and I would read his publications  
 24 looking for insights into how mercury was  
 25 reacting on activated carbon.

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1 Q. Do you consider Mr. Pavlish and  
 2 Mr. Olson to be colleagues in the field of  
 3 mercury capture?  
 4 A. Yes.  
 5 Q. When did you first learn about the  
 6 two-part approach of adding a bromine additive  
 7 before the boiler and activated carbon after the  
 8 boiler?  
 9 A. I am really not sure. Are you asking  
 10 for a month or a year? Or could you be  
 11 more -- tell me more about the question.  
 12 Q. I am just -- I mean the answer may be  
 13 "I don't know." But I am asking: When did you  
 14 first learn about, that you can recall, a  
 15 two-part approach of using bromine additive  
 16 before the boiler and activated carbon after the  
 17 boiler?  
 18 A. Yeah. I don't know.  
 19 Q. Do you know if that was before or after  
 20 the end of this research period coming to an end  
 21 in 2005?  
 22 A. It would have been before.  
 23 Q. Why do you say that?  
 24 A. Well, because Bernhard Vosteen had  
 25 popularized adding bromine into combustors onto

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1 coal at the very beginning of that period we're  
 2 talking about.  
 3 And in response, companies ran  
 4 field tests that implemented Vosteen's  
 5 suggestion along with activated carbon  
 6 injection.  
 7 Q. You are saying that there were field  
 8 tests conducted before 2005 using bromine  
 9 additives before the boiler and activated carbon  
 10 injection after the boiler?  
 11 A. My Sjostrom reference is August 2005.  
 12 Q. And so you were aware of the field  
 13 tests described in Sjostrom before 2005?  
 14 A. I honestly don't remember  
 15 because -- because I was given those field  
 16 reports, the field test reports, as soon as they  
 17 were issued.  
 18 And that could have been before her  
 19 presentation was scheduled in the EUEC  
 20 conference that I cite in my report. Sometimes  
 21 I got the actual test reports before people had  
 22 an opportunity to present them in conferences.  
 23 And I honestly don't remember if  
 24 this particular dataset that we're talking about  
 25 was one of those cases.

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1 Q. Is it fair to say that the first actual  
2 performance of bromine additive before the  
3 boiler, activated carbon injection after the  
4 boiler that you received was information related  
5 to the Sjostrom test?  
6 MR. TOBIN: Objection. Form.  
7 THE WITNESS: I don't -- yeah. I  
8 don't know.  
9 BY MR. NEMUNAITIS:  
10 Q. Can you recall any other sitting here  
11 today?  
12 A. Can I recall?  
13 Q. Yeah. Can you recall anything other  
14 than the -- I will try to ask the question.  
15 Can you recall receiving any  
16 information about an actual performance of using  
17 bromine additive before the boiler and activated  
18 carbon after the boiler other than data related  
19 to the Sjostrom presentation that's in your  
20 declaration?  
21 A. No. I can't.  
22 Q. If you did receive test data from  
23 Sjostrom before it was presented at the  
24 conference, why would you have received that?  
25 A. Because we were developing the database

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1 in support of our software development program,  
2 and we always wanted to include new approaches  
3 as soon as they were released.  
4 And if I found out about those  
5 tests, I would do everything I could to get that  
6 copy, that report, as soon as possible.  
7 Q. All right. You said something about  
8 incorporating tests into the program or the  
9 data? Could you explain that again? I may have  
10 misheard it.  
11 A. Yeah. Whenever a new control approach  
12 presented itself, I wanted to find data on that  
13 approach so that I could add it to the database  
14 that we were using to develop our software  
15 program.  
16 And in this, in this context, the  
17 new approach would be bromine additive plus  
18 activated carbon injection.  
19 Q. And maybe I misunderstood your  
20 description of this database. But so was this a  
21 database that had like an actual listing of  
22 mercury capture approaches and data from the  
23 tests for those different approaches?  
24 A. Yes, it is.  
25 Q. Do you still have that database?

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1 A. I sure do.  
2 Q. And did it record the date when you  
3 learned of each new approach?  
4 A. No. No, because we reconfigured the  
5 data in many, many different ways. So it wasn't  
6 connected to -- the data was not connected to  
7 the date I got the report in any way.  
8 Q. I'm going to ask you some questions  
9 about the claims of the patents at issue. Okay?  
10 A. Okay.  
11 Q. One aspect of the claims is that they  
12 talk about using bromine before the boiler.  
13 Right?  
14 A. I don't even know what patent you are  
15 talking about.  
16 Q. Well, say the '114 patent, for example,  
17 some of the claims talk about using a bromine  
18 additive before the boiler. Right?  
19 A. Let's see. '114. Okay.  
20 Q. You can pull it out of the binder if  
21 that's easier for you.  
22 A. No, it's good.  
23 I'm reading Claim 1, which says  
24 that the coal comprises added Br 2, HBr, Br- or  
25 a combination thereof added to the coal upstream

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1 in the combustion chamber.  
2 Q. Is it fair to say that that refers to  
3 adding bromine, some kind of bromine additive  
4 before the boiler?  
5 A. It is.  
6 Q. One of the distinctions you draw in  
7 your declaration is that you can add this  
8 bromine additive to primary air that contains  
9 coal or secondary air that does not contain  
10 coal. Is that fair?  
11 A. Yeah. I also describe other ways that  
12 coal can -- or that the additive can be added  
13 upstream of the combustion chamber in addition  
14 to those two ways.  
15 Q. What are those other ways?  
16 A. It could be added to secondary air.  
17 It could be added to tertiary air.  
18 It could be added to recycled flue  
19 gas that is occasionally brought back into the  
20 burners.  
21 It could be added through lances,  
22 through ports that are dedicated for injections  
23 near the burner.  
24 So there is -- there are a number  
25 of systems upstream of the boiler where

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1 something could be added.  
2 I forgot to mention over-fire  
3 airstreams. They are not as controlled. They  
4 come in varieties of separated over fire air and  
5 closed coupled over fire air. There are streams  
6 called "auxiliary airstreams." All of these are  
7 upstream of the boiler.  
8 Q. If bromine additive is added to primary  
9 air, then that bromine and the coals can be  
10 entered in the boiler at the same time. Right?  
11 MR. TOBIN: Objection. Incomplete.  
12 THE WITNESS: That's right.  
13 BY MR. NEMUNAITIS:  
14 Q. Is there kind of a general term we can  
15 use to refer to scenarios where you are adding  
16 bromine directly to the boiler so that it's not  
17 in contact with the coal before it enters the  
18 boiler?  
19 A. We just say, added to the combustion  
20 chamber, added to the furnace or added to the  
21 boiler.  
22 Q. Okay.  
23 A. Yeah.  
24 Q. Is there some other -- I mean, it seems  
25 like those are the two scenarios: There's added

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1 to coal, then it goes to the boiler or added  
2 directly to the boiler. Is there some other  
3 option?  
4 A. It could be added downstream of the  
5 boiler.  
6 The outlet temperatures are hot  
7 enough to decompose an additive.  
8 Q. If we're just focused on adding the  
9 bromine upstream into the boiler, is it fair to  
10 say either it's added to the coal and the boiler  
11 at the same time, or it's added into the boiler  
12 without the coal and there is no other option?  
13 A. The additive is going to go into -- in  
14 what you are describing, you want the additive  
15 in the boiler. So it either comes through walls  
16 or with the coal. I would agree that.  
17 Q. Is it your opinion here that when the  
18 patents talk about adding a bromine additive  
19 before the boiler, that means the additive  
20 always has to be added to the boiler separately  
21 from the coal?  
22 MR. TOBIN: Objection. Form.  
23 THE WITNESS: No. That's not  
24 right, no.  
25 BY MR. NEMUNAITIS:

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1 Q. Is there why is that?  
2 A. Because some of the systems upstream of  
3 the boiler handle coal.  
4 Q. So when the patents talk about adding  
5 an additive before the boiler, that could mean  
6 you add it to the coal and then to the boiler,  
7 or it could mean you add it to some other system  
8 that gets injected into the boiler? Is that  
9 correct?  
10 A. That's correct.  
11 Q. Or it could be some combination of  
12 those two things?  
13 A. In principle.  
14 Q. I want to ask you about something in  
15 your declaration for the '114 patent. Do you  
16 have that one in front of you?  
17 A. Yes. I do.  
18 Q. Could you turn to Page 242?  
19 A. I have it.  
20 Q. Do you see that figure taken from the  
21 patents that has your notations on it?  
22 A. I do.  
23 Q. And do you understand sort of what the  
24 chemical notation is showing in that figure?  
25 A. I do.

