Attachment 2

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON AT SEATTLE

SIERRA CLUB, a California nonprofit corporation; PUGET SOUNDKEEPER ALLIANCE, a Washington nonprofit corporation; RE SOURCES FOR SUSTAINABLE COMMUNITIES, a Washington nonprofit corporation; COLUMBIA RIVERKEEPER, a Washington nonprofit corporation; FRIENDS OF THE COLUMBIA GORGE, INC., dba FRIENDS OF THE COLUMBIA GORGE, an Oregon nonprofit corporation; SPOKANE RIVERKEEPER; NATURAL RESOURCES DEFENSE COUNCIL, a New York nonprofit corporation,	CASE NO. C13-00967JCC SEATTLE, WASHINGTON November 14, 2016 BENCH TRIAL, Vol. 5
Plaintiffs,	
v.	
BNSF RAILWAY COMPANY, a Delaware corporation,	
Defendant.	

VERBATIM REPORT OF PROCEEDINGS
BEFORE THE HONORABLE JOHN C. COUGHENOUR
UNITED STATES DISTRICT JUDGE

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1 November 14, 2016 9:35 a.m.
PROCEEDINGS
2 ---
3 THE COURT: All right. Call your next witness.
4 MR. TEBBUTT: We call Dr. Robert Breidenthal.
5 ROBERT BREIDENTHAL, HAVING BEEN FIRST DULY SWORN, TESTIFIED AS FOLLOWS:
6
7 THE CLERK: Please state your full name, and spell
8 your last name for the record.
9 THE WITNESS: Robert Edward Breidenthal, Jr.
10 B-r-e-i-d-e-n-t-h-a-l.
11 DIRECT EXAMINATION
12 BY MR. TEBBUTT:
13 Q Good morning, Dr. Breidenthal.
14 A Good morning.
15 Q Now, you've been here for some days of trial already last
16 week, have you not?
17 A Yes.
18 Q And which days were you here?
19 A Every day but Wednesday and, of course, Friday.
20 Q All right. Thank you.
21 Tell us your educational background, please.
22 A I graduated from Wichita State University in 1973, and I
23 have a bachelor of science in aeronautical engineering, a
24 bachelor's in '74 in aeronautics from Caltech, and a Ph.D.
25 in aeronautics, also from Caltech, in '79, and about a year

1 and a half as a post-doc, again at Caltech.
2 Q Where did you grow up, sir?
3 A Mainly, Wichita, Kansas.
4 Q What is your present occupation?
5 A I'm a professor at the William E. Boeing Department of
6 Aeronautics and Astronautics at the University of Washington.
7 Q As you know, Dr. Breidenthal, next to the judge the most
8 important person in the room is the court reporter, so we
9 want to make sure we don't talk over one another, and speak
10 up so the court reporter can hear you as well.
11 How long have you been a professor at the University of
12 Washington?
13 A Full professor since 1997. I started as a research
14 assistant professor there in 1980.
15 Q Do you have any professional memberships?
16 A American Physical Society and the American Institute of
17 Aeronautics and Astronautics.
18 Q Would you please describe in more detail your particular
19 areas of professional expertise?
20 A Fluid mechanics, which includes aerodynamics, and, in
21 particular, turbulence.
22 Q Have you done -- in addition to your professorial duties,
23 have you done work in that field of fluid mechanics? Is that
24 what you said?
25 A Fluid mechanics, yes.

1 Q Okay.
2 Have you done work as part of your or in addition to
3 your work as a professor at the University of Washington?
4 A Yes. I've done a lot of outside consulting for industry.
5 Q And please tell us who you've worked for.
6 A Oh, perhaps 40 or more companies, including Boeing,
7 Cessna, Learjet. The most recent one is, actually, L'Oreal,
8 for face brushes.
9 Q And without revealing any confidences, what would be --
10 how does your field apply to what you just did for L'Oreal?
11 A Well, it involves also two-phase flow. This time it is a
12 liquid water with little air bubbles, and the speeds of these
13 vibrating brushes is so high that the flow actually is
14 transitional or turbulent. So there is a pretty close
15 overlap with my research background.
16 Q You mentioned the phrase two-phase flow. Not all of us
17 understand what that concept means. Can you describe that in
18 more detail, please?
19 A Yes. Two-phase flow is where you have, as we have in this
20 case, coal dust in the air, where you have two different
21 phases.
22 In the case of coal dust, or a solid phase, the coal, and
23 the other fluid is air. And, ironically, we call those
24 liquids and gases, like air fluids. They're all behave
25 exactly the same way. As long as the Mach number is well

1 below one, the flow in air and the flow in water are
2 identical. In fact, the first F22 model tested was in a
3 water tunnel in my research group.
4 So a two-phase flow, one phase can be solid, like for
5 example, the coal dust particles, or it could be a liquid,
6 like a raindrop in air. Two-phase flow just means there are
7 two separate phases.
8 Q Sir, did I ask you if you were a member of any
9 professional associations?
10 A I believe you did, but I can repeat that answer.
11 Q If I did, then I won't ask you again.
12 Describe for us the classes that you teach at the
13 University of Washington.
14 A I teach both undergraduate and graduate classes in
15 aerodynamics, more broadly fluid mechanics, turbulence. Most
16 of the classes are either graduate or upper-division,
17 undergraduate classes, the juniors and seniors, but I've also
18 taught sophmore thermodynamics in a freshman case.
19 Q So are your generally upper-level classes like 3- and
20 400-level classes?
21 A Correct, as well as higher-level graduate classes.
22 Q And are you -- do you have master's students?
23 A Yes. I have a handful of them at the moment. I've had
24 many of them over the years.
25 Q And what about Ph.D. students?

A Yes, I've had a number of them over the years. At the moment I think I have one or two.

Q The classes that you teach in physics -- I'm sorry. The classes that you teach, do they involve physical principles?

A Yes. In fact, I like to emphasize the fundamentals in my classes.

Q Okay. And are you a quantum physicist?

A No.

Q What type of physicist are you?

A It's classic physics. Basically, it's the physics of before Einstein, the physics before relativity and quantum mechanics.

It turns out that my field of turbulence, although it is part of the class of physics, it's really not handled by a physics department. It involves engineers to do the bulk of the work on turbo flows.

Q Do you consider yourself an engineer or a scientist or both?

A Both.

Q Describe for us projects that you've -- some projects -- specific projects that you've worked on that are applicable to the type of problem that's before this court right now.

A The problem before the court -- before the court now has to do with turbulence and two-phase flow. And I worked on turbulence problems for a long time, since the '70s, mixing

1 and entrainment and turbulent waste and sheer layers, and
2 that work in turbulence continues to this day.
3 Two-phase flows have included not only this L'Oreal facial
4 brush that I mentioned, but a flow around a bus -- turns out
5 Metro city buses had a problem that the rear left-view mirror
6 on the driver's side would be obscured as soon as the bus
7 drove onto wet pavement. And the problem was that this
8 particular type of bus had a very poorly designed, from an
9 aeronomic viewpoint, front end, and there was massive flow
10 separation around the a-pillar, the vertical pillars at the
11 very front corners of the bus. And when the bus would drive
12 over wet payment, the left front tire would throw up mud and
13 water. And because of this mass of separation there, that
14 debris would be conducted forward and impinge and deposit
15 itself on the mirror, and the bus driver couldn't see.
16 Q Were you able to solve that problem?
17 A Yeah. For a while there were thousands of Metro buses
18 that had this black, vertical turning vanes installed on
19 them. I designed it.
20 Q And the other, you said, 40 or so companies that you had
21 worked for, were you hired to help solves problems?
22 A Yes.
23 Q And were you able to satisfactorily solve problems for the
24 companies you worked for?
25 A Yes. There was one case where we only had a partial

1 solution, but I think in all the other cases we solved them.
2 Q Do you have any patents or copyrights that you own?
3 A No copyrights. I think 10 or so patents, and maybe 50
4 pending.
5 Q Are you published, sir?
6 A Yeah. I have 60-something publications.
7 Q And of those publications, how many are related to
8 two-phase flow problems?
9 A I'd have to count them, but to estimate, in the order of
10 five, I suppose.
11 Q And of the other literature that you've published, how
12 many relate to fluid mechanics?
13 A All of them except for one book chapter I wrote.
14 Q And I'd also like to ask you about aerodynamics. When you
15 talk about fluid mechanics, does that incorporate
16 aerodynamics?
17 A Yes.
18 Q Do you consider yourself an expert in fluid mechanics?
19 A Yes.
20 Q And do you consider yourself an expert in aerodynamics?
21 A Yes.
22 MR. TEBBUTT: Your Honor, at this point I'd like to
23 tender Dr. Breidenthal as an expert in fluid mechanics and
24 aerodynamics.
25 MR. KLEIN: Your Honor, I object, and I'd ask for the

1 opportunity to voir dire the witness about it.
2 THE COURT: All right.
3 VOIR DIRE EXAMINATION
4 BY MR. KLEIN:
5 Q Good morning, Dr. Breidenthal.
6 A Good morning.
7 Q For the record, I'm Eric Klein. We've met once before.
8 Good to see you, sir.
9 You filed your expert report in this case on May 6,
10 2016, right?
11 A I can double-check, if you want.
12 Q Let me ask it this way: You filed an expert report
13 rebuttal and a supplemental report in this case, right?
14 A Correct.
15 Q And are all your opinions contained within those three
16 reports?
17 A I think that is a fair statement. The broad-brush
18 treatment of my opinions are all in those reports.
19 Q Have you drawn conclusions in this case that are not
20 reflected in one of those three reports?
21 A No. All of my broad-brush conclusions are in those
22 reports.
23 Q Have you done any research or analysis that was not
24 reported in one of those three reports?
25 A Nothing pertaining to the broad conclusions. I have

1 continued to look at the numbers since then.
2 Q Can you tell me what you have done specifically when you
3 say you've continued to look at the numbers since then?
4 A I've looked at the kinds of particle numbers associated
5 with the Jaffe paper that we discussed.
6 Q Have you reviewed any other documents in this case to work
7 with numbers, other than the Jaffe study?
8 A No.
9 Q So your work in this case that you're referring to that is
10 not reflected in one of your three reports pertains to the
11 study of the Jaffe report only; is that right?
12 A Yes. But as I said, my comments about the Jaffe report,
13 the broad-brush comments are reflected in those three
14 reports.
15 Q And if I may ask, sir, how did you come to be involved in
16 this case?
17 A I got an email from a colleague at the University of
18 Washington, Marsha Baker, and she asked me if I was
19 interested, to get in touch with Mr. Tebbutt.
20 Q Are you a member of any plaintiff organizations in this
21 case?
22 A No.
23 Q And did you have a relationship prior to this case with
24 any of the witnesses or attorneys that are working in this
25 case?

1 A No.
2 Q And aeronautics is the engineering and science of flight
3 vehicles, right?
4 A Yeah, narrowly defined, that's true.
5 Q Aeronautics does not typically involve engineering or
6 science of trains, right?
7 A I would say, especially my education, especially at
8 Caltech, the emphasis there that it is a science school and
9 the emphasis is on the fundamentals. And, in fact, almost
10 none of the research in aeronautics at Caltech had anything
11 to do with airplanes. It had to do with fundamental fluid
12 mechanics.
13 So that training and work that I've done since then has
14 been almost completely at a very fundamental level that is
15 applicable for all kinds of applications: Boats, trains,
16 planes, submarines, the atmosphere of the oceanic,
17 geophysics.
18 Q So you're telling me that aeronautics does include the
19 engineering and science of trains?
20 A Well, certainly the research done in aeronautics
21 departments and my own particular training and research was
22 at a fundamental level and is applicable to an extremely wide
23 variety of engineering devices.
24 MR. KLEIN: Your Honor, I'd like to use his
25 transcript. I'm not a master of this court's procedure.

1 Shall I approach and hand the court a copy of his sealed
2 transcript?
3 THE COURT: Yes, that's fine.
4 THE CLERK: I've got one already.
5 MR. KLEIN: Okay. Mr. Pierson, if you wouldn't mind
6 handing him a copy of that, please.
7 Q (By Mr. Klein) Dr. Breidenthal, did you give a deposition
8 in this case?
9 A Yes.
10 Q And did I take that deposition?
11 A Yes.
12 Q At the beginning of that deposition, did you take a oath?
13 A Yes.
14 Q Did you swear to tell the truth?
15 A Yes, I did.
16 Q Did you tell the truth?
17 A Yes, I did.
18 Q Is the transcript before you a copy of the transcript of
19 the deposition you gave, to the best you can ascertain by
20 looking at it now?
21 A Yes.
22 Q Would you turn with me to page 10? Are you there?
23 A Yes.
24 Q At line 8, did I ask you, "Tell me about the field of
25 aeronautics." And Mr. Tebbutt objected. I said, "You may

1 answer."
2 And did you answer, "It has to do with the engineering
3 and science of flight vehicles"? Is that what you said?
4 A Yes.
5 Q And did I ask you, "Does that include trains?"
6 A Yes.
7 Q And you answered, "I would say that not specifically under
8 the title of aeronautics," didn't you?
9 A Yes.
10 Q Okay.
11 You have, prior to this case, had no more than
12 expertise with trains than the average person, correct?
13 A No.
14 Q That's not right?
15 A That is not right.
16 Q Okay.
17 Would you turn to me to page 156? Are you there?
18 A Yes.
19 Q At line 9 did I ask you, "And you don't have particular
20 experience with trains, do you?" Is that what I said?
21 A Yes, you asked about experience.
22 Q And your answer was, "I took Light Rail getting to our
23 meeting today, but other than that kind of experience, no."
24 Is that what you said?
25 A Yes.

1 Q You've done no consulting projects relating to trains,
2 right?
3 A I've not consulted on train problems, but as I indicated
4 to you at the time of my deposition, this Metro bus problem
5 is related. It is two-phase flow about a blind vehicle with
6 mass transportation.
7 Q Sir, this is going to take a very long time unless you
8 answer my questions directly.
9 I ask you --
10 MR. TEBBUTT: Your Honor, objection; argumentative.
11 THE COURT: Overruled.
12 Q (By Mr. Klein) I asked you, you've done no consulting
13 projects related to trains, have you?
14 A If by "related" you mean pertaining specifically to train
15 application, the answer is no.
16 Q And you've conducted no experiments or collected no data
17 from trains, correct?
18 A Except for my Rule 34 assignment of answers, correct.
19 Q Prior to this case, you've read no papers on rail
20 operations or the associated engineering issues?
21 A Correct.
22 Q And you conducted no observations of rail operations in
23 particular?
24 A Yes, you're correct.
25 Q And prior to this case, you've not spent any time thinking

about how materials carried by trains can behave in transit, right?
A Correct.
Q And prior to this case, you've spent no time thinking about train vibration, right?
A Correct.
Q And this is your first experience analyzing coal or coal piles, right?
A Yes.
Q It is your first experience analyzing coal loss from trains, right?
A Right.
Q And it is your first experience analyzing the erosion of coal from coal piles, correct?
A Correct.
Q It is your first experience analyzing how a pile of coal will behave when expose to wind, right?
A Yes.
Q Or moisture?
A Yes.
Q And it's your first experience analyzing how train vibration might impact coal erosion?
A Correct.
Q Or how train vibration would impact any kind of particle erosion, right?