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1 Q. All right. Can you -- and just for the  
2 record, the figure you are looking at is from  
3 Figure 2 of the patents at issue? Right?  
4 MR. TOBIN: Objection. Form.  
5 THE WITNESS: The figure comes from  
6 the patent which we labeled as "Olson 235." So  
7 this is not from the '114 patent that we had  
8 been talking about.  
9 BY MR. NEMUNAITIS:  
10 Q. The figure we're talking about is  
11 Figure 2 from Olson 235?  
12 A. That's right.  
13 Q. Can you walk me through what Figure 2  
14 is showing starting with the thing that's  
15 labeled "carbon basic zigzag site"?  
16 THE COURT REPORTER: I'm sorry.  
17 That's labeled?  
18 MR. NEMUNAITIS: Carbon basic  
19 zigzag site.  
20 THE WITNESS: Are you okay?  
21 THE COURT REPORTER: Yes.  
22 THE WITNESS: Okay. So the carbon  
23 basic zigzag site is intended to represent a  
24 defect in the structure of the activated carbon.  
25 And we know it's a defect because

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|  |  |
|--|--|
| <p>1 to the right of that hexagon, you have these two<br/> 2 little dots. Those are -- that's an electron<br/> 3 pair, and that imparts what we call a "basic<br/> 4 character" to the carbon surface.<br/> 5       And that basic character attracts<br/> 6 HBr. You see there is a pair of parallel arrows<br/> 7 to the right of that zigzag site, that HBr. HBr<br/> 8 is an acid gas. And any person of ordinary<br/> 9 skill would know that acids and bases are<br/> 10 strongly inclined to react.<br/> 11       So this is showing how HBr can<br/> 12 react with defects on the carbon structure to<br/> 13 create this bromine anion, the Br-.<br/> 14       And it's the bromine anion attached<br/> 15 to the carbon cation that attracts the mercury,<br/> 16 the Hg0. It allows that mercury to push<br/> 17 electrons into the cation and thereby form a<br/> 18 carbon mercury bromine composition.<br/> 19       Those three atoms are now attached<br/> 20 to the carbon surface.<br/> 21       There are other channels that<br/> 22 appear in the figure. These have to do with how<br/> 23 sulfur may or may not promote the primary<br/> 24 process.<br/> 25       There is also a lower channel that</p> <p style="text-align: right;">Page 58</p> | <p>1 What happens to sodium bromide or calcium<br/> 2 bromide when it's injected into a furnace?<br/> 3       Does it retain its basic<br/> 4 composition, or does it decompose?<br/> 5       Q. Let me try coming at this a different<br/> 6 way.<br/> 7       A. Okay.<br/> 8       Q. Because I don't want to go down a --<br/> 9       A. Okay.<br/> 10       Q. -- complicated chemistry hole if we<br/> 11 don't need to.<br/> 12       A. It's so much fun.<br/> 13       Q. I'm happy to do it. I just want to<br/> 14 make sure we are talking the same language<br/> 15 before we get too deep in the weeds.<br/> 16       If a bromide, like calcium bromide<br/> 17 or sodium bromide or HBr or Br<sub>2</sub>, any of those<br/> 18 things are added to coal or added to the<br/> 19 combustion chamber and present there, will they<br/> 20 all produce some amount of HBr through that<br/> 21 processes?<br/> 22       MR. TOBIN: Objection. Compound,<br/> 23 incomplete.<br/> 24       THE WITNESS: It's very hard to<br/> 25 say. It's very hard to say. Eventually, when</p> <p style="text-align: right;">Page 60</p>                                   |
| <p>1 talks about how that mercury carbon bromine<br/> 2 composition decomposes into this HgBr<sub>2</sub>, which is<br/> 3 oxidized mercury.<br/> 4       But for -- if I understand the<br/> 5 service of your question, you are primarily<br/> 6 interested in that channel that goes zigzag<br/> 7 carbon site, bromine anion, carbon cation, and<br/> 8 then ultimately, the mercury bromine carbon<br/> 9 composition.<br/> 10       Q. To try to sum it up a bit, what the<br/> 11 figure shows is that you have some amount of<br/> 12 activated carbon, conventional activated carbon<br/> 13 that comes into contact with HBr. The<br/> 14 combination of that carbon H and Br- comes into<br/> 15 contact with mercury and now all of those things<br/> 16 are bound together?<br/> 17       Is that fair?<br/> 18       A. Yeah. That's it.<br/> 19       Q. If a bromide, like sodium bromide or<br/> 20 calcium bromide, is present in a coal combustion<br/> 21 chamber, what happens to it?<br/> 22       Does it stay in that compound, or<br/> 23 does it break down into something else?<br/> 24       A. Could you -- you say -- I'm sorry. If<br/> 25 I understand your question, you're asking me:</p> <p style="text-align: right;">Page 59</p>      | <p>1 the temperature is cooler than it is in the<br/> 2 flame, HBr will form.<br/> 3       But that's not necessarily the<br/> 4 first thing that forms.<br/> 5 BY MR. NEMUNAITIS:<br/> 6       Q. Why are you certain that HBr forms at a<br/> 7 cooler temperature?<br/> 8       A. We ran -- we developed the first and<br/> 9 still, I would argue, the best reaction<br/> 10 mechanism for bromine in coal-derived flue<br/> 11 gases.<br/> 12       It involved many, many dozens of<br/> 13 distinct chemical reactions in the gas phase and<br/> 14 several reactions on carbon.<br/> 15       And when we simulated that<br/> 16 mechanism for the conditions you find in coal<br/> 17 combustors, it told us that bromine atoms are<br/> 18 what most of the bromine additive become at the<br/> 19 furnace exit.<br/> 20       And then as the gases are cooled<br/> 21 further, those bromine atoms react with water to<br/> 22 make HBr. And as it's cooled even further,<br/> 23 those bromine atoms recombine with each other to<br/> 24 make molecular bromine.<br/> 25       So you have a mixture of bromine</p> <p style="text-align: right;">Page 61</p> |

1 atoms, HBr, and Br<sub>2</sub>.  
2 Q. Did you say that when bromine additives  
3 go through the combustion chamber and you are  
4 looking at the furnace exit, that's where they  
5 become bromine atoms?  
6 A. No. They become bromine atoms in the  
7 flame.  
8 Q. Okay.  
9 A. The higher the temperature, the bigger  
10 the proportion of bromine atoms.  
11 Q. So when we're talking about a bromine  
12 additive that's bromide and HBr or Br<sub>2</sub>, it's  
13 going to produce bromine atoms in the flames of  
14 the combustion chamber. Right?  
15 A. That's it.  
16 Q. And when you say, "bromine atom," what  
17 do you mean by that?  
18 A. This is something that's a little  
19 curious because bromine is a halogen and  
20 halogens have seven electrons in their outer  
21 valance shell. That is a bromine atom.  
22 Other people often refer to this as  
23 a "bromine radical" because it's very reactive  
24 since it has one less electron than it needs for  
25 completion. So it's anxious to find another

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1 electron by forming a chemical bond.  
2 Q. Can you explain the terminology? What  
3 is the difference between an atom, a radical,  
4 and an ion?  
5 A. An atom simply refers to the name in  
6 the periodic table. Every element listed in the  
7 periodic table is an atom.  
8 A radical is any atom that contains  
9 an unpaired electron in its outer valance shell.  
10 And that may sound like an ion, but  
11 it's not. There is no -- there is no charge.  
12 If that atom of bromine picks up a  
13 free electron, then it has an extra electron  
14 compared to its atom, so that's an ion.  
15 An ion is one that has an excess  
16 charge.  
17 Q. What does the notation BR<sup>-</sup> refer to?  
18 A. That refers to an ion of bromine.  
19 Q. If you dissolve a bromine salt in  
20 water, for example, would that contain bromine  
21 ions?  
22 A. It would.  
23 Q. Can you explain the difference between  
24 homogenous reactions versus heterogenous  
25 reactions as it relates to using bromine

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1 additives?  
2 A. "Homogenous" is a term for occurring in  
3 one phase.  
4 And when we say, in the context of  
5 mercury control, that reactions are homogenous,  
6 that means they are exclusive confined to the  
7 gas phase. All of the chemistry is in the gas  
8 phase.  
9 Heterogenous involves more than one  
10 phases. And in the context of mercury capture,  
11 mercury chemistry, carbon is a solid, and it's  
12 reacting with species in the gas phase.  
13 Q. Does the distinction between homogenous  
14 versus heterogenous, is that something that  
15 matters to the performance of mercury capture  
16 when we're talking about using activated carbon  
17 or bromine additives?  
18 MR. TOBIN: Objection. Form.  
19 THE WITNESS: It is.  
20 MR. TOBIN: Hold on one second,  
21 please, so we don't talk over each other.  
22 THE WITNESS: Sorry.  
23 It is.  
24 BY MR. NEMUNAITIS:  
25 Q. And can you explain why?

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1 A. Whenever coal is burned, there is a  
2 carbon residue which we call "unburned carbon."  
3 And in addition, another form of  
4 carbon, activated carbon, is injected  
5 deliberately to capture mercury.  
6 So the heterogenous chemistry is  
7 the process whereby unburned carbon or activated  
8 carbon adsorb mercury, capture it from the gas  
9 phase.  
10 And once its captured, it not going  
11 back into the gas phase. It's bonded to the  
12 carbon.  
13 So heterogenous chemistry is the  
14 process you want to occur.  
15 Homogeneous chemistry is important,  
16 also, because I mentioned earlier that oxidized  
17 mercury has a greater affinity for carbon than  
18 metallic mercury. And the oxidation of mercury  
19 can occur homogeneously as well as  
20 heterogeneously.  
21 So you want to know two things.  
22 You want to know how much of the mercury has  
23 been oxidized upstream of the activated carbon  
24 injection point, and then you want to know how  
25 much mercury is that carbon going to collect?