1 MR. TEBBUTT: Objection; vague and ambiguous.
2 THE COURT: Overruled.
3 THE WITNESS: Could you repeat the question? I'm
4 sorry.
5 Q (By Mr. Klein) You've never analyzed before this case how
6 train vibration impacts any kind of aeolian erosion, right?
7 A Correct.
8 MR. KLEIN: Your Honor, Mr. Tebbutt, if I may.
9 As part of the plaintiffs proffer the witness as an expert
10 of aeronautics, it is my understanding that the plaintiff
11 will testify about rail car covers, and if that is the case,
12 I'd like to continue my voir dire on the topic of rail car
13 covers.
14 MR. TEBBUTT: Your Honor, Dr. Breidenthal's testimony
15 will be limited to the aerodynamics and the feasibility of
16 car covers from an aerodynamic physical perspective, not, for
17 instance, the mechanical attachment of how you attach a car
18 cover that might be designed to a physical rail car. But the
19 aerodynamics are clearly within Dr. Breidenthal's realm.
20 MR. KLEIN: And if I may, Your Honor, our argument is
21 that the feasibility of railcar covers necessarily includes
22 and incorporates questions about how railcar covers are
23 attached, how they function on a rail line logistically.
24 THE COURT: You can take that up on cross.
25 MR. KLEIN: Okay.

1 Q (By Mr. Klein) Do you consider yourself an expert in dust
2 compression systems?
3 A No.
4 Q Prior to this case, you had no experience evaluating any
5 kind of dust compression systems?
6 A Correct.
7 Q It is your expert opinion that BNSF coal trains at typical
8 train speeds emit coal dust continuously, right?
9 A I think the term I might have used is "essentially
10 continuously," but, yes.
11 Q Did you not write in paragraph 3 of your expert report in
12 this case that the data indicates that low-level dusting is
13 continuous at typical train speeds?
14 A Yes.
15 Q Do you stand by that now?
16 A I do.
17 Q You believe that emissions reach water whenever a train
18 passes over or near a waterbody, right?
19 A Yes, I do.
20 Q You believe that this emission to water at every waterbody
21 occurs throughout the entire state of Washington, east and
22 west?
23 A When you say "every waterbody," there is always the
24 question of proximity of the waterbody to the rails.
25 Q Is it your opinion that every train passing over or

1 adjacent to water in Washington releases coal to that water
2 every time?
3 A I would say a very conservative estimate is at least 99
4 percent of the time. There can be very, very special
5 circumstances when the -- when the discharge is zero for a
6 short time.
7 Q And that's in Eastern and Western Washington?
8 MR. TEBBUTT: Your Honor, at this point it seems like
9 Mr. Klein is venturing into cross-examination and not voir
10 dire.
11 THE COURT: I agree.
12 MR. KLEIN: We would object to his qualification as a
13 witness on the topics of coal emission, dust suppression, and
14 the feasibility of railcar covers, Your Honor.
15 THE COURT: The objection is overruled. Go ahead.
16 DIRECT EXAMINATION continued
17 BY MR. TEBBUTT:
18 Q Dr. Breidenthal, let's just talk about the concept I
19 believe you mentioned under voir dire, the concept of bluff
20 bodies.
21 What are bluff bodies?
22 A A bluff body is what it sounds like; something that is not
23 sleeking streamline. A bus, a train, a car are all bluff
24 bodies.
25 Q So that's an area that you're familiar with, correct?

1 A Yeah. I've published several papers on bluff body flow.
2 Q And it really doesn't matter what type of bluff body.
3 It's just a slightly different application of the same
4 physical principles?
5 A In term of the aerodynamics and the fluid mechanics, yes.
6 Q Sir, I'd like to get into some areas of -- well, let me
7 just say, you -- under voir dire from Mr. Klein, you
8 identified three documents that you have created for this
9 case, correct? And those are your expert report, your
10 rebuttal report of E. Daniel Carré, and your supplemental
11 expert report that was filed in late September of this year,
12 correct?
13 A Yes.
14 Q And, sir, would it be helpful in your testimony today to
15 have those documents in front of you to refer to?
16 A Yes.
17 Q And do you have them with you today?
18 A Yes.
19 Q Sir, I'm going to ask you right now what is your ultimate
20 conclusion -- let me first ask what was the task that you
21 were assigned to do in this case as an expert?
22 A Well, I was asked, based on the literature studied -- a
23 bunch of BNSF documents, a lot of plaintiffs' site-specific
24 documents and videos, as well as also these two Rule 34
25 inspections -- to try to understand the physics of coal

1 discharge from these open coal cars.
2 Q Okay. And in your report, have you identified the
3 documents that you've relied on in reaching your opinion?
4 A Yes. For example, in my -- the original expert report,
5 paragraph 6, and then starting again at paragraph 13, are the
6 documents that I relied on. And then there was some
7 subsequent documents that I saw that were not available at
8 the time of this original report or my deposition, and there
9 are additional citations in those.
10 MR. TEBBUTT: Your Honor, I'll ask you a question.
11 Would you like the -- as I go through the list with
12 Dr. Breidenthal, would you like that part of his expert
13 report on the screen so you can see what documents he
14 reviewed?
15 THE COURT: Whatever you think is most effective.
16 MR. TEBBUTT: All right.
17 Q (By Mr. Tebbutt) Sir, on the screen is Plaintiffs'
18 Exhibit 1500, and if you will turn to the second page of the
19 report. And is paragraph 6 here on this page?
20 A Yes.
21 Q And starting at 6A, are these the documents that you
22 relied on in forming your opinions in your original expert
23 report?
24 A Yes.
25 Q And that includes -- if you can describe for the court

1 what 6A is in a little more detail, please?
2 A Well, this is a large number of studies produced by the
3 defendant, as I recall, related to measurements that they
4 and, perhaps, their consultants had made for coal discharge.
5 Q And do those include such things as the -- what will be
6 referred to as the RTEPS studies?
7 A I believe that's right, yes.
8 Q And the passive ducts dust collector studies?
9 MR. KLEIN: Object to the leading questions.
10 THE COURT: Overruled.
11 A Yes, I believe so.
12 Q (By Mr. Tebbutt) And were there other forms of testing
13 that BNSF did that you reviewed?
14 A There were passive dust collectors and track side
15 monitors, as I recall, and other documents which showed dust
16 being collected at various distances from the tracks, on or
17 near the ground.
18 Q And there were other analytical methods that BNSF did as
19 well; for instance, like on the profiling of the coal and the
20 cars?
21 A In terms of -- yeah, measuring the shape of the top. I
22 think they even used lasers to look at the settling of the
23 coal pile and how uniform it was distributed initially and so
24 forth.
25 Q And BNSF had some type of a name and an acronym that they

gave to that, correct?
A Yes. The laser one, I think, was four or five letters. I don't remember the letters, but I could dig it out if I had a little time.
Q And that's mentioned in your expert report?
A I'm sure it is.
Q And those are what I think we'll call the CCLPS?
A Yes.
Q C-C-L-P-S?
A Yes.
Q That stands for Coal Car Load Profiling System?
A Yes.
Q And there were studies done by BNSF in Washington and outside of Washington, correct?
A Correct. Studies in Wyoming, for example.
Q Okay. And are the studies that were done in Wyoming the type of studies that would also be relevant in the state of Washington?
A Yes. The physics are the same in both states.
Q Explain that a little bit more. Why are the studies that were done in Wyoming -- why would they be relevant to the activity of coal and coal cars in Washington as well?
A Well, I was tasked with trying to understand and make a rough estimate for how much coal was lost between Pasco and Vancouver, and the best available data was the Wyoming data.

1 There was also data available from Bellingham. Bellingham's
2 on the west side of the mountains, and it turns out moisture
3 has a strong effect on how much dust comes off a pile of
4 coal.
5 And the Wyoming data was the best available. And I
6 thought it was conservative to use the Wyoming data,
7 especially for discharge along the Columbia River, because
8 trains travel through Eastern Washington before they get to
9 Columbia River and the Gorge, and because that's a dry
10 environment, I think the rainfall in Pasco is less than ten
11 inches a year on average, the coal tend to get dryer, so by
12 the time it got into the Gorge, it would be even more
13 susceptible to aeolian erosion.
14 Q Let me stop you there for just a minute and just ask you
15 some questions.
16 The concepts, the physical principles at issue that
17 affect how much coal is lost, whether it's in Wyoming or
18 Washington, I think you started to discuss them.
19 What are the variables, the factors that would
20 influence how much coal is lost, where, based on client and
21 other forces? What are those forces?
22 A There are a number of them. I already mentioned moisture
23 was important, the relative wind. The train has a certain
24 ground speed, as we say in aviation, over the tracks, but
25 there also can be a headwind or a tailwind or a side wind,

and so if you take the net and factor the difference, that gives it a relative wind train, and that has a strong effect on a certain type of aeolian erosion, a very episodic type.

Q Okay. So we have -- relative wind speed is one factor. What is another factor?

A Relative wind, moisture.

Q Besides moisture, what else?

A Vibration turns out to be important, disturbances. And it's not just the -- the current temperature. It's how the temperature changes. Both temperature changes and moisture changes cause stresses in the coal pile, which are important for the continuous discharge component that --

Q We'll get -- sorry for interrupting. We'll get into the details of each of these variables, but right now I'd just like to talk about what those variables are.

So I heard you just mention temperature as being another one.

A Temperature and the rate of change in temperature.

Q What other variables and factors influence the behavior of coal in a coal car?

A I think I mentioned vibration.

Q Yes.

So how does vibration fit into the variables? What would vibration do?

A It turns out that when wind blows over a pile of stuff, as

you slowly increase wind speed, it's not the smallest particles that are levitated and blown away first. It's an undisturbed pile of stuff. They are protected in the small interstitial spaces in between the big pieces. So in the absence of any disturbances, the small particles, in general, are not blown away at low speeds.

But vibration completely changes the story. Vibration liberates these small particles and exposes them to the wind. And because it only takes a tiny, tiny wind to push around a tiny particle, vibration is really essential to this question of the continuous discharge of coal particles.

Q When you say it only takes a tiny amount of wind to disturb small particles, let me break that down and ask you questions first about what small particles you're talking about.

A The best scientific paper I've found is the Jaffe, et al. paper in which he measured so-called $PM_{2.5}$ particles, which means their diameter is equal to or less than two and a half microns. A micron is a millionth of a meter.

Q And try to put some real terms in what a millionth of a micron is.

A A micron.

Q Or a millionth of a meter. I'm sorry.

A One of these $PM_{2.5}$ particles has a diameter of 2.5 microns. You'd need to line up 30 of them in a row in order to span

1 the thickness of a human hair. So these are extremely tiny
2 particles.
3 Q Okay. And would these be present in coal piles?
4 A Yes. The Jaffe measurements prove that.
5 Q Okay. So we talked about vibration, and vibration is
6 mentioned in your expert report, correct?
7 A Yes.
8 Q What other factors -- can you find what paragraph you
9 discuss the concepts of vibration in your expert report,
10 please?
11 A In paragraph 21, I refer to what's called desert pavement,
12 which is what happens when you don't have vibration. When
13 the wind blows over the ground in a desert, sooner or later
14 all the available small particles are blown away and you're
15 left with a very clean surface of relatively large rocks and
16 pebbles. And geologists love to camp on that because it's so
17 clean. And that's what you get when the wind blows for a
18 long time and there are no disturbances. And sooner or later
19 there are no longer any small particles left to blow away.
20 Q That's what you mean, sir, in your report by "undisturbed,
21 windblown deserts"?
22 A Yes. If it is undisturbed, there is no vibration. And
23 that's a totally different situation from where if you have
24 continuous disturbances.
25 Q Let me ask you a question of vibration. I think on voir

1 dire Mr. Klein asked you if you were an expert in vibration
2 of trains.
3 In the real world is there -- what's the likelihood of
4 there being no vibration on a coal train?
5 A I think extremely tiny. You would have to have a long run
6 of perfectly straight track, no flat spots on any of the
7 wheels, no wind causing the car to bounce back and forth, the
8 rails would have to be as smooth as a baby's bottom. It
9 would be extraordinary to have such incredible vibration-free
10 situation.
11 Q Is there anything in the history of mankind that you know
12 that's been manufactured that's perfect that would fit that
13 bill?
14 A No.
15 Q You mentioned vibration in other areas of your expert
16 report, correct?
17 A Yes.
18 Q Again, factors that influence the way a coal pile moves in
19 transit?
20 A Yes. And there's lots of indication that the -- these
21 coal piles settle. BNSF documents show that they settle over
22 time. And it's a noisy, vibrating environment.
23 Q So what happens when the coal pile settles? What happens
24 to the coal? What happens to the particles of coal?
25 A These coal piles are deep. The bottom of a car is, I

1 don't know, maybe 10 feet below the top. So if the car is
2 full, the pressure on the bottom is a lot, and it's like a
3 turbulent atmosphere.
4 So if you were laying down and they put all this coal on
5 top of you -- if you started laying down at the bottom of a
6 coal pile, you'd have hundreds of pounds per square foot
7 pushing on your body. And the coal particles down there are
8 also subject to the same pressure, and due to the vibration
9 and the contact points, this breaks off new particles and it
10 liberates old ones, and there is a continual production of
11 particles that are free to be blown away by the wind.
12 Q Sir, earlier I asked -- have we covered the variables in
13 play? We've covered temperature, moisture, relative wind
14 speed, vibration. Are there any that we're missing here?
15 A Not that I can think of off the top of my head, but
16 perhaps I'm forgetting something.
17 Q All right.
18 What is your ultimate conclusion in this case about the
19 movement of coal particles on moving open-top coal cars?
20 A In a nutshell, every car, essentially, continuously
21 discharges coal.
22 Q All right. Let's get into that.
23 So what are the mechanisms for discharge?
24 A Well, there can be --
25 Q Well, let me stop you there. I think that opens up a

1 couple of different areas.
2 What are the means of transport of discharge?
3 A I don't know if you're asking where the coal comes from.
4 It can --
5 Q Let's start with that, where it comes from on a moving
6 train.
7 A Well, it can, obviously, come out of the top of the cars.
8 It can also come from coal that is sitting on horizontal
9 surfaces and sills on the side of the car. And, of course,
10 it can come out of the bottom of the car. These cars, since
11 they're open at the top, they have to have weep holes at the
12 bottom to allow for precipitation to drain out. So as the
13 cars roll along, all the time there are holes at the bottom
14 of the car, and coal can and does fall out through those
15 holes.
16 Q And does coal fall out through those holes whether or not
17 rain is falling or some type of precipitation is added to
18 those cars?
19 A Yes. Because of the continual production of liberated
20 particles, you would expect small particles -- by "small," I
21 mean they're narrow enough to fit in through these -- the
22 diameters in these holes at the bottom of the car.
23 Q So the limiting factor on the coal loss from the bottoms
24 would be the size of the holes or interstices or whatever
25 they are in the trains -- in the train cars?