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1 And the answers to those two things  
 2 involve both homogeneous and heterogenous  
 3 chemistry.  
 4 Q. If we're looking at a power plant that  
 5 is just using conventional activated carbon  
 6 injection for mercury capture and they then  
 7 introduce a bromine additive before the boiler,  
 8 is it fair to say that that could improve  
 9 mercury capture because that bromine will  
 10 oxidize the mercury before it gets to the  
 11 carbon?  
 12 MR. TOBIN: Objection. Incomplete.  
 13 THE WITNESS: My answer would be  
 14 the same in that that's part of the story as to  
 15 why the additive improved the mercury capture.  
 16 So I agree that that improves the mercury  
 17 capture, but that's not the only reason, because  
 18 you're focusing on the homogenous chemistry.  
 19 And then in addition, as I just  
 20 said, there is heterogenous chemistry affected  
 21 by the bromine also.  
 22 BY MR. NEMUNAITIS:  
 23 Q. If we introduce a bromine additive  
 24 before the boiler --  
 25 A. Uh-huh.

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1 Q. -- to a power plant that was previously  
 2 just using activated carbon injection, what are  
 3 all of the mechanisms that introducing that  
 4 bromine can use to improve mercury capture?  
 5 MR. TOBIN: Objection to form.  
 6 THE WITNESS: There are two. Two  
 7 main ones. Right? I mean there are always  
 8 going to be lots and lots and lots of things  
 9 that are affected.  
 10 But the two that we think about  
 11 most is that the bromine is going to  
 12 convert -- see, when the flue gas leaves the  
 13 combustor, all of its mercury is in the metallic  
 14 form. All of the mercury in the coal is  
 15 released in the combustor as metallic mercury.  
 16 In the presence of a bromine  
 17 additive and all of those bromine atoms that I  
 18 talked about earlier, some of that metallic  
 19 mercury is going to be oxidized to ionic mercury  
 20 in the gas phase.  
 21 So before we get to the activated  
 22 carbon injection position, some of that metallic  
 23 mercury is going to be oxidized.  
 24 Once we get to the activated carbon  
 25 injection station, now, the bromine can adsorb

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1 onto the carbon, create the oxidation sites in  
 2 that Olson diagram, and those sites will further  
 3 oxidize metallic mercury into oxidized mercury  
 4 and also capture mercury and bond with it on the  
 5 surface.  
 6 BY MR. NEMUNAITIS:  
 7 Q. Did you just describe both of the  
 8 mechanisms?  
 9 A. Both of the benefits.  
 10 Q. Right.  
 11 A. One is that the oxidized -- now, why is  
 12 that a benefit to convert metallic mercury into  
 13 oxidized mercury before the activated carbon  
 14 injections station?  
 15 That's because oxidized mercury has  
 16 a greater affinity for carbon than metallic  
 17 mercury does. It will bind faster to the carbon  
 18 than metallic mercury does.  
 19 Q. You said, "metallic mercury." Is that  
 20 sometimes written with the notation, "HG0"?  
 21 A. It is.  
 22 Q. Just to make sure I have this clearly,  
 23 the two ways that introducing a bromine additive  
 24 can improve a system that's just using  
 25 conventional activated carbon is: The bromine

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1 can oxidize some of the metallic mercury before  
 2 it arrives at the activated carbon injection  
 3 site, and, two, the bromine can bind to some of  
 4 that carbon that's injected and improve mercury  
 5 capture on that carbon?  
 6 A. Yeah. Now, my answer was restricted to  
 7 bromine, carbon and mercury.  
 8 The bromine will also enhance the  
 9 performance of SCR catalysts in oxidizing  
 10 mercury, and an FGD will also capture oxidized  
 11 mercury and retain it.  
 12 I just restricted my answer since  
 13 we have been talking about adsorbing bromine  
 14 additives; but for the sake of completeness now,  
 15 there are other important impacts of that  
 16 bromine additive.  
 17 Q. Why does oxidized mercury have a  
 18 greater affinity for carbon, if that's the  
 19 correct way to say it?  
 20 A. I would refer you to Ed Olson. I don't  
 21 know. I don't know that. I haven't unraveled  
 22 any of the chemistry on the surface to know the  
 23 answer to that question.  
 24 Q. But do you believe that to be a true  
 25 statement?

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1 A. It's empirically, I observed it in the  
2 interpretations of our field test data.  
3 Q. And just so we are clear: You believe  
4 it to be true that oxidized mercury has a  
5 greater affinity for activated carbon even  
6 though you don't personally understand the  
7 chemistry as to why that's the case?  
8 Is that right?  
9 A. Uh-huh.  
10 Q. Is that a "yes"?  
11 A. Sorry?  
12 Q. That's a "yes"?  
13 A. That's a "yes."  
14 Q. I was just clarifying because the  
15 "uh-huh" doesn't make it clear on the record.  
16 A. Sure.  
17 Q. I want to ask you a question about  
18 something in your '517 declaration.  
19 A. Okay.  
20 Q. And its on Page 260 to 261.  
21 A. Okay. I have it.  
22 Q. Do you see Paragraph 319?  
23 A. Yes. I do.  
24 Q. In your '517 declaration, you say, in  
25 referring to Vosteen, that these

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1 discloses adding molecular bromine even though  
2 the quotations that I put on Page 261 do not  
3 contain Br 2?  
4 Q. Right.  
5 A. The answer is yes, Vosteen does  
6 disclose molecular bromine. He refers to it by  
7 name.  
8 Q. And just so I am clear, on -- near the  
9 top of Page 261 of your declaration, there are  
10 some quotes from Vosteen there.  
11 Are you saying that that is  
12 referring to Br 2, or are you saying that other  
13 spots in Vosteen talk about molecular bromine  
14 which means Br 2?  
15 A. I'm saying the latter, that other parts  
16 of his patent disclosure refer to molecular  
17 bromine.  
18 Q. Do you have a copy of Vosteen in front  
19 of you there?  
20 A. Let's see. Exhibit -- let's see.  
21 MR. TOBIN: Counsel, are you  
22 referring to Exhibit 1005?  
23 MR. NEMUNAITIS: Correct.  
24 THE WITNESS: No, I don't think I  
25 do.

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1 bromine-containing ingredients include HBr,  
2 bromine, Br 2, and bromine compounds. Do you  
3 see that?  
4 A. I do.  
5 Q. And then further down, you have some  
6 quotes from Vosteen?  
7 A. I see that.  
8 Q. And I don't see Br 2 in those quotes.  
9 So my question to you is: Is it your opinion  
10 that Vosteen discloses using Br 2, or is it your  
11 opinion that Vosteen discloses other forms of  
12 bromine so that it would be obvious that Br 2  
13 would also work?  
14 A. Well, before I answer, I just want to  
15 make sure I know where, which section this is.  
16 It looks like this is Ground A-2, a combination  
17 of Vosteen with Mass EPA. Is that right?  
18 Q. Sure. Take your time. Read through  
19 it.  
20 A. I want to see where... Oh, no. This  
21 is -- okay. Disclosure and teaching of the  
22 combinations. So this is -- okay. So this is  
23 both Ground A-1 and A-2.  
24 And you're asking me if  
25 Vosteen -- if my opinion is that Vosteen

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1 MR. TOBIN: Counsel, do you want me  
2 to hand him a copy of it?  
3 MR. NEMUNAITIS: Sure.  
4 MR. TOBIN: I'll give it to you.  
5 You can hand it to him.  
6 THE WITNESS: Thank you very much.  
7 BY MR. NEMUNAITIS:  
8 Q. You've just been handed a document  
9 that's been marked "Exhibit 1005." Could you  
10 confirm that that's the Vosteen 589 reference?  
11 A. I can.  
12 Q. Can you turn to Page 11?  
13 A. I have it.  
14 Q. Can you see Paragraph 9?  
15 A. Yes. I can.  
16 Q. It says there, "It is not critical for  
17 the inventive process in what form of bromine  
18 supply is present."  
19 Do you see that?  
20 A. I do.  
21 Q. Do you agree with that?  
22 A. Not necessarily. What happens to the  
23 additive depends on where it is injected.  
24 Q. What do you mean by that?  
25 A. Well, the temperature from the point in

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|   |  |
|---|--|
| <p>1 the furnace where the coal is injected through<br/> 2 the furnace and along the gas-cleaning system<br/> 3 changes by a few thousand degrees.<br/> 4 So where you add the bromine<br/> 5 compound affects the composition -- or I should<br/> 6 say where you add the bromine additive is<br/> 7 largely determined by the temperature at which<br/> 8 it decomposes.<br/> 9 Q. If we are talking about adding a<br/> 10 bromine additive before the boiler or directly<br/> 11 into the boiler, would you agree that it's not<br/> 12 critical what form the bromine is in?<br/> 13 A. It's certainly a lot less important<br/> 14 because the temperature in the flame is so high.<br/> 15 Q. So do you think Vosteen was wrong when<br/> 16 he said it's not critical for the process in<br/> 17 what form the bromine supply is present?<br/> 18 A. No. It's just that he's -- you are<br/> 19 taking the sentence out of context. No. There<br/> 20 is nothing wrong with it if you provide the<br/> 21 context that you are talking about adding the<br/> 22 bromine upstream of the furnace.<br/> 23 Q. Can you take a look at Page 16 of<br/> 24 Vosteen?<br/> 25 A. Uh-huh.</p> <p style="text-align: right;">Page 74</p> | <p>1 A. Uh-huh.<br/> 2 Q. Do you know why Vosteen was running an<br/> 3 experiment at a power plant where he was adding<br/> 4 mercury to the combustion chamber?<br/> 5 A. No. I don't.<br/> 6 Q. Are you familiar with other report or<br/> 7 test or something like that where the power<br/> 8 plant was adding mercury to the coal combustion<br/> 9 chamber?<br/> 10 A. I don't recall ever seeing that before<br/> 11 at full scale. Certainly at lab scale, but not<br/> 12 at full scale.<br/> 13 Q. When you say, "lab scale," is that like<br/> 14 crating a simulated gas in a laboratory?<br/> 15 Something like that?<br/> 16 A. Yes. Something about as big as a<br/> 17 benchtop, yeah.<br/> 18 Q. And so you would have to have mercury,<br/> 19 otherwise there is nothing for you to study?<br/> 20 A. Well, you could burn coal.<br/> 21 Q. Okay.<br/> 22 A. Some have one system to burn the coal<br/> 23 and then they take the flue gases and study it.<br/> 24 But either way.<br/> 25 Q. Do power plants today use the two-part</p> <p style="text-align: right;">Page 76</p> |
| <p>1 MR. TOBIN: And to be clear,<br/> 2 Counsel, when we are talking about pages, are<br/> 3 you talking about the page at the bottom right<br/> 4 corner of that page labeling?<br/> 5 MR. NEMUNAITIS: Yes.<br/> 6 THE WITNESS: I have it.<br/> 7 BY MR. NEMUNAITIS:<br/> 8 Q. Do you see where it refers to Example<br/> 9 5?<br/> 10 A. I do.<br/> 11 Q. Are you familiar with Example 5 and<br/> 12 what this is supposed to be showing?<br/> 13 A. No, it's not in my mind right now. I<br/> 14 am sure I read it several times, but I don't<br/> 15 remember Example 5.<br/> 16 Q. If you need some time to look over, let<br/> 17 me know. I'm not trying to put you on the spot<br/> 18 if you don't remember.<br/> 19 A. Thank you.<br/> 20 Q. Do you see Paragraph 47?<br/> 21 A. Yes. I do.<br/> 22 Q. It says, "In the coal-fired power<br/> 23 station, an experiment was carried out with the<br/> 24 addition of aqueous mercury chloride solution."<br/> 25 Is that right?</p> <p style="text-align: right;">Page 75</p>  | <p>1 system of a bromine additive before the boiler<br/> 2 and activated carbon after the boiler?<br/> 3 A. No.<br/> 4 MR. TOBIN: Objection. Relevance.<br/> 5 BY MR. NEMUNAITIS:<br/> 6 Q. What are the main mercury capture<br/> 7 approaches that compete with that approach of<br/> 8 the two-part bromine before the boiler; carbon<br/> 9 after the boiler?<br/> 10 MR. TOBIN: Are you talking about<br/> 11 today, Counsel?<br/> 12 MR. NEMUNAITIS: Yes.<br/> 13 MR. TOBIN: Objection. Relevance.<br/> 14 THE WITNESS: I really don't know.<br/> 15 BY MR. NEMUNAITIS:<br/> 16 Q. Is there a time period where you would<br/> 17 know the answer to that question?<br/> 18 A. Probably not.<br/> 19 Q. Why is that?<br/> 20 A. The regulations didn't come into effect<br/> 21 until 2015/2016. And at that point, I had moved<br/> 22 away from mercury research so I haven't kept up<br/> 23 with what's happened since and the industry<br/> 24 really responded.<br/> 25 Q. What about in the 2004/2005 time period</p> <p style="text-align: right;">Page 77</p>                           |

1 when you were still involved with mercury  
2 capture? What was your understanding of the  
3 main techniques that would compete against the  
4 two-part bromine before the boiler and carbon  
5 after the boiler approach?  
6 A. The problem is there were no  
7 regulations. So everything was an option. The  
8 marketplace hadn't called winners and losers in  
9 that period.  
10 And from our point of view, we  
11 tried to incorporate as many as we possibly  
12 could into our software package. We didn't know  
13 which ones were going to shake out and become  
14 the winners.  
15 So our approach was to incorporate  
16 as many as we possibly could.  
17 Q. How many different mercury capture  
18 approaches did you incorporate into your  
19 database during that 2004/2005 time period?  
20 A. Approximately two dozen.  
21 Q. Do you know how many of those two dozen  
22 ended up actually being used in actual power  
23 plants when actual regulations went into effect?  
24 A. I do not.  
25 Q. Do you think the two-part system of

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1 adding a bromine additive to coal and using  
2 activated carbon injection is a good option for  
3 mercury capture?  
4 MR. TOBIN: Objection. Relevance.  
5 MR. NEMUNAITIS: You can answer.  
6 MR. TOBIN: Yeah. Unless I  
7 instruct you not to answer, I am just objecting  
8 for the record.  
9 THE WITNESS: Okay. Not  
10 necessarily. It depends on the coal type, the  
11 gas-cleaning configuration, all of those things  
12 come into play.  
13 BY MR. NEMUNAITIS:  
14 Q. Just so it's clear on the record, what  
15 are "all of those things" that you are referring  
16 to?  
17 A. The coal quality, the units in the  
18 gas-cleaning system, the urgency of impending  
19 regulations on NOx, sulfur and other pollutants,  
20 whether or not the plant is likely to be shut  
21 down because of CO2 because of greenhouse gas  
22 considerations.  
23 There is a long list of factors  
24 that come into play in those decisions. Whether  
25 the Trump administration will continue to roll

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1 back active environmental regulations.  
2 MR. NEMUNAITIS: We have been going  
3 about another hour. I think now is a good time  
4 for a break.  
5 MR. TOBIN: Do you want a break  
6 now? Or do you want to keep going until lunch  
7 or take a break?  
8 THE WITNESS: I think we can keep  
9 going to lunch.  
10 MR. NEMUNAITIS: I was going to ask  
11 about some documents that I probably need to put  
12 onto a USB drive.  
13 THE WITNESS: Okay.  
14 MR. TOBIN: Okay.  
15 THE COURT REPORTER: Off of the  
16 record.  
17 (Recess taken.)  
18 THE COURT REPORTER: Back on the  
19 record.  
20 MR. NEMUNAITIS: Are we on the  
21 record?  
22 THE COURT REPORTER: Yes.  
23 BY MR. NEMUNAITIS:  
24 Q. If we're talking about a coal-fired  
25 power plant, where does the flue gas start?

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1 A. I'm going to give you two answers. The  
2 conventional sort of popular answer is at the  
3 furnace exit, which is the boundary between the  
4 last heat exchanger inside the furnace and  
5 what's called "the economizer." Temperature is  
6 usually around 1,000, 1,050 centigrade at that  
7 point.  
8 In my mind, there is no  
9 discontinuity before that. So I think of flue  
10 gas as the combustion products. You have a  
11 flame that's converting the solid coal into  
12 gases; and those gases are added into the  
13 airstreams.  
14 So I think of everything, all of  
15 that gas stream within the furnace, and then  
16 downstream of the furnace as a continuous flow.  
17 But conventionally, flue gas is the  
18 term applied to gases beyond the furnace exit.  
19 Q. So the conventional definition of flue  
20 gas is the gas that exists after the furnace  
21 exit? Right?  
22 A. Yes.  
23 Q. But you are saying that you would  
24 personally drop a distinction somewhere in the  
25 furnace where the heat exchangers end? Is that

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1 correct?  
2 A. No. That's where the furnace exit is.  
3 I am saying that I don't feel any distinction  
4 between the gas at the exit and the gas that's  
5 coming off of the coal in the flame. That's  
6 all, in my mind, it's all the same stream.  
7 Q. Under what you are describing, gas in  
8 the --  
9 A. In the furnace.  
10 Q. -- in the combustion chamber --  
11 A. Yeah.  
12 Q. -- is all part of the same stream?  
13 A. As the flue gas, conventional flue gas.  
14 Q. Okay. Got it. Understood. Can you  
15 explain what a heat exchanger is?  
16 MR. TOBIN: Objection. Form.  
17 THE WITNESS: A heat exchanger is a  
18 mechanical assembly that moves heat from one  
19 stream to another stream.  
20 BY MR. NEMUNAITIS:  
21 Q. So that would be for heating water, for  
22 example?  
23 A. For example.  
24 Q. Are there other uses of heat exchangers  
25 at a coal-fired power plant?