1 A Yeah, whatever is smallest. And the width of the weep
2 holes, that would be the determining factor for how big of a
3 coal particle could get out.
4 Q Okay. Are there other ways other than weep holes where
5 the coal material can be lost?
6 A Yeah. There can be cracks in the car. And these cars
7 typically have doors at the bottom. That's how they unload
8 the coal. And if those door-mating surfaces don't come
9 together perfectly, that's also an opportunity for things to
10 fall out.
11 Q Is it possible for -- or is it likely that a door can be
12 perfectly closed and sealed all the time?
13 A I'd say it's unlikely -- very unlikely.
14 Q And, again, sir, for today's purposes, the opinions that
15 you're going to give and have given, are those opinions to,
16 at least, a more-likely-than-not standard?
17 A Yes. The --
18 Q That's good. That answers the question.
19 And if you're giving a opinion that is either less than
20 more likely than not or greater than that, will you express
21 that specifically?
22 A Yes.
23 Q Thank you.
24 Have you seen studies by BNSF that indicate whether
25 coal is lost through the bottoms of the trains in transit?

A Yes.

Q And do those studies at all -- how does that affect your opinions about coal loss through the bottoms of the trains?

A Well, one important way is that -- as I've said, I believe the loss of very small particles is, essentially, continuous.

There is one scenario I can imagine where you might not be losing continuous particles, and that's if you had the very peculiar situation where every single coal particle inside the car had been successfully wetted by a rain, but somehow no moisture was dropping through the bottoms -- at the bottom of the car through these holes.

Q And what is the possibility of that occurring?

A Well, I think it is extremely remote because it requires perfect wetting in one area and no wetting somewhere else.

Q So the discussion you just said a few -- a minute ago, that coal particles are lost continuously -- and I think earlier we were referring to out the top -- are you also saying that that's your opinion, that coal particles will be lost continuously through openings in the bottoms?

A Yes. These $PM_{2.5}$ particles are so incredibly tiny that it takes almost no breeze at all to move them along.

Think about the particles in cigarette smoke. Cigarette smoke particles are maybe ten times smaller, but just from a visual picture. There will be sufficient wind throughout the coal pile to cause these $PM_{2.5}$ particles to go out both the

1 top and the bottom, any hole.
2 Q Okay. And with regard to $PM_{2.5}$ particles, I understand
3 that, but you also said just a little while ago that the size
4 of the particles that would be lost through the bottoms is
5 limited by the size of the holes in the bottom?
6 A Right. And so --
7 Q Let me just ask you the next question.
8 The holes in the bottom are much larger than the
9 diameter of a $PM_{2.5}$ particle, correct?
10 A Oh, yes, vastly.
11 Q Okay. So, again, is your opinion just that $PM_{2.5}$ particles
12 are emitted continuously through the bottoms, or that other
13 larger particles are also regularly emitted, discharged?
14 A Well, certainly if the larger particles are regularly
15 discharged all the way up to the diameter of the hole, the
16 width of the whole.
17 Q And how frequently will those be discharged?
18 A I recall seeing BNSF data showing that they lose something
19 like 10 pounds per car per 100-mile trip, I believe, out the
20 bottoms of the cars. So that's the average loss rate.
21 Q Okay. So did BNSF attempt to measure whether coal
22 particles were lost every second or every minute?
23 A I'm unaware, off the top of my head, of any measurements
24 that showed the time interval between the loss of particles
25 through the bottom.

Q What is your opinion about the time intervals of the loss of coal through the bottoms?

A Well, for the $PM_{2.5}$ particles, it is continuous, essentially, all the time. Larger particles wouldn't be as -- there might be intervals of seconds between the losses, or even longer, of larger particles, but the smaller ones are coming out all the time.

Q So the timeframe is from all the time to seconds? So for the larger particles, it would only be seconds before they're discharged?

A Yes.

Q On a regular basis?

A Yes, I think that is a fair statement.

Q And on what level of certainty are you of the regular loss, through the bottom, of the larger particles?

A All I've seen are these average measurements. But -- and so the time interval between the larger particles, there's more uncertainty associated with that. So I wouldn't -- I wouldn't want to put a hard number on the -- on the maximum time interval between the loss of those. But it would be coming out such that you would lose something like 10 pounds per car per hundred miles on a -- I would presume it's on a regular -- not presume, but I believe on a somewhat regular basis because the jostling occurs all the time.

Q And so the somewhat regular basis is on intervals of

1 seconds, not minutes or hours, correct?
2 A Correct.
3 Q And so if a train were crossing a bridge over a waterway,
4 what is the likelihood that that coal is going to discharge
5 directly from a train into a waterway under the bridge?
6 A Well, for the $PM_{2.5}$ particles, it is, essentially, certain,
7 to an extremely high level of confidence.
8 Larger particles, if the bridge is very short, I suppose
9 there's a tiny chance a larger particle wouldn't fall out
10 during that interval. But since there has to be, on average,
11 10 pounds lost per hundred miles, that gives an idea of the
12 average rate of mass loss.
13 Q So, again, a tiny chance that the particles would miss the
14 water?
15 A In the case of $PM_{2.5}$, I would say there is virtually zero
16 chance.
17 Q Right. And for the larger particles, there is a small
18 chance?
19 A I would say a small chance for the larger particles.
20 Q Let's get back to open-top car dusting. We're talking
21 about $PM_{2.5}$ particles. What was, again, your ultimate
22 conclusion?
23 A Every car dusts, essentially, continuously.
24 Q Okay. And what do you base that opinion on?
25 A Well, of course, literature review; the testing that was

1 done by BNSF, which confirms the fundamentals of aeolian
2 erosion and pollutant mechanics that I've studied; the
3 plaintiffs produced documents showing videos and measurements
4 of coal discharge; and also my site visits.
5 Q Okay. Let's go back to paragraph 6, for a moment, of your
6 expert report, page 2. It is still up on the screen.
7 Category 6b of the documents, the Sierra, et al. group.
8 Just describe, generally, for the court what those documents
9 contain.
10 A As I recall, they contain evidence of coal discharge.
11 There were measurements of particles falling out of cars.
12 I'd probably have to review those documents again to recall
13 the precise quantities that were measured.
14 Q All right. And then paragraph 6c, documents about
15 investigations of coal loss, correct?
16 A Yes.
17 Q And that included the Mecsko investigation report?
18 A Yes.
19 Q And you were here for Mr. Mecsko's testimony, correct?
20 A Correct.
21 Q And then letter D is the Jaffe study; is that right?
22 A Yes.
23 Q You referred to?
24 A That's it, yes.
25 Q And then let's go to the next page.

1 Letter 6e on page three are documents and spreadsheets
2 from BNSF, correct?
3 A Yes, a large number of them.
4 Q Okay. And those include, again, the BNSF's studies of
5 coal loss?
6 A Yes.
7 Q And F, again, it describes more specifically other
8 documents that you've reviewed that BNSF produced?
9 A Yes. I've looked at every one of these documents.
10 Q Okay.
11 And then G, some of the documents provided at the
12 deposition of Mr. Dean Dalquist?
13 A Yes.
14 MR. TEBBUTT: And then the rest of them I won't
15 reiterate, Your Honor. You can see those for yourself.
16 Q (By Mr. Tebbutt) Going back to your discussion about coal
17 coming off the top of the rail cars, have you come to any
18 conclusions about how much particles are discharged on a
19 continuous basis?
20 A Yes, I have.
21 Q And what is your conclusion?
22 A There is an astronomical number of really small particles
23 that come off the tops of these coal cars.
24 Using extremely conservative estimates, based on the Jaffe
25 study which showed large numbers of $PM_{2.5}$ particles coming off

of the cars, an extremely conservative number is 6,000 particles per second per car are leaving a car, even in the worst case, on the wet side of the Cascades.

Q So 6,000 particles per car per second?

A Correct.

Q And tell us what the conservative factors are that you accounted for in reaching that conclusion.

A It's based on this Jaffe report, which is the best scientific study I've seen. And the minimum detection level of his probe was one microgram per cubic meter. And a microgram is an incredibly small amount of mass.

If you take a little, ordinary sugar cube like you put in your coffee, and you chop that sugar up into a million equal-sized pieces, and you looked at one of those pieces, that would be about a microgram. It's an incredibly tiny amount of mass.

But these $PM_{2.5}$ particles, their mass is smaller than that. It takes a hundred thousand $PM_{2.5}$ particles to equal the mass of one-millionth of a sugar cube. So -- and that's really the key point .

Jaffe showed that, even at the minimum sensitivity of his probe, there are vast numbers of coal particles coming off of trains. Just astronomical numbers.

And if you -- if you make plausible, in fact, conservative assumptions for the width of the wake, the turbulent wake

1 coming off of the train, and if you assume that the topping
2 treatment is providing an 85-percent reduction, which is a
3 figure that, I think, was specified by the railroad, and if
4 you assume, again very generously, that half of all the
5 particles are re-entrained, in other words, particles landed
6 on the roadbed and then were lifted up by the turbulent wake
7 of the passage of the train, and if you finally account for
8 the vastly reduced discharge in the Bellingham area compared
9 with the relatively dry gorge, which, by itself, according to
10 the BNSF numbers, results in a factor of 31 drop in
11 discharge, when you put all of those factors together, you
12 get the final number of about 6,000 particles per second per
13 car.
14 Q Okay. And that is based on giving the benefit of the
15 doubt, if you will, to the most conservative variables,
16 applying all the most conservative variables on the wet or
17 west side, where we live here in Seattle, right?
18 MR. KLEIN: Your Honor, I'll raise an objection at
19 this time.
20 All these calculations about the 6,000 particles per
21 second per car were in none of his three reports that he
22 provided in this case. I'd move to strike that testimony.
23 THE COURT: The objection is overruled. Go ahead.
24 Q (By Mr. Tebbutt) Sir, let's get into what the most
25 likely, in your opinion, number of particles are coming off

1 the trains, let's say, in the Columbia Gorge, on the east
2 side.
3 You gave us your conservative numbers of, I believe, 6,000
4 particles per second per car, and then you have to multiply
5 that out times the number of cars, correct?
6 A Correct.
7 Q And is it your opinion that each of those cars are
8 discharging approximately the same number of particles all
9 the time?
10 A Yes. When I look at the train -- these trains, the third
11 car looks a lot like the 15th or the 47th or the 96th or the
12 115th. I think the discharge rates per car are likely to be
13 pretty much the same over the entire length of the train.
14 Q All right. Now let's talk about the Columbia Gorge. What
15 kind of numbers are we talking about? What's the likely
16 number of particles discharged on a continuous basis per car
17 per second?
18 A About half a million particles per second per car.
19 Q Sir, do you have an equation in front of you?
20 A Yes.
21 Q Would you mind stepping up to the easel and drawing on the
22 easel, with the blue pen there, your equation?
23 MR. KLEIN: I'm going to object to this as all brand
24 new.
25 THE COURT: Overruled.

Q (By Mr. Tebbutt) And, sir, I'm going to ask you not to speak. Just draw the equation, and then go back to the witness stand, and I'll ask you about the equation itself. Okay?

A (Witness complies.)

Q Are you done, sir?

A Yes.

Q All right. Now, let's describe for Judge Coughenour -- go ahead and sit down, and if you can -- if you need to turn or look at your notes, whatever works best for you, please describe the assumptions or the data that you have to come to your conclusions.

A I estimated things for a 30-mile-an-hour train. It turns out it doesn't matter what the train speed is because it is the concentration that's fixed. It is clamped by the Jaffe measurements.

Q Why do you say the speed doesn't matter?

A If you double the speed from, say, 30 to 60 miles an hour and you you insist on keeping the concentration the same, then that means that the fluxed particles per car has to go up by that same factor of two.

So, in fact, this is conservative. The numbers would be even worse on a per-second basis if you went to a higher speed.

On a per-length basis, how many particles per, say, foot

1 or meter of track length are discharged, it wouldn't matter
2 at all. If you double the speed, you have to double the rate
3 per unit time because, as I say, the concentration is fixed.
4 So you get the same number of particles per foot of track
5 length.
6 MR. KLEIN: Your Honor, at the risk of testing the
7 court's patience one more time, it's unreasonable to ask
8 defendants to try to unpack this for the first time now, and
9 I'd ask to strike the testimony.
10 THE COURT: Overruled.
11 Q (By Mr. Tebbutt) So, sir, "N" in your top equation -- is
12 that "N"?
13 A Yeah, N, dot. That is the number of particles per second.
14 And I should have written the subscript "train" under it
15 because that's the total number of particles per second that
16 are lost from the entire train.
17 Q From the entire train. Okay. So N equals ten to the
18 fifth. Ten to the fifth is equivalent to?
19 A Yes. Remember I said if you break the sugar cube up into
20 a million pieces, and only one of those pieces is the
21 measurement threshold of Jaffe, it still meets ten to the
22 fifth of these $PM_{2.5}$ particles. That is to say, you need
23 100,000 of these $PM_{2.5}$ particles to add up to the mass of
24 one-millionth of a sugar cube.
25 Q And that was -- his minimum detection limit would have

100,000 particles?

A Per cubic meter.

Q Per cubic meter. Okay.

A And by the way, these numbers are all for Jaffe's minimum detection limit. He actually used a detection limit, an artificial one, three times higher than this. So you could triple all these numbers. But I'm being, again, ultraconservative.

Q Okay. And then the second part right after "ten to the fifth" is "part over M3." That's part per --

A Particles per cubic meter. A meter is about a yard, so if you measure a cube that's roughly a yardstick on a side, that's a cubic meter.

Q So within that cubic meter, the threshold detection of the Jaffe study was one particle?

A The probe has a published sensitivity of one particle -- sorry -- one microgram per cubic meter.

Q Okay. And, again, we've just discussed that one microgram is equivalent to 100,000 particles?

A Correct. That first term, "ten to the fifth."

Q All right. And what is the "15" number? What is that?

A 15 meters a second -- 30 miles an hour is about 15 meters a second.

Q Okay. And then 26 meters in parentheses?