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1 acronym stands for selective catalytic reduction  
2 unit. It's a unit for NOx control. And that  
3 unit contains a catalyst which converts nitric  
4 oxide, NO, in the flue gas into molecular  
5 nitrogen, N2.  
6 So an SCR is units that's used to  
7 reduce the emissions of nitric oxide, which we  
8 continually call "NOx."  
9 Q. How can an SCR impact mercury capture?  
10 A. It turns out in addition to  
11 oxidizing -- or I should say to reducing NO into  
12 N2, that same catalysts oxidizes mercury by  
13 converting it from metallic mercury to ionic  
14 mercury.  
15 Nothing has to be done any  
16 differently. It will do both simultaneously.  
17 Q. Earlier, you referred to a wet FGD.  
18 Right? There is also something referred to as a  
19 dry FGD?  
20 A. Yeah. A dry scrubber.  
21 Q. Is a dry scrubber the same thing as a  
22 dry FGD?  
23 A. I am not familiar with the term "dry  
24 FGD."  
25 Q. Okay. Is a scrubber the same thing as

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1 A. One important use is called the "air  
2 preheater," it's a heat exchanger, and it has  
3 the function of raising the temperature of the  
4 air that's going to be injected into the  
5 furnace.  
6 Q. Why is that done?  
7 A. It's all about maximizing thermal  
8 efficiency.  
9 Q. Are there pollution control units that  
10 are better at capturing oxidized mercury versus  
11 metallic mercury?  
12 A. Yes. There are.  
13 Q. Would that include the FGD and SCR?  
14 A. No.  
15 Q. What are the pollution control units  
16 that are better at capturing oxidized mercury as  
17 opposed to metallic mercury?  
18 A. The epitome is the FGD because the  
19 metallic mercury is insoluble in water. It just  
20 passes right through the FGD. And the ionic  
21 mercury, the oxidized mercury is very soluble in  
22 water. So it's almost entirely recovered in the  
23 wastewater from the FGD.  
24 Q. Can you explain what an SCR is?  
25 A. An SCR, the letters, an acronym, the

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1 a dry FGD?  
2 A. A scrubber is a term that's applied to  
3 any configuration of removing sulfur dioxide  
4 from the flue gas. It could be wet or dry. You  
5 can have a wet scrubber or a dry scrubber.  
6 Q. Is a dry scrubber a pollution control  
7 unit that's better at capturing oxidized mercury  
8 versus metallic mercury?  
9 A. It is, but not by as much as a wet  
10 scrubber.  
11 Q. I want to ask you some questions about  
12 brominated activated carbon. Okay?  
13 Do you know how brominated  
14 activated carbon is produced?  
15 A. I have seen several descriptions of  
16 processes to produce brominated activated  
17 carbon.  
18 Q. What's your understanding of how  
19 brominated activated carbon is produced?  
20 A. One way is that molecular bromine can  
21 be introduced into a barrel that's being mixed  
22 with the carbon. So just by rotating the  
23 barrel, the solids contact the bromine in the  
24 gas phase and it absorbs some of it.  
25 Q. How long does it take for bromine to

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1 absorb to carbon?  
 2 MR. TOBIN: Objection. Incomplete.  
 3 THE WITNESS: Yeah. The answer to  
 4 that question, like almost all questions today  
 5 is: It depends on a long list of different  
 6 factors, the size of the carbon, the type of the  
 7 carbon, where the carbon came from, what's the  
 8 contacting configuration?  
 9 Time connects directly to rate, and  
 10 rate depends on lots of different things:  
 11 Temperature, pressure. All of that stuff  
 12 matters.  
 13 BY MR. NEMUNAITIS:  
 14 Q. Does -- if a power plant is using  
 15 brominated activated carbon, will that convert  
 16 some of the metallic mercury to oxidized  
 17 mercury?  
 18 A. It can.  
 19 Q. Before, when we talked about bromine  
 20 additives and conventional carbon, you said that  
 21 there were two ways that that can improve  
 22 mercury capture. Is that right?  
 23 A. (Nods.)  
 24 Q. Does using brominated activated carbon  
 25 also rely on those same two ways?

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1 activated carbon.  
 2 So this is a question that connects  
 3 with the actual reaction mechanism on the  
 4 surface, and I don't want to register an opinion  
 5 on that aspect of this process.  
 6 You are really asking me about how  
 7 metallic mercury comes to form a chemical bond  
 8 with the carbon surface, and I am not prepared  
 9 to offer an opinion about that.  
 10 Q. Is that because that's outside of your  
 11 area of expertise?  
 12 A. You could say that.  
 13 Q. It is true, though, that using  
 14 brominated activated carbon can capture metallic  
 15 mercury. Right?  
 16 A. It is. Yes.  
 17 Q. And you are saying you are not sure it  
 18 would be a correct way to characterize how that  
 19 metallic mercury comes to be connected to the  
 20 brominated activated carbon. Right?  
 21 A. Right.  
 22 Q. Can you explain how metallic -- or  
 23 strike that.  
 24 Can conventional activated carbon  
 25 without any -- I'm sorry. Strike that.

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1 A. Well, the -- here, again, the  
 2 temperature at the carbon injection point is  
 3 crucial. When I talked about how a bromine  
 4 additive in the gas phase oxidizes metallic  
 5 mercury to ionic mercury, that chemistry occurs  
 6 soon after the furnace exit where the  
 7 temperature is several hundred degrees Celsius.  
 8 Typically, B-PAC is injected after  
 9 the air preheater where the temperature is only  
 10 150 degrees. And at that regime, at the low  
 11 temperature, mercury is not being oxidized.  
 12 It's being adsorbed.  
 13 So it's captured without changing  
 14 anything in the gas phase. It's just removed  
 15 from the gas phase. It's not going to go into  
 16 the gas phase as oxidized mercury.  
 17 Q. When mercury is absorbed to carbon,  
 18 does that mercury have to be in an oxidized  
 19 form?  
 20 A. No.  
 21 Q. Can it be in a metallic form?  
 22 A. Well, the metallic form is not able to  
 23 receive electrons.  
 24 The reactivity is different, but  
 25 the oxidized mercury will adsorb to the

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1 Can conventional activated carbon  
 2 capture metallic mercury?  
 3 A. You know, are we talking about a  
 4 gas-cleaning system or in general or -- what's  
 5 the question?  
 6 Q. The question I am trying to get to,  
 7 although I may be struggling to ask it the right  
 8 way is: If your answer is about brominated  
 9 activated carbon being useful for metallic  
 10 mercury also applied to conventional activated  
 11 carbon.  
 12 So I'll try to ask another  
 13 question. Okay?  
 14 A. (Nods.)  
 15 Q. Can conventional activated carbon be  
 16 injected into a coal-power plant, pollution  
 17 clean-up system so that it can capture metallic  
 18 mercury?  
 19 MR. TOBIN: Objection. Incomplete  
 20 hypothetical.  
 21 THE COURT REPORTER: I'm sorry. I  
 22 missed the last part.  
 23 MR. TOBIN: Sorry. Objection.  
 24 Incomplete hypothetical.  
 25 THE WITNESS: It can be, but it

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1 isn't necessarily going to capture metallic  
2 mercury.  
3 BY MR. NEMUNAITIS:  
4 Q. Do you have an understanding of the  
5 chemistry of how metallic mercury can be  
6 captured by conventional activated carbon, or is  
7 that outside your area of expertise?  
8 A. Well, I have a phenomenological  
9 understanding about that process. And that  
10 phenomenological understanding led to  
11 mathematical simulation capability that has been  
12 very accurate in predicting the transformation  
13 and removal of mercury along the units in a  
14 gas-cleaning system.  
15 But to do that simulation, we did  
16 not need to describe the chemical bond that  
17 forms between the metallic mercury and the  
18 activated carbon surface.  
19 Q. Do you know if metallic mercury adsorbs  
20 or has some other chemical reaction with  
21 conventional activated carbon?  
22 A. We do.  
23 Q. What's your understanding of that?  
24 A. It must be what's called a  
25 "chemisorption." It must form a chemical bond,

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1 and we know that because you can't leach the  
2 mercury in a simple way off of the activated  
3 carbon once it's been removed from the flue gas.  
4 It's stable, and the only way it  
5 can be stable is through a chemical bond.  
6 Q. Do you know what the nature of that  
7 chemical bond is?  
8 A. No. I don't.  
9 Q. Does the word "sorbent" just refer to  
10 types of activated carbon?  
11 A. No. It does not.  
12 Q. What does the word "sorbent" refer to  
13 in the field of mercury capture?  
14 A. It refers to the solid material which  
15 forms a chemical bond and thereby removes the  
16 mercury from the flue gas.  
17 Q. Are sorbents used at power plants for  
18 anything other than mercury capture?  
19 A. Yes, they are.  
20 Q. Can you give me some examples?  
21 A. Well, one is the removal of arsenic.  
22 It turns out lime calcium hydroxide is useful in  
23 removing arsenic from coal-derived flue gases.  
24 Selenium can be removed on carbon  
25 and it also can be removed on calcium sulfate so

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1 there are a couple of different instance where  
2 sorbents are applied.  
3 Q. Were sorbents other than carbon, like  
4 lime or calcium-based sorbents, were those  
5 studied for mercury capture in that 2000 to 2005  
6 time period?  
7 A. They were.  
8 Q. Do you know what the results of the  
9 research into those other sorbents was?  
10 A. Can you be more specific with  
11 "results"?  
12 Q. Can lime or calcium-based sorbents be  
13 used for mercury capture?  
14 A. In a utility gas-cleaning system?  
15 Q. Yes.  
16 A. Not really.  
17 Q. Why is that?  
18 A. Their adsorption rate for mercury is  
19 slower than carbons, and the available residence  
20 time is too short for them to be very effective.  
21 Now, there is a notable exception  
22 to what I just said, but as we're talking about  
23 a comparison between -- let me explain. The  
24 answer to my question is based on some  
25 hypothetical where you take an activated carbon

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1 injection system and replace the sorbent with  
2 lime.  
3 So if you are looking at that kind  
4 of direct comparison, the lime is too slow.  
5 Q. You said there is a notable exception  
6 to this. What was that?  
7 A. It's called a "spray dryer absorber."  
8 It's another form of desulfurization. And in  
9 that unit, a slurry of lime is sprayed into a  
10 vessel, and then contacted with the flue gases.  
11 And they can be very effective.  
12 Those sprays can be very effective at removing  
13 mercury.  
14 Q. When you say, "a slurry of lime," is  
15 that like a liquid that has lime?  
16 A. Yes.  
17 Q. Crushed-up lime in it?  
18 A. Yes.  
19 Q. You used the phrase "residence time."  
20 What is residence time as it relates to mercury  
21 capture?  
22 A. Well, for -- these issues, one really  
23 important residence time is the time it takes  
24 the flue gas on average to move from the outlet  
25 of the air preheater to the inlet of the

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1 particle collector because that's where all of  
2 the chemistry you want to happen has to happen.  
3 Q. I want to ask you a question about the  
4 Sjostrom reference. I think you have a copy of  
5 that, or I can give you a copy.  
6 A. I think I have a copy of it, too. Here  
7 it is. Yes, I have it.  
8 Q. And are you looking right now at what's  
9 been marked as "Exhibit 1010"?  
10 A. I am.  
11 Q. I think earlier today, you had said  
12 that sitting here today, this presentation  
13 describes the first testing you are aware of  
14 where someone actually did bromine before the  
15 boiler and activated carbon after the boiler.  
16 Is that right?  
17 A. Well, I think my answer was somewhat  
18 more ambiguous. I said I didn't remember the  
19 first time that I saw test data on upstream  
20 injection of a bromine additive and  
21 downstream-activated carbon injection, but  
22 that I was certain that Sjostrom provided that  
23 data.  
24 And do you remember I also said  
25 that I may have seen report that she issued

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1 testing program -- and I am not sure -- oh, this  
2 is Meramac Station. So they valued both coal  
3 additives in the same test campaign, and I can  
4 see that KNX and SEA2.  
5 Q. All right. I'm going to ask about  
6 something else here.  
7 MR. TOBIN: Sjostrom, by the way,  
8 is spelled with an J -- S-j-o-s-t-r-o-m.  
9 THE COURT REPORTER: Okay.  
10 MR. TOBIN: S-j-o-s-t-r-o-m. Sorry  
11 about that.  
12 MR. NEMUNAITIS: Here's some  
13 documents. There's one I want to ask about now.  
14 MR. TOBIN: I have three -- well,  
15 let's go off of the record.  
16 (Recess taken.)  
17 MR. NEMUNAITIS: We can go back on  
18 the record.  
19 BY MR. NEMUNAITIS:  
20 Q. All right. Dr. Niksa, can you open up  
21 the file that starts with Exhibit 2034?  
22 A. I have it.  
23 Q. And do you at the bottom, it's marked  
24 "Exhibit 2034"?  
25 A. I keep getting all of these windows

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1 on these tests before she made the  
2 presentation?  
3 Q. Right. Could you take a look at Page  
4 23?  
5 A. I'm sorry. Page?  
6 Q. 23.  
7 A. 23. I have it.  
8 Q. Do you see where it says: KNX, Alstom  
9 Power and SEA2 EERC?  
10 A. Yes, I do.  
11 Q. And do you understand that the  
12 inventors, the patents at issue here, they said  
13 that when they developed their approach, they  
14 referred to the bromine additive as SEA2?  
15 MR. TOBIN: Objection. Form.  
16 THE WITNESS: I'm aware of that.  
17 BY MR. NEMUNAITIS:  
18 Q. Is it possible that the first time you  
19 learned about this two-part process of using  
20 bromine on the coal and activated carbon after  
21 the boiler was based on test data that you  
22 received from the inventors' work?  
23 A. Well, again, I don't remember how I  
24 learned about this scheme the first time. What  
25 you are pointing out is that this particular

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1 flying up here. I don't know how. All of this  
2 generic stuff about Adobe. How did that happen?  
3 Okay. Thank you.  
4 MR. COCHRANE: Yes, sir.  
5 BY MR. NEMUNAITIS:  
6 Q. Have you seen this document before?  
7 A. Let's see. I don't recognize it from  
8 the first page that I am looking at.  
9 MR. TOBIN: Counsel, do you want to  
10 lay some foundation as to why this is  
11 disclosable with Rule 42.53 and why it's in the  
12 scope of direct?  
13 BY MR. NEMUNAITIS:  
14 Q. Do you see at the top, it says, "U.S.  
15 Department of Energy National Energy Technology  
16 Laboratory"?  
17 A. I do.  
18 Q. And is that the same DOE and metal that  
19 we have been talking about today?  
20 A. It is.  
21 Q. And do you see at the top of the second  
22 paragraph, it refers to the Energy and  
23 Environmental Research Center, EERC?  
24 A. Am I -- do I see in the second  
25 paragraph?

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25 (Pages 94 - 97)

1 Q. Yes.  
2 A. Yes, I do.  
3 Q. And is that the EERC that we talked  
4 about earlier today where the inventors were  
5 working at?  
6 A. It is.  
7 Q. And further down, do you see the  
8 paragraph with the title, "Technology Approach"?  
9 A. What page are we on?  
10 Q. Page 1.  
11 A. Page 1. Yes, I do.  
12 Q. And just take a minute to read through  
13 that paragraph if you want.  
14 A. Okay.  
15 Q. You can take more than that if you  
16 need.  
17 A. Okay. I have read through the  
18 paragraph.  
19 Q. Do you see the sentence near the bottom  
20 that says, "Early tests showed that activated  
21 carbon was somewhat effective at capturing  
22 mercury for these coals but was in most cases  
23 limited to about 60 percent removal"?  
24 A. I see it.  
25 Q. And is that consistent with what you

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1 have been describing in your declaration and in  
2 your testimony today?  
3 A. It is.  
4 Q. The document goes on to say -- I'm  
5 sorry. Strike that.  
6 On Page 2, at the top, it says, "To  
7 overcome this limitation, the EERC developed a  
8 sorbent enhancement additive, a technology that  
9 significantly improves the reactivity of AC by  
10 making it more effective at capturing both  
11 elemental and oxidized forms of mercury."  
12 Do you see that?  
13 A. I do.  
14 Q. Do you agree with me that this is an  
15 example of the Department of Energy and NETL  
16 crediting the EERC of developing absorbent  
17 enhancement additive technology?  
18 MR. TOBIN: Objection. Lacks  
19 foundation.  
20 THE WITNESS: You haven't said  
21 anything. You haven't said anything to define  
22 "sorbent enhancement additives." So I have no  
23 way to assess what they are -- what they are  
24 doing.  
25 BY MR. NEMUNAITIS:

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1 Q. You are unfamiliar with the EERC's  
2 sorbent enhancement additive technology?  
3 MR. TOBIN: Objection. Lacks  
4 foundation.  
5 THE WITNESS: I am familiar with  
6 the way that term is used in my references. If  
7 I assume -- maybe I am not willing to assume  
8 that it's the same kind of terminology, but why  
9 don't you give me an example of those, SEA?  
10 BY MR. NEMUNAITIS:  
11 Q. Well, what's your understanding of the  
12 EERC's SEA technology?  
13 MR. TOBIN: Objection. Lacks  
14 foundation. Outside of the scope.  
15 THE WITNESS: My understanding is  
16 that it's some halogen additive.  
17 BY MR. NEMUNAITIS:  
18 Q. Do you agree that the DOE and NETL  
19 credited the EERC with developing halogen  
20 additive technology as it relates to mercury  
21 capture?  
22 MR. TOBIN: Objection. Lacks  
23 foundation and outside of the scope of direct.  
24 THE WITNESS: Well, I certainly  
25 reinforce the idea that it lacks foundation

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1 because you have shown me a paragraph in a flyer  
2 that's advertising one of a multitude of  
3 projects.  
4 This doesn't speak in any way,  
5 shape, or form, to innovation or discovery.  
6 BY MR. NEMUNAITIS:  
7 Q. Do you know what secondary  
8 considerations are and how they are relevant to  
9 the obviousness analysis?  
10 A. I have been instructed about that.  
11 Q. What's your understanding of the  
12 relevance of secondary consideration to an  
13 obviousness analysis?  
14 THE COURT REPORTER: I'm sorry.  
15 Secondary consideration to?  
16 MR. NEMUNAITIS: An obviousness  
17 analysis.  
18 THE WITNESS: If you don't mind, I  
19 would like to take a look at my discussion of  
20 obviousness analyses and see how the  
21 secondary...  
22 Okay. Here we go. Okay. You're  
23 asking me about secondary considerations of  
24 non-obviousness?  
25 BY MR. NEMUNAITIS:

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1 Q. Yes.  
2 A. Well, these can be some longstanding,  
3 unmet need in an area. It could be -- it could  
4 relate to commercial success or a lack of  
5 commercial success.  
6 It could be something like how  
7 unexpected the results were.  
8 It could be how other entities  
9 acknowledge and describe the invention as it's  
10 claimed.  
11 It could be whether anybody bothers  
12 to copy it.  
13 So those are the sorts of things  
14 that I have noted my report.  
15 Q. Is it important to consider secondary  
16 considerations when drawing a conclusion on the  
17 question of obviousness?  
18 MR. TOBIN: Objection to the form.  
19 THE WITNESS: It's a part of an  
20 obviousness analysis of a structure.  
21 BY MR. NEMUNAITIS:  
22 Q. And did you -- was there any evidence  
23 of secondary considerations that you considered  
24 when forming your obviousness opinions?  
25 A. About what?