A If you estimate the width of the turbulent wake coming off

1 of the train, it's about 26 meters wide, in crude terms.
2 Q And the turbulent wake, that is a concept we haven't
3 really discussed yet.
4 Can you describe for the court what the turbulent wake
5 is?
6 A If you have flow past any body that has drag, there will
7 be a region of disturbed flow behind the body called a
8 turbulent wake. If you're in a car or a boat, and you look
9 at the flow in the lead behind that vehicle, you'll see a
10 turbulent wake. And whatever came off the body ends up in
11 that turbulent wake.
12 So imagine you had a body on fire -- imagine a train was
13 on fire, every one of these coal cars was on fire and you had
14 smoke coming out of every coal car. Except for buoyancy
15 effects, which tend to cause the smoke to lift, you can think
16 of the cloud of these small particles to be enveloped around
17 this train, and the width of that envelope would be the
18 turbulent wake.
19 Q So that's 26 meters, about 75 feet?
20 A Yeah. A meter is about yard, so that's right.
21 THE COURT: All right. Let's takes our morning
22 recess.
23 (Court in recess.)
24 THE COURT: All right.
25 Q (By Mr. Tebbutt) Dr. Breidenthal, we were in the middle

1 of a very fun equation for you, I assume, as an engineer,
2 correct?
3 A Yes.
4 Q All right. We had just -- we were talking about the width
5 of the turbulent wake.
6 So the turbulent wake of the train is something that, I
7 believe you said, is approximately 75 feet.
8 How does it start at the top of the train, and how does
9 it -- does it change from the beginning to the end of the
10 train?
11 A Yes.
12 The growth of a three-dimensional or axisymmetric
13 weight goes likely the width of the body times the downstream
14 distance.
15 Well, let me start over.
16 Goes likely square the width of the body times the
17 downstream distance all to the one-third power. And so it's
18 proportional to the one-third power to the width of the body
19 and to the -- I'm sorry -- two-thirds power to the width of
20 the body and the one-third power to the downstream distance.
21 So it grows as the cube root of downstream distance.
22 Q Okay. Remember you're talking to a bunch of lawyers here,
23 so you're going have to try to explain this more in real
24 people's terms than engineering terms.
25 In other words, it starts about how wide at the

beginning of the train?

A Well, at the very beginning of the train, it is the width of the train, and then it grows initially rapidly and then progressively more slowly as you go towards the end of the train.

Q Okay.

And so the turbulent wake with no wind, how would it be dispersed from the train itself if there was no wind at all, no ambient wind?

A In the absence of ambient wind, the wake would be symmetric around the train, and by the time you get to the tail end of the train, it would be approximately 26 meters or so wide.

It will continue to grow even after the train -- even far behind the train, it will continue to grow progressively more slowly like time or distance to the one-third power.

Q Okay. And so we're just about at the equal sign here in the equation.

What do they equal? The parts that we've just talked about, just summarize the variables in the equation equals what.

A You're referring to this top equation?

Q Yes.

A Well, the term on the far right side is the total number of these tiny 2.5 particles that are emitted from the whole

1 train per second.
2 Q Per second. And what is that number?
3 A A hundred million particles per second per car -- I'm
4 sorry -- per train.
5 Q Per train?
6 A Per train. I beg your pardon. Per train.
7 Q And a train is about -- just for rounding purpose we'll
8 use 100 cars. How many particles per car?
9 A That's about a million particles per second per car.
10 Q And, sir, how -- what level of certainty do you have that
11 a million particles per second are coming off of each car
12 continuously?
13 A These are rough estimates. But no matter how conservative
14 you are, you end up with huge numbers. I'm a pilot, and
15 before every takeoff I do a careful preflight inspection, and
16 I have to be confident that the airplane is airworthy. I'm
17 betting the lives of my passengers and me that the plane will
18 stay in one piece, and my confidence level in this estimate
19 is at the same level: I'd bet my life.
20 Q The next part of the equation. So you say for a 100-car
21 train N equals ten to the sixth. Is that particles per
22 second?
23 A Particles per second.
24 Q Particles per second. So that's -- is that what you
25 discussed as a million particles per second?

A That's a million, yes.

Q And what's the next line referring to?

A Well, some particles come out of the top of the train, but previous trains may have left dust on the ground. And so when a train comes by, it has a possibility of entraining and levitating dust that had earlier been deposited by previous trains.

And to be very conservative, I assume that only half of the measured particles are from this preexisting dust that's already on the ground. There are a bunch of reasons for thinking that that is just extremely conservative.

The main reason is that these particles are like smoke particles. They drift with the wind, and they get distributed and dispersed over a very wide sort of bell-shaped curve at the lead of a train. And so there aren't that many tiny particles left around riding on the tracks to be entrained by the next train.

Q I lost my train of thought here for a second.

So the 100 million particles coming off the train, again, per second, what is that distance that those particles will travel?

A Think of these little particles as, like, tiny smoke particles from, say, cigarette smoke. Smoke is actually about ten times smaller, but qualitatively the -- for visualization purposes, it will be about the same.

1 These tiny particles drift in the wind just like smoke
2 particles.
3 Q May I stop you there for just a second, Dr. Breidenthal?
4 The wind that you're talking about, what type of wind
5 does it take to move a $PM_{2.5}$ particle?
6 A The settling speed of one of these particles is only
7 1/100th of an inch per second. So it takes a hundred seconds
8 in still air for one of these particles to sink just an inch.
9 So it takes over an hour for it to drop a yard through still
10 air. These particles are suspended in the air for a long
11 time.
12 Q Okay. But the particles we're talking about, what type of
13 a wind does it take to move a particle?
14 A The magnitude of the wind it takes to move it is
15 comparable to its settling speed, again, about 1/100th of an
16 inch per second.
17 Q And what does 1/100th of an inch per second translate to
18 in miles per hour?
19 A I worked out the math ahead of time. 0.00057 miles an
20 hour.
21 Q So, far less than one mile an hour will move these
22 particles?
23 A If they are liberated. If they are available to be moved,
24 and that is why the vibration is so critical.
25 If these little particles are protected in these small

1 interstitial spaces to where a breeze can't get to them, then
2 they're not eroded away by the wind. But if they're
3 liberated, practically any detectable breeze will carry them
4 away, just like smoke.
5 Q And you've been on trains before in your life, I assume?
6 A Yes. I rode one here this morning.
7 Q And have you ever been on a train that didn't vibrate or
8 move?
9 A No.
10 Q Okay. Getting to the question -- you talked about
11 suspension of the particles in the air. But we have, let's
12 say, a million particles per car, a hundred million per
13 train -- and I may ask you, actually, to go to the board, but
14 hang on just a second -- is there some kind of a way to
15 determine what the fallout rate of the particles will be
16 relative to the train?
17 A I'm not quite sure what you mean by that.
18 Q The particles, you said they fall out. They'll fall out,
19 some slow, some will suspend for some period of time. Is
20 that based on wind flow?
21 A Yes.
22 And at the moment I'm just talking about a single-size
23 particle, these $PM_{2.5}$ particles. Bigger particles, of course,
24 settle faster. But $PM_{2.5}$ particles, they sink at this
25 incredible low sinking speed in still air, but usually when

1 the ambient wind is blowing -- in fact, virtually
2 always there is turbulent eddies in the ambient wind. And if
3 the rotation velocities of these turbulent eddies is
4 comparable to the greater sedimentation speed, then some of
5 the particles will basically stay forever until the
6 turbulence eventually dies down.
7 Q Okay. What will happen to the rest of them?
8 A Well, there is typically this sort of a Gaussian-shaped
9 distribution, which can be displaced to the side if there is
10 a crosswind.
11 But most of the -- even the fine articles in the absence
12 of an ambient wind would tend to settle at a maximum amount
13 right over the tracks at the source. It's just that the
14 width of this Gaussian-shaped, bell-shaped curve becomes
15 very, very wide for tiny particles. So some settle out right
16 away near the tracks in the absence of crosswinds, and some
17 very far away.
18 Q Would you mind stepping to the easel, sir, and draw the
19 Gaussian distribution that you were talking about, first for
20 the large particles, and then for -- draw the distribution
21 for the larger particles, the Gaussian distribution you're
22 talking about, and then the Gaussian distribution for the
23 smaller particles, side by side.
24 A (Witness complies.)
25 Q Okay. Go ahead and sit down.

1 For the larger particles, what kind of distance are we
2 talking about? The visible particles that you can see, what
3 kind of distribution would you expect over -- spread out,
4 assuming no ambient wind, how would you expect that
5 distribution in terms of length from the center of the track?
6 A Well, of course, everything depends on the size of the
7 particle. Even really big bowling balls would fall out right
8 away, so to speak.
9 Q This size of chunks of coal would fall out pretty fast?
10 A Yeah. Wind is not going to keep them levitated very long.
11 Q What about a particle about the size of your thumbnail?
12 A It would settle out more slowly. And it's really the
13 turbulent wake which determines this near-field deposition
14 pattern. And when the sedimentation speed of the particle
15 equals the decaying speed of the turbulent wake, that's when
16 the particles have a lot of -- when many of them will hit the
17 ground.
18 Q And over what kind of length -- have you seen any -- well,
19 actually, you were here for the testimony of Mr. Cornelison,
20 correct?
21 A Yes.
22 Q And you saw the video that was admitted into evidence,
23 Exhibit 1423, the video of the -- taken from the camera in
24 the tree of the train passing and the rain of coal that was
25 coming off of that. You saw that?

A Yes.

Q Explain for the court -- please apply that video to the discussion of the large-particle Gaussian distribution.

A Well, these particles in that video were big enough to see, and they're vastly larger compared to these $PM_{2.5}$ particles that I've been talking about as small. So the width of that Gaussian associated with the large particles is relatively narrow, so these somewhat bigger particles are going to be deposited, in the absence of a crosswind, in fairly small distances from the tracks.

Q What does "small distance" mean? Just give us a range.

A Oh, 10 meters, 15 meters, depending on the size of the particle. Everything critically depends on the size of the particle.

But even for a single-size particle, you still get this Gaussian broadening, in which the maximum concentration in the absence of a crosswind is right at the source, and it tapers off very gradually in these long wings.

Q And so even, again, some of the large particles, if I may translate to laymen's terms, can go even further?

A Some. You see how those wings taper off, and there would be a few relatively large particles that could get out in the extreme edges of those wings.

Q All right.

And does the video that you saw of Mr. Cornelison's --

1 that Mr. Cornelison's camera took confirm your opinions in
2 this case about the way coal moves?
3 A Oh, yeah. It's perfectly consistent. This is well-known
4 behavior of turbulent dispersion and also the distribution of
5 particles sedimenting out of a two-phase flow.
6 Q And then if you add a crosswind, how does that affect
7 Gaussian distribution? Let's use the real-life example of
8 that video with a wind coming from across the train
9 towards -- you know, from Horsethief Lake towards the
10 Columbia River. How would that influence that distribution?
11 And you can draw it if you'd like.
12 A Well, let me first say that it does just what intuition
13 will tell you. That cloud of particles gets pushed downwind,
14 and so the Gaussian gets shifted. Once the train has passed,
15 that Gaussian is shifted on the downwind side of the tracks.
16 Q Okay. So would it go -- right where it is next to the
17 Columbia River, would that plume go further out into the
18 Columbia River?
19 A Yeah. If the wind is towards the Columbia River, that
20 plume would be headed that way.
21 Q And if the wind was heading towards Horsethief Lake, the
22 plume would head towards Horsethief Lake?
23 A Correct.
24 Q And so it would move it more away from that short area of
25 land, directly into the water?

1 A Correct.
2 Q Let's talk about the small distribution. We're talking
3 about 100 million particles of $PM_{2.5}$ right now. How will that
4 disperse? Describe for the court how that will disperse.
5 A Think of it as smoke. That's the best visual I can
6 imagine, smoke that's non-buoyant that just drifts with the
7 wind. These particles in a real wind go, essentially,
8 forever. They're extremely tiny. It takes almost no
9 vertical velocity component to exceed .00057 miles an hour in
10 a typical atmospheric wind.
11 Q You said the particles will go forever. Will all of them
12 go forever?
13 A No. Again, there is a distribution. Some particles
14 settle out right away, and others are suspended for a long,
15 long time.
16 Q What are the forces that would cause the particles to
17 settle out right away?
18 A Well, of course, gravity is acting on them all the time.
19 But in addition, the turbulent dispersion of these rotating
20 eddies is transporting some particles close to the ground,
21 and some of them, when they get close to the ground, will
22 settle out.
23 Q So if there's a waterbody right there, going to hit the
24 waterbody and stay in the waterbody?
25 A Yeah. Some of the particles, when they land on the land,

are subject to a subsequent re-entrainment of blowing away. But you'd expect that not to occur with water. The particles, when they hit the water, they stick. There is no saltation over water.

Q I heard you use the word "saltation." I don't think that's been discussed yet today. What is the concept of saltation, sir?

A I think it was originally discovered by Bagnold in '41.

If you have wind blowing over a sandy surface -- think of a sand dune. If you progressively turn up the wind speed, eventually some particles are going to start rolling and then bouncing along. And a curious thing happens. When a particle is picked up by the wind and then lands due to gravity, that impact kicks up other particles. And so the first particle may actually quit moving, but it's transferred its momentum and liberated the powder particle. So this hopping process is called saltation. And that's what happens over dry land, but it doesn't happen over water.

Q How does saltation occur in a moving coal car?

A Especially for these super duster -- these super-duster events, as Jaffe calls them, where you have -- on the really rare occasions you can actually see the plume coming off of the car, you expect these particles to be bouncing along the top. And just like sand grains in Bagnold's sand dunes, when they hit another particle, they can knock it up and liberate

it.

Q And is that process of saltation part of the physical processes that caused these hundred million particles to come off of each train?

A Well, that would be part of the process, but you don't need these episodic big events to account for the -- the continuous discharge is physically separate from the -- fundamentally separate from these -- these big episodic spikes.

The BNSF data are full of records where they get very intermittent discharges of coal particles, and sometimes even visible.

Jaffe found about five percent of the trains in the Gorge emitted a visible dust cloud. But I think he said almost all of them emitted an invisible dust cloud.

Q So just because it is invisible doesn't mean that coal isn't being discharged, correct?

A Correct.

Q And, in fact, just the opposite. It is your opinion that coal is always being discharged?

A Yeah. I use the term "essentially always" because I can imagine extremely rare condition when it might not be. But for the vast majority of the time, every car is emitting thousands of particles a second.