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1 Q. About the patents at issue in these  
2 IPRs?  
3 A. Do we have any secondary  
4 considerations? I would have to really go  
5 through and take a look at each patent. You  
6 know, take a look at the arguments in each  
7 patent.  
8 Q. Are you aware of any evidence of  
9 secondary considerations of non-obviousness as  
10 it relates to the patents at issue in these IPRs  
11 just sitting here today?  
12 A. I don't recall any right now, which is  
13 not to say that there are none.  
14 Q. I want to ask you about the Starns  
15 reference.  
16 A. Okay.  
17 Q. Which I think you might have a paper  
18 copy.  
19 A. I do, yeah. I do have a paper copy.  
20 Q. And this is a document that's been  
21 marked "1008." Is that right? Can you take a  
22 look at Page 16?  
23 A. I have it.  
24 Q. Do you see Table 7?  
25 A. I do.

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1 Q. Is Table 7 describing how much mercury  
2 was captured during a test at a power plant  
3 using power-activated carbon injection?  
4 A. It is.  
5 Q. And does Table 7 of Starns show that  
6 during that test using activated carbon  
7 injection, they were able to capture 70.7  
8 percent of the elemental mercury?  
9 A. It does.  
10 Q. Does it show that they were able to  
11 capture 74.5 percent of the oxidized mercury?  
12 A. It does.  
13 Q. Is that consistent with your  
14 understanding of the ability of activated carbon  
15 to capture elemental and oxidized mercury?  
16 A. Well, the ability of activated carbon,  
17 untreated activated carbon to capture elemental  
18 and oxidized mercury depends on many, many  
19 different factors.  
20 What you are showing me is, one  
21 particular test result. I wouldn't generalize  
22 anything about anything based on the values in  
23 this table.  
24 Q. So Table 7 shows that the activated  
25 carbon was a little bit more effective at

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1 capturing oxidized mercury than elemental  
2 mercury, but it was not terribly significant.  
3 Would you agree with that?  
4 A. I would agree with that. 74.5 is not  
5 that much greater than 70.7.  
6 Q. Is it your understanding that other  
7 testing was done at some point that showed a  
8 more significant difference between elemental  
9 versus oxidized mercury capture by untreated  
10 activated carbon?  
11 A. That is my understanding. There are  
12 other tests that show more. There are probably  
13 a handful of other tests that show less. So as  
14 I said, these numbers bounce around.  
15 Q. What are the tests that you are  
16 referring to?  
17 A. Other tests in the NETL program.  
18 Q. Are you referring to like a particular  
19 document that's been an issue in these IPRs, or  
20 are you just referring to your general  
21 background of being involved in that space?  
22 A. I am just referring to my general  
23 exposure to data from over 200 different tests,  
24 not all of them directed at this particular  
25 issue, but some were.

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1 Q. Table 7 also shows -- it looks like 100  
2 percent capture of particulate mercury. Is that  
3 right?  
4 A. Yeah.  
5 Q. What is particulate mercury?  
6 A. That's the mercury which is adsorbed to  
7 the activated carbon.  
8 And in this case, you had said 5.7  
9 percent at the inlet.  
10 So this is before the carbon is  
11 injected. That tells me that 5 percent, 5.7  
12 percent, of the mercury released by the coal was  
13 captured on unburned carbon.  
14 MR. NEMUNAITIS: Do you mind if we  
15 take a break to give me a chance to check and  
16 look over my notes? I may be getting close to  
17 done.  
18 MR. TOBIN: Off of the record.  
19 THE COURT REPORTER: Off of the  
20 record.  
21 (Recess taken.)  
22 THE COURT REPORTER: Back on the  
23 record.  
24 BY MR. NEMUNAITIS:  
25 Q. I wanted to ask you a couple of

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1 Q. Okay. And so could you just explain,  
2 what is Table 1 on the Mass EPA?  
3 A. Okay. Table 1, the legend is a  
4 selection of approaches demonstrated or under  
5 investigation to control mercury. Some of those  
6 could reasonably fall into more one category.  
7 Q. So Table 1 is basically a list of the  
8 EPA's approaches for mercury capture that were  
9 being studied at that time. Is that right?  
10 A. Well, let's distinguish the federal EPA  
11 from the Massachusetts EPA. This is the  
12 assessment of the Massachusetts EPA.  
13 Q. Do you know if there are any  
14 differences between what the Massachusetts EPA  
15 was stating versus the federal EPA?  
16 A. Well, no. I am not privy to any kind  
17 of comparison between... I'm not aware of any  
18 direct comparisons between this table and any  
19 other hypothetical table prepared by the federal  
20 EPA.  
21 Q. Table 1 does not list as one of the  
22 approaches being studied adding bromine before  
23 the boiler and adding activated carbon injection  
24 after the boiler? Right?  
25 A. Table 1 does not list that option, but

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1 questions about the Mass EPA reference.  
2 A. Okay.  
3 Q. It's on Exhibit 1009.  
4 A. I have that.  
5 Q. In particular, at page 7.  
6 MR. TOBIN: Counsel, are you  
7 talking about the bottom right corner of Page 7,  
8 which is Page 3 of the document? Is that right?  
9 BY MR. NEMUNAITIS:  
10 Q. Page -- could you turn to Page 11 under  
11 the Exhibit Number 1009?  
12 A. Okay. I have a Table 1 on Page 11.  
13  
14 Q. Right. Do you remember at the  
15 beginning of the deposition, I asked you if  
16 there was a list of sort of the best mercury  
17 capture technologies that came out of NETL's  
18 research?  
19 A. I do.  
20 Q. And I believe you had referenced a  
21 table in the Mass EPA document. Is that  
22 correct?  
23 A. I do. It's this table.  
24 Q. Table 1?  
25 A. Yeah.

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1 certainly this document discusses halogen  
2 promotion of activated carbon.  
3 Q. Halogen -- what do you mean by "halogen  
4 promotion of activated carbon"?  
5 A. It means, specifically in context of  
6 our session, adding bromine to activated carbon  
7 to enhance mercury removal.  
8 Q. Do you have a memory of the first time  
9 you learned about using brominated activated  
10 carbon injection?  
11 A. No. I wouldn't go that far. What I  
12 would say is that in this time period, we have  
13 often referred to 2002 to 2006. I heard many,  
14 many presentations by Sid Nelson talking about  
15 his commercialization of B-PAC as a viable  
16 mercury control technology.  
17 Q. Do you remember if you learned about  
18 B-PAC before or after you learned about the  
19 two-part process of adding bromine before the  
20 boiler and activated carbon after the boiler?  
21 A. I learned about B-PAC first.  
22 Q. How do you know that?  
23 A. Well, what I -- to give you the answer  
24 that I want to give, I would go through all of  
25 the conference proceedings of the conferences

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28 (Pages 106 - 109)

|   |  |
|---|--|
| <p>1 that I attended in this period, and I would look<br/>2 to see how Vosteen and Nelson, how those<br/>3 presentations were arranged in time.<br/>4 Because Vosteen disclosed bromine<br/>5 additives with activated carbon and Nelson<br/>6 disclosed B-PAC, and then these presentations,<br/>7 they talked about different implementations of<br/>8 their technologies.<br/>9 Q. You are saying Vosteen put out a paper<br/>10 or gave a presentation where he said to use<br/>11 bromine additives with activated carbon<br/>12 injection?<br/>13 A. I am saying that Vosteen's patent, what<br/>14 we referred to as the '586 patent, teaches the<br/>15 combination of a bromine additive with activated<br/>16 carbon.<br/>17 Q. I am going to be real specific here.<br/>18 You are saying that the Vosteen patent discloses<br/>19 the use of bromine additives before the boiler<br/>20 and activated carbon injection after the boiler?<br/>21 A. I didn't say, "activated carbon<br/>22 injection." I said, "activated carbon."<br/>23 Q. When you talked about Vosteen attended<br/>24 the conferences, do you have a memory of Vosteen<br/>25 saying to use bromine additives with activated</p> <p style="text-align: right;">Page 110</p> | <p>1 THE COURT REPORTER: Off the<br/>2 record.<br/>3 (Conversation held off the record.)<br/>4 THE COURT REPORTER: Back on the<br/>5 record.<br/>6 EXAMINATION<br/>7 BY MR. TOBIN:<br/>8 Q. Hi, Doctor. So this is David Tobin. I<br/>9 want to follow up on the discussion of flue gas.<br/>10 Can a combustion chamber have<br/>11 multiple combustion zones such as primary or<br/>12 re-burn?<br/>13 A. Yes, it can.<br/>14 Q. Can you explain that?<br/>15 A. Well, if we think of the height of the<br/>16 combustor from bottom to top, then we use the<br/>17 term "elevation" to describe some location up.<br/>18 And if you start from the very<br/>19 bottom, there is an ash recovery zone. It's<br/>20 where the combustor necks down into a duct.<br/>21 That's -- there is no combustion happening here<br/>22 because immediately above that zone, you have<br/>23 what's called the "burner belt."<br/>24 Q. I'm sorry. Burner what?<br/>25 A. Burner belt.</p> <p style="text-align: right;">Page 112</p>   |
| <p>1 carbon injection?<br/>2 A. No. I mean, this was 20-something<br/>3 years ago. And that's what -- that's what I<br/>4 certainly don't remember. I don't remember if I<br/>5 first -- if I heard Vosteen before I heard<br/>6 Nelson.<br/>7 You know, coincidentally, their<br/>8 patents were issued on the same day, just by a<br/>9 striking coincidence. So I certainly don't<br/>10 recall who happened to make a presentation to my<br/>11 ears first, but it was certainly around the same<br/>12 time.<br/>13 And I had many conversations with<br/>14 both Vosteen and Nelson, and I don't remember<br/>15 any of the specifics about those conversations.<br/>16 Q. When -- how did you first learn about<br/>17 bromine or Vosteen's work? Was that through<br/>18 presentations or reviewing the patents?<br/>19 A. It was definitely not reviewing the<br/>20 patents. It was definitely through conference<br/>21 presentations.<br/>22 MR. NEMUNAITIS: I will pass the<br/>23 witness.<br/>24 MR. TOBIN: Give me a few minutes<br/>25 to check my notes. Let's go off of the record.</p> <p style="text-align: right;">Page 111</p>   | <p>1 Q. Okay. Continue, please.<br/>2 A. And That's where the coal and primary<br/>3 air and secondary air are mixed into these<br/>4 flames.<br/>5 So that's where the combustion<br/>6 starts, and that's where typically anywhere from<br/>7 a third to two-thirds of the coal is converted<br/>8 into gases.<br/>9 Those gases then mix with vitiated<br/>10 air because the oxygen came from the air. So it<br/>11 was consumed in the combustion.<br/>12 And mixed with that vitiated air,<br/>13 it makes this stream which flows up into further<br/>14 up towards the top of the combustor.<br/>15 Now, if one is applying selective<br/>16 non-catalytic reduction technology for NOx<br/>17 control, in that case, they would inject<br/>18 additional coal a little above the mid-way point<br/>19 in the elevation and make new flames that can<br/>20 reduce the NO produced in the first primary zone<br/>21 to N2.<br/>22 So you can have flue gas in the<br/>23 burner belt, what I call "flue gas in the burner<br/>24 belt," some people call it "combustion gases."<br/>25 You can have additional combustion</p> <p style="text-align: right;">Page 113</p> |

1 gases generated further upstream.  
 2 Q. So is it fair to say that flue gas  
 3 exists in multiple locations within the  
 4 combustion chamber, itself?  
 5 A. I see it that way, yeah. But  
 6 conventionally, in terms of, you know, a strict  
 7 definition, a lot of people say you don't use  
 8 flue gas until you are at the furnace exit.  
 9 Q. You would say that flue gas is in the  
 10 combustion chamber?  
 11 A. Yeah. Because I don't see any  
 12 difference between -- there is nothing happening  
 13 to the flue gas that traverses that boundary.  
 14 Q. Okay.  
 15 A. It didn't change.  
 16 MR. TOBIN: I'll pass the witness.  
 17 RE-EXAMINATION  
 18 BY MR. NEMUNAITIS:  
 19 Q. Just briefly, is there something called  
 20 a "flue" at a power plant?  
 21 A. No. It's, you know, this goes back to  
 22 the days. There is something called a  
 23 "stoker-fired combustor," which literally is a  
 24 chain, a grate that moves. You pile these big  
 25 lumps of coal on it, and then air comes in from

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1 the bottom and burns up the coal.  
 2 That combustor has a flue. There  
 3 is a pipe that collects all of the gases from  
 4 that.  
 5 Now, we don't burn hardly any coal  
 6 anymore in stoker-fired combustors, but that's  
 7 where the terminology comes from. Even though  
 8 now we have gas-cleaning systems, people still  
 9 apply the terminology of "flue" to the gases as  
 10 they move along the gas-cleaning system.  
 11 MR. NEMUNAITIS: Nothing further.  
 12 MR. TOBIN: Okay. Let's end it.  
 13 And we will reserve the right to review and  
 14 sign.  
 15 THE COURT REPORTER: Thank you.  
 16 Off of the record.  
 17 (Deposition concluded at 1:33 p.m.)  
 18  
 19  
 20  
 21  
 22  
 23  
 24  
 25

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1 CHANGES AND SIGNATURE  
 2 TO THE ORAL DEPOSITION OF  
 3 STEPHEN NIKSA, PhD  
 4 November 20, 2025


| 5 Page | Line | Change | Reason |
|--------|------|--------|--------|
| 6      |      |        |        |
| 7      |      |        |        |
| 8      |      |        |        |
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| 24     |      |        |        |
| 25     |      |        |        |

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1 I, STEPHEN NIKSA, PhD, have read the foregoing  
 2 deposition and hereby affix my signature that same is  
 3 true and correct, except as noted above.  
 4 \_\_\_\_\_  
 5 (Signature of witness)  
 6 STATE OF \_\_\_\_\_  
 7 COUNTY OF \_\_\_\_\_  
 8 Before me, \_\_\_\_\_, on this day  
 9 personally appeared STEPHEN NIKSA, PhD, known to me  
 10 (proved to me under oath or through  
 11 \_\_\_\_\_) (description of identity card  
 12 or other document) to be the person whose name is  
 13 subscribed to the foregoing instrument and  
 14 acknowledged to me that he executed the same for the  
 15 purposes and consideration therein expressed.  
 16 (Seal) Given under my hand and seal of office  
 17 this \_\_\_\_\_ day of \_\_\_\_\_, 2025.  
 18  
 19  
 20  
 21 \_\_\_\_\_  
 22 Notary Public in and for  
 23 the State of \_\_\_\_\_.  
 24  
 25

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1 UNITED STATES PATENT AND TRADEMARK OFFICE  
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD  
3 BERKSHIRE HATHAWAY ENERGY COMPANY  
4 Petitioners  
5 v.  
6 BIRCHTECH CORP.  
7 Patent Owner  
8 IPR2025-00274 (Patent No. 10,343,114 B2)  
9 IPR2025-00278 (Patent No. 10,343,114 B2)  
10 IPR2025-00280 (Patent No. 10,596,517 B2)  
11 IPR2025-00281 (Patent No. 10,596,517 B2)  
12  
13 DEPOSITION OF STEPHEN NIKSA, PhD  
November 20, 2025  
14  
15 I, Suzanne Kelly, RDR, CRR, in and for the State  
of Texas hereby certify to the following:  
16 That the witness, STEPHEN NIKSA, PhD, was duly  
sworn by the officer and that the transcript of the  
17 oral deposition is a true record of the testimony  
given by the witness;  
18  
That the deposition transcript was submitted on  
19 the \_\_\_\_ day of \_\_\_\_\_, 2025, to the witness for  
examination, signature and return to Suzanne Kelly by  
20 the \_\_\_\_ day of \_\_\_\_\_, 2025;  
21 That the amount of time used by each party at the  
deposition is as follows:  
22  
Mr. Nemunaitis: 3 hours and one minute used;  
23 Mr. Tobin: Three minutes used;  
24  
25

1 That pursuant to the information given to the  
deposition officer at the time said testimony was  
2 taken, the following includes counsel for all parties  
of record  
3  
FOR THE PETITIONER:  
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14 rcrochane@caldwellcc.com  
15 I further certify that I am neither counsel for,  
related to, nor employed by any of the parties or  
16 attorneys in the action in which this proceeding was  
taken, and further that I am not financially or  
17 otherwise interested in the outcome of the action.  
18 In witness whereof, I have this date subscribed my  
name on this 12th day of December, 2025.  
19  
20   
21 \_\_\_\_\_, CRR  
Certification No. 1260  
22 Expiration Date: 11-30-25  
VERITEXT LEGAL SOLUTIONS  
23 Firm Registration No. 571  
300 Throckmorton Street  
24 Suite 1600  
Fort Worth, Texas 76102  
25 817.336.3042 1.800.336.4000

[& - 5]

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| <b>1</b>   | <b>1260</b> 1:16<br>119:21  | <b>2001</b> 15:22  | <b>214.210.2793</b>   |
| <b>1</b> 52:23 71:23<br>98:10,11<br>107:12,24<br>108:2,3,7,21,25 | <b>12th</b> 119:18  | <b>2002</b> 15:23<br>25:18,22 26:1<br>26:19 109:13   | 2:5 119:7<br><b>214.888.4848</b>  |
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[5.7 - adding]

|                        |                       |                       |                       |
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[addition - anybody]

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[anymore - behave]

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[behaves - bromine]

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[bromine - carbon]

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[carbon - clear]

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[clear - comparing]

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[controlled - decision]

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[dissolve - engineer]

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[enhance - fair]

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[impacts - interpreting]

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[introduce - laboratory]

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[niksa - options]

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[oral - pavlish]

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[temperature - tobin]

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[tobin - understanding]

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[understanding - vosten's]

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate.

The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

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COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

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