Q And you described earlier the very unlikely event when

1 something might not be emitted, correct?
2 A Yes.
3 Q I'm going to show you, these are pictures in your report
4 on page 15. Is this -- what type of an event do we see here?
5 A Well, this is a visible dusting. You can see the dust
6 cloud. And this would be associated with one of these
7 episodic events. This is different than the $PM_{2.5}$ continuous
8 discharge that I talked about earlier.
9 Q And is it your understanding that this picture was taken
10 at Horsethief Lake?
11 A Yes.
12 Q So this is one of the so-called -- did you call them
13 "super dusters"?
14 A Yeah. I think that was Jaffe's term.
15 Q Okay.
16 A He observed, I believe it was four trains that had a
17 visible plume.
18 Q Okay. And the plume that Mr. Cornelison got the video of,
19 Exhibit 1423, would that be an example of a visible duster?
20 A I think probably. I can't recall off the top of my head
21 if that video showed the dust coming off the train, but
22 certainly seeing meteors hit the water indicates big
23 particles are coming off.
24 Q And so compared to the video, the Cornelison video,
25 Exhibit 1423, compared to the pictures on page 15 of your

1 report, how would you compare the magnitude of the dusting
2 events?
3 A Well, of course, I don't have any -- any quantitative
4 numbers, but I think they're both indicative of these really
5 big particles that are associated with episodic erosion.
6 Q Okay. And again, I don't mean to belabor this, but a
7 hundred million particles coming off the train of $PM_{2.5}$, would
8 you be able to see them or not if it's just those particles
9 coming off?
10 A Almost certainly not. These are so tiny. It takes 30 of
11 them to add up to the width of a human hair. These are
12 really small particles.
13 Q You've described the concept of saltation, and I believe
14 earlier you mentioned -- and forgive me if I'm wrong -- the
15 concept of aeolian erosion. How does aeolian erosion affect
16 the loss of coal from open-top coal cars?
17 A Well, through, I would say, two separate mechanisms that
18 I've already described. The first is these episodic events
19 which involve saltation and blow off the big pieces and lead
20 to these visible plumes -- visible clouds. And that's for
21 particles that are, essentially, undisturbed, except, of
22 course, for the saltation impact.
23 And that, of course, is why the impacts are so important,
24 because the wind has a hard time getting down to small
25 particles. In fact, right at the exact surface, the wind

velocity is always exactly zero. It is called the no-slip condition. And so it could be a 50-mile-an-hour or a hundred-mile-an-hour breeze five feet above the train, but right at the surface the velocity is exactly zero. So it's all about the dynamics of these protected particles getting down deep into what's called the boundary layer, this region of the retarded flow near the surface.

As I said earlier, the continuous discharge is attributable to the jostling because that continuously liberates old particles and generates new ones.

And, in fact, it has another important effect. Not only is that jostling, of course, occurring at the top of the coal car, but it is liberating particles throughout the depth of the coal pile. And because there are interstitial spaces and passages between these discrete pieces of coal, any breeze throughout the entire depth of the coal car exceeding .00057 miles an hour or thereabouts will transport these liberated particles.

So you have the entire volume of the car now being sources or a source of these $PM_{2.5}$ particles.

Q And what is the likelihood of the air flowing through that body being greater than the number you just mentioned?

A If the car is moving hardly at all, you will see speeds in excess of this. This speed is incredibly tiny. It is one inch every hundred seconds.

1 The pressure distribution over the top of the car is not
2 uniform. The boundary layers are separating and there's
3 reattachment. So there's a pressure grading over the top of
4 the car, and the pressure at the bottom of the car around
5 these weep holes and the gaps in the doors is, in general,
6 different from the top. And those pressure differences drive
7 airflow through the coal pile.
8 So you have the jostling liberating particles, you have
9 this ventilation through the pile, and it takes, essentially,
10 no ventilation speed and, hence, almost no car speed or
11 relative wind speed through the air to blow out the
12 particles.
13 Q Sir, under voir dire from Mr. Klein, we've established
14 that you're not an expert in membrane function, membrane
15 being the topping agents that are applied to cars, correct?
16 A That's correct.
17 Q But you are an expert in aeolian erosion?
18 A Yes.
19 Q Showing you what's been previously admitted as Plaintiffs'
20 Exhibit 1421, can you describe for us some of the physical
21 principles at play in FOCG 003463?
22 A The top of the coal pile shows this sharp cliff.
23 Q Feel free to draw on the screen, sir, with your finger.
24 A Oh, yeah.
25 So there is this sharp cliff or escarpment. There's

more of it up here, which I believe is at the edge of the surviving membrane.

Q Why do you believe that?

A The membrane, I saw the application of this liquid, this topping agent at my Rule 34 site visit to the Pasco spray facility, and my report shows pictures from that. And that distribution of spray -- sprayed material is relatively smooth. But as the coal cars are subject to the relative wind and the jostling, the membrane deteriorates.

And these cliffs show the edge of the surviving membrane. Above those cliffs, I believe the membrane is still surviving, and below the cliffs the membrane has been removed from the train. In fact, the reason why there is a cliff there -- there wasn't a cliff there originally, but the bread-loaf loading profile was originally smooth.

Q How do you know that it was smooth originally?

A Well, of course, I wasn't there when they loaded this coal car.

Q This particular one?

A This particular one.

But BNSF's specifications call for a smooth bread-loaf profile. And the reason why they do that, of course, is because that minimizes the aeolian erosion. If you don't have the smooth bread-loaf profile, you suffer more erosion.

Q The bread-loaf profile, does it eliminate aeolian erosion?

A No.

Q So the bread-loaf profile will reduce the erosion rate but it will not eliminate it, correct?

A That's correct.

Q Okay. Get back to the exhibit in front of you, and describe what happens as the coal train moves and these ledges start occurring.

A As you can see in my report, the topping spray doesn't cover the complete top of a coal car. It leaves exposed edges. And the combination of aerodynamic effects and mass movement and jostling and slumping of the coal pile -- and, remember, the coal pile is not flat on the top of it. It has this arched bread-loaf shape -- and the combination of those things start to damage the membrane, and the membrane starts leaving.

And these cliffs represent that receding edge of the progressively deteriorating membrane. And the reason why there is a cliff there, even though there wasn't a cliff there originally, according to the bread-loaf profiling, is because coal, unprotected by that membrane, is now subject to being blown off the train and also subject to downslope slumping so that some of that coal could slump down towards the side of the car and can also be blown off.

Q When you say it can be "blown off," what do you mean by that? Like, the membrane itself can be blown off --

A Well --

Q -- or the membrane-covered coal?

A Yeah. I was initially referring to not the exposed coal after the membrane is gone, but the membrane has to leave for that to happen. And because the membrane is a continuous surface, originally, any pressure fluctuations in the turbulent flow over the car cause fluctuating loads on the membrane over, in some cases, large scale. And because pressure is force-per-unit area, and you multiply pressure difference by a large area, you get big load fluctuations on the membrane, big enough to rupture the membrane.

And once the membrane is torn on that, it just accelerates its degradation and its ultimate departure.

Q Is there anything else that you'd like to describe to the court that's represented by the principles that we've discussed here this morning in this particular photograph, 3463?

A No, none that I can think of.

Q All right.

Sir, we're going to go back to your report. I'd like to discuss the Rule 34 inspection that we did.

That was in approximately February of 2016, I think, right? It was this year?

A Yeah. I can look it up here. Hmm. I'm not seeing it quickly.

1 Q Well, I'll represent to the court that it was February of
2 2016.
3 And who was present with you that day, if you recall,
4 sir?
5 A Well, I recall a few people. You are there, and there was
6 a photographer. Of course, I remember BNSF people, including
7 counsel.
8 Q Was Mr. Wagner there?
9 A I believe he was, yes.
10 Q And Mr. Sullivan?
11 A Yes.
12 Q Mr. Carré?
13 A Yes, Mr. Carré was there. In fact, he reminded me of that
14 just last week.
15 Q And Ms. Rodgers was there?
16 A I do not remember.
17 Q All right. Fair enough.
18 A I'm sorry. How could I forget Ms. Rodgers?
19 Q And there were photographs taken by the photographer?
20 A Yes.
21 Q And are some of those pictures included in your expert
22 report?
23 A Yes, they are.
24 Q Let's look at Exhibit B to your expert report.
25 And the first, Figure 1, sir, can you describe what

1 those are?
2 A Those are the cars and their identification numbers for
3 the cars we particularly focused on, near the front, the
4 middle, and near the end of the train.
5 Q So we took two cars from there, two from the front, two
6 from the middle, and two from the back, and looked at for
7 comparison purposes to Pasco and at Everett?
8 A That's right. It was the same train we looked at a day or
9 so in Everett, after it had passed through the Columbia
10 Gorge.
11 Q Right. And we had arranged with counsel to see these
12 trains?
13 A This train, yeah. It was a single train.
14 Q The same train we saw in Pasco, we saw a day later in
15 Vancouver, Washington -- or no. Everett --
16 A Everett, yes.
17 Q -- Everett, Washington.
18 Taking a look at Figure 7 in Exhibit B, where was this
19 picture taken?
20 A This was taken at the Pasco re-spray facility.
21 Q And does this picture accurately depict what you saw that
22 day?
23 A Yes.
24 Q And Figure 8, is that also a picture taken at the same
25 place, same day?

A Yeah. I was standing on this railing, or this walkway, along with these other people. So I was close to the photographer.

Q Okay.

Describe what -- what is present in Figure 7 as it applies to the concepts of aeolian erosion and saltation that have been -- that you've discussed this morning.

A Well, the first thing that I observe when I see this picture is this. And I'll take the liberty of drawing this longitudinal streak or strip along the crest of the coal pile.

You can see it has a different color than the surrounding material. And although the lightening wasn't producing the greatest contrast because we're undercover, inside this shed, you can still see is this cliff. This -- this escarpment that separates the protected coal under the membrane from the coal that's exposed to an aeolian erosion.

Q Sir, I'll clear the screen for just a second.

If you could, again, just with your finger, describe where the escarpment is?

A Would you like my finger just along --

Q Just along -- give an example.

A Well, right in there you can see -- if I can make it work -- that escarpment is right there.

Q All right. And that is, in your opinion, what?

A The edge of the surviving membrane.
Q Okay.
And in Figure 8, can you see something similar, a different rail car from a different angle?
A Yes. Since we see the whole length of the car, and we're looking more or less along its axis, you see that cliff runs some distance, and it has a largely longitudinal aspect.
Q Can you draw on that what you're talking about?
A Say that again. Excuse me?
Q Can you draw that longitudinal aspect you were talking about?
A (Witness complies.)
Q And is this similar to the membrane loss or cracking that we saw in Exhibit 1421?
A Yep. Same thing.
Q And these pictures were taken before the re-spray, correct?
A Right. These cars -- my understanding is these cars have been sprayed at the mine in Wyoming, and it arrived at the re-spray facility, and we were afforded the opportunity to see the cars before they were re-sprayed and after.
Q And they brought the train in once, and then backed it up for us before it was re-sprayed?
A Correct.
Q And brought it back again to be re-sprayed?

A That's right.
Q Let's take a look at Figure 12 of the exhibit that is your expert report. Do you have that on your screen?
A Yes.
Q What doe you see depicted in Figure 12?
A Well, in addition to these cliffs we've been talking that that separate the surviving membrane from the places where it's gone, you also see some coal piled along the sill there. Oops. Sorry. I inadvertently marked it. I'll just finish marking.
Q That's fine.
A Which may have gotten there by sloping of mass movements downslope, over the top of this bread-loaf pile.
Q What is the likelihood of this coal that's on the sill there staying on the train on its trip to Everett?
A Well, since it is going through the Gorge, and with the winds there and the vibration, I would say the odds are slim.
Q You have other pictures in your report of the spraying itself at the Pasco re-spray station, correct?
A Correct.
Q And is the picture on page 8 of your report an accurate depiction of what you saw that day?
A Yes.
Q And describe for the court what you believe to be -- or how you saw the coal cars sprayed.

1 A Well, as we've heard, the cars are pulled at a constant
2 speed through the facility, and as a car comes underneath
3 this array of spray nozzles, the fluid is turned on out of
4 those nozzles, and this liquid topping agent, or membrane as
5 it's been called, is sprayed out.
6 Q Where you see the spray hitting this car, is that -- at
7 what -- had the spray started before that, or is this the
8 beginning of the spray period?
9 A It's the beginning. And as a consequence, the spray and
10 the liquid don't coat the first part of the car. And the
11 same thing happens at the other end. And you can see the car
12 to the left, where the spray is turned off and there is a
13 lighter-colored coal that hasn't been wetted by the spray.
14 Q So this is the beginning and the end of each car?
15 A And some of the sides as well.
16 THE COURT: When did the Pasco re-spray start?
17 MR. TEBBUTT: Late January of 2015.
18 THE COURT: All right.
19 MR. TEBBUTT: So this was a little over a year later.
20 Q (By Mr. Tebbutt) The picture on page 9 of your expert
21 report, what does that depict?
22 A Again, spraying another car. And you can see at the left
23 a demarcation.
24 Q Go ahead and draw with your finger.
25 A Okay. So the spray missed the front and back.

1 Q Okay. And what about the sides? You testified about the
2 sides being missed, too.
3 A Yeah. You can see here two things. One is, the coal at
4 the side of the train car is -- is not really sprayed very
5 well. And also you can see, because of the -- oh, I
6 inadvertently touched it -- because the spray pattern is not
7 uniform, you get these longitudinal streaks, and they can
8 persist over the entire length of the train. Not surprising.
9 They're very correlated because every train car is sprayed by
10 the same machine.
11 Q Were the trains sprayed twice?
12 A As I recall, yes, going one way and then backing up and
13 doing the other.
14 Q And then, sir, the next day the same train you testified
15 earlier we saw at Everett, correct?
16 A Yeah. I think it was the next day. They were very nice
17 and parked it there so we could take a look at it.
18 Q Okay. So it was parked at the Everett -- I don't know if
19 it was the rail yard, but somewhere in the public access area
20 of Everett, correct?
21 A Yeah. There was a freeway or a road overpass so we could
22 look down on the train. We were also permitted to walk
23 beside some cars on the ground.
24 Q Okay. And what were the conditions like, the weather
25 conditions, outdoor conditions like that day during the

1 inspection?
2 A Typical Seattle, overcast and gray. I don't remember if
3 it was spitting rain or not, but it was your standard Seattle
4 winter day.
5 Q And how does that kind of gray affect the quality of the
6 pictures that are depicted on page 10 of your expert report?
7 A Well, unfortunately, when you have overcast sky, you don't
8 get shadows and you don't get much contrast in the picture.
9 So the cliffs that we've seen at the edge of the membrane in
10 earlier pictures are harder to see.
11 Q What is the basis of that, sir?
12 A I'm an amateur photographer, and I know something about
13 photography.
14 Q So is that a fairly fundamental concept of photography,
15 lighting?
16 A Yeah. Overcast skies produce contrast.
17 MR. KLEIN: I object to the photography testimony.
18 THE COURT: Sustained. Let's move on.
19 Q (By Mr. Tebbutt) What can you see depicted in the coal
20 cars at Everett that are depicted in the picture on page 10?
21 A Well, you see these cliffs. You also can see some faint,
22 faint longitudinal markings from the nonuniform spraying.
23 Q They are harder to see because of the contrast?
24 A Yeah. They're really hard to see in this picture.
25 Q Okay.

1 And do you see any patterns that develop car after car?
2 A Yeah. Every car had missing topping membrane. I saw
3 damage to the membrane on every car. Typically, membrane was
4 missing at each end of the car and along the sides.
5 Q And was the amount that was missing in Everett the same or
6 greater than what was missed in the re-spray at Pasco?
7 A I'm not sure what I -- what you mean by "missed in the
8 re-spray."
9 Q Well, what I'm trying to ask you is, was the area that was
10 covered by the membrane when it reached Everett the same as
11 or less than what had been re-sprayed at Pasco?
12 A If I understand your question correctly, the re-spray at
13 Pasco got within a few feet of each end of the cars, as we
14 saw in those pictures, and within some distance from the
15 sides but not all the way to the sides.
16 The surviving membrane in Everett is much less than the
17 area that was re-sprayed in Pasco.
18 THE COURT: Let's stop there. I'm going to have to
19 take a longer lunch today. We'll start up at 1:30.
20 (Court in recess.)
21 MR. TEBBUTT: Your Honor, all parties have a proposal
22 to the court.
23 THE COURT: Okay.
24 MR. TEBBUTT: And that is that, while Dr. Breidenthal
25 continues his testimony, Mr. Wagner and Mr. Snyder, and

1 anyone else who wishes to join them from counsel group, may
2 go and work on language of what we hope will be an agreement
3 in principle.
4 THE COURT: All right.
5 MR. TEBBUTT: That can be presented to BNSF's
6 executives for final approval while we get final approval
7 from my clients so that the language, hopefully, will be read
8 on the record later today, and that would forestall trial.
9 THE COURT: All right.
10 MR. TEBBUTT: Okay?
11 THE COURT: That's fine.
12 MR. TEBBUTT: Is that an accurate representation?
13 MR. WAGNER: That is an accurate representation, Your
14 Honor.
15 THE COURT: Okay.
16 MR. TEBBUTT: So there may be a little activity of
17 lawyers --
18 THE COURT: Let me have the ones that are going to be
19 talking about the language up to sidebar.
20 (Sidebar held without the court reporter.)
21 MR. TEBBUTT: May I resume?
22 Q (By Mr. Tebbutt) Dr. Breidenthal, we're going to try to
23 pick up where we left off.
24 I was just about to show you page 11 of your expert
25 report, which is identified as Plaintiffs' Exhibit 1500.

1 Sir, is this a picture that you took?
2 A No, it is not.
3 Q Okay. And it's been represented -- and I believe,
4 actually this picture is already in evidence through
5 Mr. Anderson, Mr. Paul Anderson, but separately.
6 Describe what you see in this picture, please.
7 A This is a nice picture showing these longitudinal stripes
8 over the top of the surviving surfactant. And you see how
9 those stripes have a very long coherent strength over many,
10 many cars, which is not surprising, since the same topping
11 spray bar sprayed every car on the train.
12 Q So this, sir, would have been before the re-spray station
13 in Pasco was in place, so this would be likely surfactant
14 that was applied at or near the mines.
15 When you talk about the longitudinal, was it cracking?
16 A I was initially referring to just the variations in the
17 pattern that I interpret to be associated with the nonuniform
18 spray.
19 Q Okay.
20 A But there also --
21 Q Use your finger to --
22 THE COURT: I can see what he's talking about.
23 MR. TEBBUTT: Thank you, Your Honor.
24 A And also visible in this picture are the edges of the
25 surfactant. Like, for example, the closest car, you see the

1 rough, irregular edge, below which is a different color than
2 the surfactant or topping coating, which has the longitudinal
3 stripes. And that rough, irregular edge with the little
4 islands and so forth, I believe, represents the boundary
5 between the fraction of the car that is -- part of the car
6 that's still covered by the membrane and part that's not.
7 Q (By Mr. Tebbutt) Sir, also in your report, Figure 9, the
8 picture that was taken at the Pasco re-spray station during
9 the Rule 34 inspection in February of 2016, correct?
10 A Correct.
11 Q What does Figure 9 depict, sir?
12 A What is notable in Figure 9 is it didn't have this
13 bread-loaf pattern where the top is smooth and rounded like
14 the top of a bread loaf. And because it is flat, that, of
15 course, allows opportunity for more coal near the edges that
16 are just below the sill to go over the lip of the car sill.
17 Q So in terms of the aerodynamics, how does a flattened bed
18 of coal act versus a bread-loaf profile bed of coal?
19 A Well, according to what I've seen from the railroad's
20 documents, the bread-loaf profile reduces the aeolian
21 erosion, so departures of that can be expected to increase
22 the erosion ring.
23 Q Sir, it seems counterintuitive, doesn't it? Wouldn't you
24 think a flat car would produce less erosion?
25 A It's true, flat covers are aerodynamically cleaner from a

1 drag standpoint, but the variations in weightiness in the top
2 from departures of the bread loaf, I think, are likely to
3 increase erosion.
4 Q And, sir, Figure 11 in your expert report, Plaintiffs'
5 Exhibit 1500, what is this picture of?
6 A It is a picture of empty coal cars. Nearly empty. You
7 see a little bit of residual coal at the bottom.
8 Q And this was taken the same day as the Rule 34 inspection
9 when we were in Everett?
10 A Yes.
11 Q You actually didn't observe the empty cars yourself, did
12 you?
13 A I didn't. I think this may have even been a somewhat
14 different site than where we had our Rule 34 inspection.
15 Q And it was stipulated by counsel that Mr. Sears, our
16 photographer, could take pictures in order to -- because the
17 train was still up closer to Bellingham, was on its way down
18 to the Everett yard.
19 MR. KLEIN: Your Honor, I object to these
20 representations.
21 MR. TEBBUTT: We have a stipulation, counsel. You
22 weren't here. Mr. Sullivan can help us on this one.
23 MR. KLEIN: I object to the relevance.
24 THE COURT: Ask another question.
25 MR. TEBBUTT: It's just foundational, Your Honor.

1 THE COURT: Ask another question.
2 Q (By Mr. Tebbutt) The types of residual coal in these
3 cars, what would happen when the empty cars are moving?
4 A Well, you'd expect some of it to be blown out as well.
5 Q And what about the aerodynamics of empty cars versus full
6 cars, how do they compare?
7 A There is a dramatic increase in the aerodynamic drag in an
8 empty car compared to a full one. There is really a big
9 difference. The empty cars have much more drag and can be
10 almost as hard to pull around as the full ones. Even though
11 you have the added weight when they're full, the aerodynamic
12 drag is so important, the empties can take almost as much
13 effort to tug.
14 Q If you had these cars covered properly with an
15 aerodynamically designed cover, would that reduce fuel costs?
16 A Yeah, in the order of 9 or 10 percent. Those are the
17 kinds of figures I've seen.
18 Q Sir, getting to an area of your report -- do you recall
19 what these are pictures of, Figures 14 and 15 of your expert
20 report, Exhibit 1500?
21 A Those are pictures of the lower parts of the sides of the
22 coal cars. We were allowed to walk near some coal cars in
23 this train.
24 Q Okay. And do you discuss your observations that are
25 depicted in these pictures in your report at paragraph 60?

1 A I do.
2 And you can see a little bit of coal on this lower
3 sill associated with these cars.
4 Q Okay. How far away from these actual cars were you,
5 approximately?
6 A Maybe 10 feet or so.
7 Q Were you allowed to get closer?
8 A No. We were told we couldn't get closer and touch the
9 cars.
10 Q And these were not moving cars, correct?
11 A No, they were stationary.
12 Q Who told you that?
13 A BNSF counsel.
14 Q Do you remember the reason they gave for that?
15 A Well, I recall the word "safety" was mentioned.
16 Q This was on a public road where you were standing,
17 correct?
18 A Yes.
19 Q And it was a matter of, like you said, 10 feet to walk up
20 to them?
21 A Roughly.
22 Q Did you see any safety issues between those 10 feet when
23 you were walking up to the car?
24 THE COURT: Enough. Move on.
25 MR. TEBBUTT: Okay.

1 Q (By Mr. Tebbutt) Sir, did you see -- did you discuss in
2 paragraph 60 the observations of the patterns you saw?
3 A Yes, I did.
4 Q And what were the -- just summarize for the court what the
5 conclusions are of that report, please.
6 A Well, almost all the cars had coal on the sills, 13 out of
7 16, and the other three had a different type of sill. It was
8 much narrower. So all the coal cars we looked at with white
9 sills had coal on the sills.
10 Q And were they in approximately the same location on each
11 car?
12 A Yes. They were about the third ridge back, which
13 corresponds to about the place where the top of the bread
14 loaf is reached in the loading of the cars.
15 Q And what do you attribute that -- do you see a correlation
16 there, if you will?
17 A Yeah. Because that's the first place where the coal pile
18 is really high, it doesn't take much mass movement for coal
19 to move down the slope and over the side, onto the sill.
20 Q And did all of the cars that you viewed in that one
21 segment that had bottom sills have coal on them in about the
22 same place?
23 A The ones that had the wider sill, that's true.
24 Q Of the 16 that you could see standing right there on the
25 street?

A Yeah. Well, 13 of the 16 had the coal, and those 13 all had the wide sills. Three had narrow sills, and I didn't see coal there.

THE COURT: Somewhere in my background and experience, it may have been grain cars, I'm not sure, I remember an unloading technique -- it might be down here at the grain terminal -- where they actually -- a car goes on to a platform and is disconnected from the cars before and after it, and then it is hydraulically flipped upsidedown and dumped. Do they do that with coal?

MS. KAITALA: They aren't unbuckled, but they are coupled.

MR. TEBBUTT: And there are two methods, Your Honor, of cars. There's the rotary dump that they call it, and there's also a bottom dump, where just the bottoms open up and dump out. And those are the two active ones, I believe, we stipulated -- I don't know if we stipulated or not, but we're in agreement that those two were generally the type used in the Pacific Northwest.

THE COURT: As long as I've interrupted, has there been any effort to calculate the weight of the cars when they leave Wyoming and calculate the the weight of the spray and then the weight of the cars when they reach their destination?

MR. KLEIN: There have been such efforts. There are

1 complications with those efforts. Your Honor will be hearing
2 more about that from Mr. Carré.
3 MR. TEBBUTT: And, actually, Dr. Breidenthal could
4 talk a little bit about some of that, too. That's in his
5 report as well.
6 THE COURT: Okay.
7 Q (By Mr. Tebbutt) Quickly looking at Figure 7 of your
8 report which is in front of you, is this the type of car that
9 didn't have the bottom sill?
10 A Yes. It just has a very thin, narrow plate.
11 Q Right. Before I go on to the next issue, there was some
12 discussion earlier about the train's movement and wind. Does
13 the train create its own wind? In the absence of ambient
14 wind, does the train create its own wind?
15 A Sure.
16 Q How does it do that? Maybe it's elementary, but how does
17 it do that?
18 A If the air is not moving with respect to the ground, and
19 the train is moving forward over the ground, it's also moving
20 forward through the air.
21 THE COURT: Does anybody manufacture the locomotives
22 today other than GE? Is there just one manufacturer?
23 MS. KAITALA: There is another manufacturer, and the
24 name of them is -- I can't remember it right now.
25 THE COURT: Is it Baldwin?

1 MS. KAITALA: Oh, EMD.
2 THE COURT: Where are they based?
3 MS. KAITALA: In Illinois. I think they're in
4 Illinois. GE just opened a plant in Fort Worth.
5 THE COURT: Okay. Go ahead.
6 Q (By Mr. Tebbutt) Going back to 1421 for a moment, we
7 talked about that this morning in the series and we were
8 looking at this particular picture, 3463 of 1421. I'd like
9 to look at 3462 for a moment.
10 The patterns of cracking that we saw in 3463, are those
11 present in the coal cars that are depicted in 3462 as well?
12 A Yep. Same animal.
13 THE COURT: Why aren't there graffiti on the coal
14 cars?
15 MS. KAITALA: Well, we clean them up every once in a
16 while.
17 THE COURT: Good for you. That is one of the most
18 disgusting things in the world, in my mind, what has happened
19 to railcars in this country.
20 MR. TEBBUTT: There are a few in some of the
21 pictures.
22 Q (By Mr. Tebbutt) Let's go back to page 18 of your report,
23 sir, and I want to talk a little bit about the spray at the
24 Pasco station.
25 This is a picture, again, of the re-spray facility at the

1 Pasco station when you were present during the Rule 34
2 inspection, correct?
3 A Correct.
4 Q And what is depicted in this picture?
5 A Well, we're looking down on the floor. Of course, there
6 is no train there at the moment, but you see the tracks and
7 the spray bars are off to the right, and the building opens
8 up to the left, so we're near an opening door of the
9 building.
10 And you see this dark material on the -- on the floor.
11 Q Okay. And what do you believe that dark material to be,
12 from your observation that day?
13 A Well, I strongly suspect it's coal.
14 Q And from what you observed that day, what is your opinion
15 about how that coal got there?
16 A Well, as we said, all these cars have holes in the bottom,
17 and it's pretty likely that coal can leak out of those holes.
18 In addition, you've got the spray coming down. But I think
19 just mechanical disturbances are probably sufficient to
20 account for that kind of loss of coal out of the bottoms of
21 the cars.
22 Q Going back to tie up a loose end that I think I left, on
23 the pictures of coal on the bottom sills is a different
24 issue, the bottom sill pictures. I just want to tie this up.
25 The material that's depicted in Figures 14 and 15, did

1 you determine that to be coal?
2 A Well, I didn't take any samples, of course. It looked
3 like coal to me.
4 Q Right. From the distance you were allowed to go, you
5 thought it was coal?
6 A Yes.
7 Q Sir, did you do a rebuttal report in this case to
8 Mr. Carré, who is scheduled to testify next?
9 A Yes.
10 Q And do you have that report in front of you, sir?
11 A I do.
12 MR. TEBBUTT: And before I move on, Your Honor, I've
13 been in a number of trials, and I've seen expert reports
14 handled a number of different ways. I'm looking for some
15 guidance from the court. The plaintiffs would move
16 Plaintiffs' Exhibit 1500 into evidence, and I understand
17 sometimes the reports themselves don't come in, but we would
18 offer it into evidence.
19 MR. KLEIN: We object on hearsay grounds, Your Honor.
20 THE COURT: No. I'm going to admit it.
21 (Exhibit 1500 admitted.)
22 MR. TEBBUTT: Thank you.
23 Q (By Mr. Tebbutt) 1501 is your rebuttal report of
24 Mr. Carré.
25 Would you please just summarize for the court what the

1 main rebuttal issues are that you went into some detail on in
2 your rebuttal report of Mr. Carré? And feel free to look at
3 the report.
4 MR. KLEIN: Object; calls for narrative.
5 THE COURT: Overruled.
6 A Well, one issue concerned the effectiveness of the bread
7 loaf and surface topping treatments to reducing the coal
8 discharge.
9 Q (By Mr. Tebbutt) Let me stop you there.
10 In order to come to the opinions in your report, what
11 did you review to help shape your opinions?
12 A Well, the documents cited in this rebuttal report.
13 Q Okay. And are those documents cited in paragraphs 5 and 6
14 of that report?
15 A Yes. And also paragraph 11 is a citation, paragraph 9,
16 13, 14.
17 Q Okay. And what is -- give us just a thumbnail of your
18 conclusions of the compliance issues with -- let's start with
19 the bread-loaf profile.
20 A Well, I don't think they're achieving this ideal bread
21 loaf all the time. And there are even documents which show
22 that they're missing some of these bread-loaf treatments in
23 the trains at the mines.
24 Q And the statistics that you cite in your report are not
25 ones that you created, are they?

1 A No, they're BNSF documents.
2 Q Okay. So the statistics came from their documents,
3 correct?
4 A Correct.
5 Q And the same thing with the -- so we were talking earlier
6 about a flat coal car. That would be one type of the -- and
7 I'm quoting from paragraph 5 of your report -- "the poor loaf
8 shape."
9 Are there other types of loadings that were described
10 in the BNSF reports as being out of compliance with BNSF's
11 loading rule?
12 A Sure. If there is coal on the sills or the shelving, or
13 rippling or gouging, as they call it, those all enhance the
14 coal discharge.
15 Q Okay. And would you agree with that, that there is an
16 aerodynamicist that would cause more erosion of those types
17 of profiles?
18 A Yes.
19 Q And are there also statistics about how many trains
20 actually received topping agents versus none?
21 A Yes. Not every train gets treated with the topping agent.
22 Q And that was true even into 2015, the documents you
23 reviewed from BNSF in paragraph 6 of that rebuttal report; is
24 that correct?
25 A Yes.

1 Q And does Exhibit 1501 describe other differences of
2 opinion that you have with Mr. Carré's opinions?
3 A Yes. We have different views on how much dust is
4 collected in dust coal collectors and also detected by these
5 aerosol probes that are mounted on the trains themselves.
6 Q Let's talk a little bit about those aerosol probes.
7 What are those? What are we talking about? Are those
8 the RTEPS monitors?
9 A Yeah. Aerosol probes are typically optical devices that
10 shine -- usually a laser light -- into a stream of air, which
11 is pulling particles along with it, and the particles scatter
12 the light in characteristic directions. And for a good
13 probe, it's -- it's very sensitive. It will actually not
14 only detect very little concentrations, but also it will
15 distinguish between different-sized particles, from, for
16 example, $PM_{2.5}$ particles, all the way down to PM_1 or up to 10
17 micron in diameter and so on.
18 MR. TEBBUTT: Before I forget, Your Honor, I'd like
19 to move into evidence Exhibit 1501.
20 MR. KLEIN: Same objection for the record.
21 THE COURT: It will be admitted.
22 (Exhibit 1501 admitted.)
23 Q (By Mr. Tebbutt) Sir, showing you what's already been
24 admitted in the case as Plaintiffs' Exhibit 6, is this one of
25 the documents that you reviewed in formulating your opinions

in this case?
A Yes.
Q And this was a study. It says it right there, "Pacific Northwest Field Study."
Can you just put into words, generally, what you understand this study to -- the scope of this study, geographically and subject-wise?
A As I recall, on one or more cars, usually at the downstream end of the coal car, probes were mounted which had these aerosol -- an aerosol detector and also a detector to collect particles. And the figure that you've displayed now shows the dust monitor. I'll just circle the -- this is the aerosol dust monitor, and this passive dust collector, which collects the particles for accumulation and measuring later.
Q Okay. And these were something that BNSF put on a certain number of cars to test for coal loss, correct?
A Correct.
Q And is some of the data that was collected from those monitors used in formulating your opinions?
A Yes.
Q The RTEPS -- Rail Transit Emission Profiling System -- instrument that we're looking at has a number of different factors that it accounts for that are listed on the page we're looking at, which is BNSF_WA_0192087_A. Do you see that?

A Yes.

Q Okay.

So there's both -- the next page of that same document, which is Exhibit 6, discusses both the RTEPS and the passive collectors, correct?

A Yes.

Q And, again, the date it was collected from this was over what lengths of the track, do you recall?

A I recall it was quite a long ways. All the ways up to, I think, Swift, Washington, which, as I understand, is up by the Canadian border. And it started a ways -- I can't recall if it started at the mines or nearby.

Q Okay.

So monitors were placed -- the passive collectors were placed some in the front and some in the rear of the test trains; is that right?

A Yes. I think, if memory serves, it was always on the downstream or the back end of each car. But there were different cars on the train, near the front and near the back.

Q Do you know, from the documents you reviewed, whether the passive collectors and RTEPS were placed in the place where you would expect the highest release of coal from the coal cars?

A It's probably not exactly at the highest place. You'd

1 have to do a survey to find out the absolute maximum emission
2 location. They were placed in, I would say, a plausible
3 place in the downstream side. But height and location, you
4 don't know ahead of time where the maximum concentration is
5 going to be.
6 Q Right. And you didn't see any surveys in BNSF's documents
7 that indicated whether it was in the largest load zone, if
8 you will, or not?
9 A That's correct.
10 Q And the next picture talks about some of the cars, where
11 they were located?
12 A Yes.
13 Q And then the results.
14 These are done by segment, it looks like, right?
15 A Yeah. You can see in the left column different segments.
16 It looks like it started in Montana rather than Wyoming, and
17 ended up in Swift, Washington.
18 Q And so of the segments that were tested, which, generally,
19 had the highest levels of coal loss, which segment?
20 A Actually, let me correct my earlier statement.
21 It looks like it started at the mine. It didn't say
22 where the mine is.
23 Can you repeat the second question?
24 Q Yes.
25 In general, where did you see some of the highest coal

1 loss?
2 A Pasco to Vancouver, Washington, the windy gorge, which is
3 right where you would expect it.
4 MR. KLEIN: I object to the testimony. It
5 mischaracterizes this document.
6 THE COURT: Overruled.
7 Q (By Mr. Tebbutt) And all of the segments that were tested
8 in Washington, were there any segments where no coal was
9 detected?
10 A Not in Washington. There are a couple zeros on the Laurel
11 to Helena, Montana -- actually, three.
12 Q My question was just about Washington.
13 A In Washington it was below the red line. The answer is
14 no.
15 Q How does the sensitivity of RTEPS and dust collectors used
16 by BNSF compare to the sensitivity of the equipment that
17 Dr. Jaffe used in his study?
18 A That's unknown. I haven't been able to find any
19 documentation that shows the sensitivity of the RTEPS aerosol
20 probe. And I read Mr. Carré's deposition several times, and
21 I don't see it there, either.
22 Q Was he asked the question about how sensitive it was, do
23 you know?
24 A Yes, I believe he was.
25 Q And did he answer it?

1 A He gave an answer, but --
2 MR. KLEIN: Objection; hearsay.
3 THE COURT: Sustained.
4 Q (By Mr. Tebbutt) Did the answers he gave give you any
5 indication of how sensitive the probes that BNSF used were?
6 A No.
7 Q Page 12 of Exhibit 6 has a rank of overall dusting. Do
8 you see that?
9 A Yes.
10 Q So the highest was the Laurel, Montana, to Helena,
11 Montana, segment, right?
12 A Yes.
13 Q And then the second highest was Pasco to Vancouver, and
14 we're talking about Vancouver, Washington, right?
15 A Right.
16 Q And each segment had measurable dust, correct?
17 A Correct.
18 Q Looking at page 13 of the same report, what does this
19 chart indicate to you, sir?
20 A The height of these columns is the dust measured by these
21 diagnostics, and it shows the different segments. So you can
22 get an idea where the coal dust is being lost, according to
23 these measurements.
24 Q And, again, at no point is there a zero point, correct?
25 A Correct.

1 Q And Exhibit 16 is a report done about eight or nine months
2 later of the same Pacific Northwest field study, correct?
3 A Yes.
4 Q And we have more pictures that we've seen before.
5 One of the charts in Exhibit 16 involves precipitation,
6 and I think you've testified before that precipitation would
7 influence the amount of coal lost; is that right?
8 A Yes, lost through the top and also influences the loss
9 from the bottom.
10 Q And it would potentially reduce the amount of loss through
11 the top?
12 A Correct.
13 Q But could increase the amount of loss through the bottom,
14 correct?
15 A Correct.
16 Q Stop me if there are any of these charts that you would
17 like to explain further for the court.
18 A Well, if you could stop there.
19 Q This one right here?
20 A Yes.
21 Q What is the importance of this chart, sir?
22 A Well, this shows, I think, even better than the numbers we
23 looked at before, which may not be as dramatic in that one
24 spreadsheet.
25 This shows the amount of dust lost or measured in these

1 passive collectors. That's the Y axis. There's a function
2 of segment location. This actually illustrates, I think, the
3 best how the Pasco to Vancouver, Washington, segment has much
4 higher average discharge than any other segment, which is,
5 again, what you'd expect in general, on average, from the
6 high winds and also a dry environment.
7 Q And the Auburn to Swift, Washington, segment has some of
8 the lowest amounts, correct?
9 A Some of the lowest. In fact, I took the ratio of these
10 average discharges when I was at the easel. I took the
11 average of the ratio of these two measured quantities in
12 order to reduce my estimates by a factor of 31 to account for
13 the defects of both moisture and headwind.
14 Q And that's what we talked about this morning in your
15 equation, with the low number of particles being on the
16 conservative side of 6,000 particles per car per second,
17 right?
18 A Correct.
19 Q And then, again, the next page of Exhibit 16, what does
20 that show, sir?
21 A More of the same. You see the Pasco to Everett -- I'm
22 sorry -- Pasco to Vancouver segment dominates the discharge.
23 Q And in this case, the Auburn to Swift was not the lowest
24 coal-loss segment, was it?
25 A No, it was not.

1 Q It was the fourth from lowest, correct?
2 A Correct. In rank and order, it is the fourth from the
3 lowest.
4 Q But, again, Pasco to Vancouver was the highest?
5 A Yes, by a mile.
6 Q So to speak, yes.
7 What does the next chart show, sir? Is that anything
8 different than we've seen previously?
9 A Well, it is the same plot. You see the variations. Not
10 every train has exactly the same experience as every other
11 train.
12 Q They will vary from train to train from time to time?
13 A That's why I took an average, to try to account for that
14 variability.
15 Q And the next chart on page 15 of Exhibit 16?
16 A You see again the Pasco to Vancouver. They're this giant
17 row of columns. They're much larger than anywhere else.
18 Q And even with the treated trains, the circle that you made
19 on the prior picture ends up in the same correct spot, the
20 same testimony of it being larger in the Pasco to Vancouver
21 segment?
22 A Correct.
23 Q And we don't, obviously, know what's on the redacted page?
24 MR. KLEIN: Objection.
25 THE COURT: Overruled.

1 Q (By Mr. Tebbutt) Sir, did you do a supplemental report in
2 this case as well?
3 A Yes, I did.
4 Q And do you have a copy of that with you today?
5 A Yes.
6 Q And I'll put Exhibit 1248 up on the screen. And is this
7 report the report that you did in this case, the supplemental
8 report that was submitted in September of this year?
9 A Yes, it is.
10 Q Sir, why is it that you did a supplemental report in this
11 case?
12 A Because new documents became available.
13 Q And what -- what documents particularly? Are they set
14 forth in paragraph 10 of your report, some of them?
15 A Yeah, they are.
16 Q Please describe for the court why -- what this study was,
17 from your understanding, and why it was relevant.
18 A Actually, paragraph 6 is the one that has most of the
19 citations.
20 Can you repeat that?
21 Q Is paragraph 6 mostly a copy of what you did in your
22 original expert report?
23 A Oh, I beg your pardon. You're right. Yes, it was the
24 Volpe study that was cited in paragraph 10.
25 Q And what was the significance of the Volpe report?

1 A It confirmed everything I had earlier written about in my
2 original expert report; that small coal particles can travel
3 significant distances and that peak concentrations can be
4 very high, with lower concentrations for longer term
5 averages. Large particles won't necessarily be picked up by
6 the RTEPS device because they may fall quickly to the ground
7 in this detector.
8 Q So your specific opinions about the significance of the
9 Volpe report are set forth in more detail in this report?
10 A Yes.
11 Q Who is Volpe? Who is the Volpe Research Center?
12 A I think it is associated with the Department of
13 Transportation. It is a governmental entity.
14 Q The United States Department of Transportation?
15 A Yes.
16 Q So this is a study that they did?
17 A Yes.
18 Q Do the conclusions and opinions expressed in the Volpe
19 report comport with the opinions that you've expressed in
20 this case?
21 A Yes, they do.
22 Q Are there any significant variations from your opinions to
23 the opinions and findings in the Volpe report?
24 A None.
25 Q The Volpe report, did that discuss the Gaussian plume that

1 you discussed here this morning?
2 A Yes. I believe there's even a figure showing a Gaussian
3 profile in that report.
4 MR. TEBBUTT: Move into evidence Plaintiffs' Exhibit
5 1248.
6 MR. KLEIN: Same objection.
7 THE COURT: Overruled. It will be admitted.
8 (Exhibit 1248 admitted.)
9 Q (By Mr. Tebbutt) Is Plaintiffs' Exhibit 8 the Volpe
10 Center study, sir?
11 A Yes.
12 THE COURT: The Volpe study is not what you just
13 moved into evidence, correct?
14 MR. TEBBUTT: It's already been admitted in evidence.
15 It is in the admitted list, Plaintiffs' Exhibit 8.
16 THE COURT: Go ahead.
17 MR. TEBBUTT: The supplemental report we moved in.
18 Q (By Mr. Tebbutt) The Gaussian distribution that's been
19 discussed this morning, is that depicted in Plaintiffs'
20 Exhibit 8?
21 A Yes. That shows a profile both from a transverse and a
22 vertical direction from, say, a plume point source.
23 Q And what is -- is that just any plume point source?
24 A Yeah. You get these Gaussian-looking bell-shaped curves
25 all the time.

1 Q Is there anything else you'd like to tell the court about
2 the significance of the Volpe study, or are we ready to move
3 on to the next one?
4 A I think that covers the highlights.
5 Q This paragraph 12 of your report discusses another report
6 that one of BNSF's own experts did concerning coal car
7 aerodynamics and coal dust suppression. Do you see that?
8 A Yes, I do.
9 Q Is this a document that you reviewed in coming to the
10 opinions expressed in your supplemental expert report?
11 A Yes.
12 Q And this report, although it was dated 2010, it wasn't
13 received until 2016 by the plaintiffs -- by you until 2016,
14 correct?
15 A Correct. Yeah, I believe I saw this after my deposition.
16 Q And after your initial expert report?
17 A Yes.
18 Q And what is the significance of this report by Mr. Paul?
19 A Well, there are several important things that he
20 discusses. He measures the aerodynamic drag of coal cars.
21 He puts them in a wind tunnel and tests models of them with
22 various modifications to try to reduce aerodynamic drag. He
23 finds several possible configurations to lower the drag, but
24 the modification that lowers the drag the most are covers
25 over the cars. And he then goes on to estimate how long it

1 would take to pay back toward the cost of installing covers.
2 And because of the reduced drag from the covers, hence the
3 lower fuel cost because the fuel economy is better.
4 MR. KLEIN: I object to this as hearsay.
5 THE COURT: Sustained.
6 Q (By Mr. Tebbutt) Did Mr. Paul come up with any estimates
7 of coal loss in his study?
8 MR. KLEIN: Same objection.
9 THE COURT: Sustained.
10 MR. TEBBUTT: I'm just asking whether the amounts --
11 not what they are and how he got there, but whether the
12 amounts of coal loss that Mr. Paul had in his report are
13 consistent with the opinions in --
14 THE COURT: I've sustained the objection.
15 MR. TEBBUTT: All right. Thank you, Your Honor.
16 Q (By Mr. Tebbutt) Having reviewed the Volpe report and the
17 Paul report, are there any opinions expressed in those
18 reports that contradict the opinions that you have given in
19 the three expert reports that you have given in this case?
20 A No contradictions from either Volpe or this Paul report.
21 They're all consistent.
22 Q You also discuss in this supplemental report additional
23 documents that you received concerning -- or additional
24 documents and evidence you received after reading Mr. Carré's
25 deposition, correct?

1 A Yes.
2 Q And did you take issue with some of the statements in
3 Mr. Carré's deposition?
4 A Yes, I did.
5 Q And are those opinions about the adequacy of Mr. Carré's
6 testimony expressed in this report?
7 A Yes.
8 Q Please summarize for the court what they are.
9 A Well, maybe the more important one is that in his analysis
10 of these RTEPS data, he excludes all measurements of dust
11 that fall below an eight-minute running average.
12 Q And why is that significant?
13 A Well, it's central to the question of the continuous
14 emission.
15 If you had a -- suppose the emissions were perfectly
16 constant. If you throw away everything that's -- except for
17 maybe one little blip, if you throw away anything that's
18 below an eight-minute average, you would throw away all of
19 that constant reading. So if you throw away the stuff below
20 the average, you don't see the small stuff.
21 Q And the small stuff is the stuff that you talked about
22 this morning, nonvisible, continuous release, correct?
23 A Correct. And I should say small in quantity, not
24 necessarily small in size, though in this case it is also
25 small in size.

1 Q And is that expressed particularly in paragraph 15 of
2 Exhibit 1248?
3 A Yes. Correct. The discussion continues beyond that
4 through paragraph 19.
5 Q Are there other opinions about Mr. Carré's opinion that
6 you discuss in paragraphs 15 through 19 that are different
7 than we just discussed?
8 A Not only did Mr. Carré throw away the measurements when
9 the quantity was low, he also threw away dusting events when
10 the quantity was high. If it exceeded what he called 100
11 relative dusting units, he excluded that. And, of course,
12 both the throwing away data below the average and the
13 throwing away above this arbitrary 100 relative dust units
14 are arbitrary.
15 Q Are there any other significant findings that Mr. Carré
16 made concerning how much, in particular, trains dust?
17 A Yeah, I didn't agree with his -- well, if you use his
18 eight-minute logic, you get percentage of dusting of 40
19 percent of the time, even using what I regard as this
20 flawed-data averaging.
21 Q So at minimum, Mr. Carré, in your opinion, agrees that the
22 trains dust at least 40 percent of the time?
23 A Correct.
24 Q Because he threw out a lot of low data, correct?
25 A Correct.

1 Q If he hadn't, is it your opinion that his data would show
2 100 percent dusting?
3 A If he had a sensitive enough aerosol detector like
4 Professor Jaffe used, I think he would have seen 100 percent
5 of the time dusting.
6 Q And going on from paragraph 20, are there other findings
7 or discussions that you make concerning Mr. Carré's opinions?
8 A Yeah. Instead of using an eight-minute average, you use a
9 five-minute running average. Using Mr. Carré's logic, you
10 would find the signal exceeds the eight-minute running
11 average -- the five-minute running average 60 percent of the
12 time. So depending on how long you use this running average,
13 you get either 40 or 60 percent even after throwing away a
14 lot of the data.
15 Q Are there -- going further down the report, are there
16 other discussions, for instance, about the re-spray facility
17 efficacy in this report?
18 A Yes. I thought Mr. Carré was too optimistic about the
19 efficacy of the re-spray facility. My Rule 34 inspection,
20 the re-spray missed a lot of the top, as I discussed earlier,
21 and the membrane, as we saw in this picture, is significantly
22 degraded as the train moves along the track.
23 Q And that's described in what paragraph, sir?
24 A Paragraph 21. And 22 talks about some BNSF documents
25 which document not all trains are receiving the second

1 application of surfactant at the Pasco re-spraying facility.
2 Q And what about paragraph 23?
3 A Yeah. Mr. Carré talks about the missing ends of the
4 coverage. He says six to ten feet of coverage at the front
5 and rear ends of the cars are being missed. So he
6 acknowledges that the re-spray facility is not hitting the
7 entire surface of the coal.
8 Q And on that, you would agree with Mr. Carré?
9 A He is -- he is right there.
10 MR. TEBBUTT: Your Honor, is this a good time for the
11 afternoon break?
12 THE COURT: All right. We'll take 15 minutes.
13 (Court in recess.)
14 THE COURT: Okay.
15 Q (By Mr. Tebbutt) Dr. Breidenthal, two clean-up questions.
16 MR. TEBBUTT: Your Honor, I know I tendered
17 Dr. Breidenthal as an expert.
18 THE COURT: Actually, in the Federal Rules of
19 Evidence, there is no provision for the court certifying
20 somebody as an expert or for counsel to tender somebody as an
21 expert. You ask questions. If there are objections, I'll
22 rule on them. If your objections are overruled, he
23 testifies. But it's for the trier of fact, in this case me,
24 to decide what weight to give to his testimony and whether he
25 is an expert or not.

1 Now, I might add, for Mr. Klein's benefit, that in a
2 nonjury context like this, frankly, your objections, if we
3 had a jury, would have probably been well taken. But in a
4 nonjury context, I just don't see any harm in listening to
5 what he has to say, and I can sort it out.
6 MR. KLEIN: Thank you, Your Honor.
7 THE COURT: Okay.
8 Q (By Mr. Tebbutt) Sir, in forming your opinions, did you
9 rely on data other than just the Wyoming data that BNSF had
10 collected?
11 A No. Other data. The Bellingham data, for example, the
12 RTEPS data, and so forth.
13 Q So you did rely on more than just the Wyoming data?
14 A Oh, yes.
15 Q And all of that data is described in paragraph 6 of your
16 original expert report?
17 A Yes.
18 Q Or as otherwise cited, as you say, in your report?
19 A Yes. Paragraph 6 doesn't have all the citations. It has
20 the bulk of them.
21 Q And the rest are cited in your report in Exhibit 1500,
22 correct?
23 A Correct.
24 Q And the additional documents you relied on for your
25 rebuttal report of Mr. Carré and your supplemental report are

1 cited in those reports, too?
2 A That's correct.
3 Q And you relied upon all of those documents in forming your
4 opinion in this case?
5 A Yes.
6 Q Is it -- so would the fact that you've testified earlier
7 that all trains are discharging coal at all times while
8 they're moving through the state of Washington, what is your
9 opinion about whether coal is discharged directly -- and what
10 I mean by "directly," I mean from the tops of coal cars, at
11 some point hitting the water before they hit anything else,
12 any other land surface.
13 What is your opinion about whether coal is going to hit
14 waterways first that are adjacent to the tracks?
15 A A wide spectrum of particle sizes would hit the water very
16 close and adjacent to the tracks, big particles as well as
17 small $PM_{2.5s}$.
18 Q And what kind of distance for the smallest particles? How
19 far away could the waterways be or how far out into the water
20 could the waterways go for the small-particle fallout into
21 the water?
22 A Well, hundreds of feet. Depends on the winds, but a long
23 ways.
24 Q And for larger particles, we've seen, for instance, the
25 Cornelison video. Is that representative of the kinds of

1 distances that you would expect the coal to travel toward
2 waterways that are adjacent to the tracks?
3 A Yes.
4 Q And for waterways that the BNSF trains cross by bridge,
5 what is the likelihood that some amount of that coal is
6 discharging directly from the cars into the water, the
7 waterways?
8 A Virtual certainty.
9 Q So it's not a question of whether the coal is discharging,
10 but there is a question of how much is discharging, and that
11 will vary by train and other conditions, correct?
12 A Correct.
13 Q And, sir, did you come to any conclusions about whether
14 car covers from an aerodynamic point of view are a solution
15 to stopping the discharges from coal trains?
16 A Yes, I did.
17 Q And what is your opinion, sir?
18 A If you put a cover on the top, you stop the losses out of
19 the top, and that allows you to also seal up the bottom
20 holes, and the discharge rate goes to zero.
21 Q And did you look at a number of car-cover proposals in
22 helping to form your opinion?
23 A Yes.
24 Q And, sir, where in your expert report do you discuss car
25 covers?

A I believe paragraphs 59 -- so that's incorrect. Let me find it.

Q 61 maybe?

A Oh, yes, there it is. 61. I was close.

Q Showing you what's been marked as Plaintiffs' Exhibit 1342, is this one of the documents you reviewed in coming to your conclusion that car covers are a viable solution?

A Yes.

Q And is there a particular -- is this page the page that discusses the viability of car covers?

MR. KLEIN: Objection, Your Honor. I object to the discussion of this document as hearsay.

THE COURT: Sustained.

Q (By Mr. Tebbutt) Do you know if this is a document covered or in -- well, skip that.

And does this document discuss other studies that refer to the viability of car covers as a means of solving the problem?

MR. KLEIN: Objection.

THE COURT: No. He can answer that question.

A Yes.

Q (By Mr. Tebbutt) Sir, showing you what's been marked as Plaintiffs' Exhibit 652, an e-mail from Dean Dalquist of BNSF to Mr. Carré, is this a document you reviewed in forming your opinions of the viability of car covers as the solution in

1 this case?
2 A Yes.
3 MR. TEBBUTT: Your Honor, I move Plaintiffs' Exhibit
4 652 as a business record of BNSF, an admission against
5 interest.
6 MR. KLEIN: I object to the lower email in this
7 chain, which is not a BNSF email. I do not object to the top
8 email from Mr. Dalquist.
9 MR. TEBBUTT: The lower email is part and parcel of
10 that business record from BNSF, as Mr. Dalquist is copied.
11 THE COURT: But this isn't the witness you can use to
12 establish that's a BNSF business record.
13 MR. TEBBUTT: This raises the question that we've
14 given to Your Honor, where we have designated testimony and
15 provided the foundation for documents such as this through
16 the designated testimony. We also provided on Monday, the
17 start of trial, a list of all the places where the documents,
18 the exhibits that are now being proffered by plaintiffs, have
19 been authenticated through testimony and the foundation laid
20 for admissibility.
21 MR. KLEIN: He's asserting that he has laid a
22 foundation, but he has not actually laid it here, so I
23 maintain my objection.
24 THE COURT: Is it in the designated deposition
25 testimony?

1 MR. KLEIN: As to this particular email, I don't know
2 standing here, Your Honor.
3 THE COURT: I'm going to admit it for the limited
4 purpose as being something he considered in arriving at his
5 determination. I'll consider it as a business record after
6 reviewing the designations and determining whether you've
7 laid foundation. So it will be admitted for that limited
8 purpose now.
9 MR. TEBBUTT: Thank you, Your Honor.
10 (Exhibit 652 admitted.)
11 Q (By Mr. Tebbutt) And this document, again, these -- these
12 emails are dated 2012, correct?
13 A Correct.
14 Q Do you see the last statement where it says, "I do think
15 there are viable cover systems being developed, and I would
16 think results of this testing would be of interest to BNSF"?
17 A Yes.
18 Q Do you think -- why are car covers of interest to you in
19 solving this problem?
20 A Well, for two reasons. One is, they would eliminate all
21 of the discharge, and it turns out I'm a co-owner of the
22 railroad.
23 Q How is that so? Are you Mr. Buffett's brother?
24 A I'm not that high up. But about all of my investable
25 assets are in Berkshire Hathaway, which is --

1 MR. KLEIN: Objection; irrelevant.
2 THE COURT: Overruled. Go ahead.
3 A Six or seven years ago, Berkshire Hathaway purchased BNSF.
4 Q (By Mr. Tebbutt) Plaintiffs' Exhibit 1215 is another
5 document that discusses, among other things, car covers,
6 correct?
7 A Yes.
8 Q Is this another document that you reviewed in determining
9 your opinion that car covers are a viable option?
10 A Yes.
11 MR. KLEIN: Objection; hearsay.
12 THE COURT: It will be admitted for the limited
13 purpose as being something that he considered in arriving at
14 his opinion.
15 MR. TEBBUTT: Thank you.
16 Q (By Mr. Tebbutt) Plaintiffs' Exhibit 1217 is a document,
17 as it says, prepared for BNSF August 8th, 2013. Is this
18 another coal cover proposal that you reviewed in forming your
19 opinion about the viability of coal car covers?
20 A Yes.
21 Q And this is a company that has a particular proposal; is
22 that correct?
23 A Yeah. There are a number of companies that are trying to
24 market coal cover -- coal covers or their designs to
25 Burlington Northern.

1 MR. TEBBUTT: Move the admittance of Plaintiffs'
2 Exhibit 1217.
3 MR. KLEIN: I object and would ask for the same
4 limitation.
5 THE COURT: It will be admitted for a limited purpose
6 as the other exhibits.
7 (Exhibit 1217 admitted.)
8 Q (By Mr. Tebbutt) Plaintiffs' Exhibit 1220, is this one of
9 the documents that you reviewed in coming to your opinion on
10 the viability of railcar covers?
11 A Yes.
12 Q For coal in particular?
13 A Yes.
14 MR. TEBBUTT: Move for the same purpose, Your Honor.
15 MR. WAGNER: Same objection.
16 THE COURT: It will be admitted for the same purpose.
17 (Exhibit 1220 admitted.)
18 Q (By Mr. Tebbutt) And, sir, showing you what's been marked
19 as Plaintiffs' Exhibit 1223, is this yet another proposal
20 that you reviewed in forming your opinions about the
21 viability of coal car covers?
22 A Yes.
23 MR. TEBBUTT: Again, move for the same purpose, Your
24 Honor.
25 MR. KLEIN: Same objection.

1 THE COURT: It will be admitted for the same purpose.
2 (Exhibit 1223 admitted.)
3 Q (By Mr. Tebbutt) Sir, showing you what's been marked as
4 Plaintiffs' Exhibit 1224, another proposal from ClearRails,
5 LLC, this time dated July 14th, 2015 to BNSF Railway. Is
6 this another document you reviewed in forming your opinion
7 about the viability of car covers?
8 A Yes.
9 MR. TEBBUTT: Move for the same purpose, Your Honor.
10 MR. KLEIN: Objection.
11 THE COURT: It will be admitted for the same purpose.
12 (Exhibit 1224 admitted.)
13 MR. WAGNER: The purpose for which the court is
14 admitting these documents is to still take Dr. Breidenthal's
15 testimony, but not as independent evidence of the content of
16 these documents, correct?
17 THE COURT: That's right. They're not being admitted
18 as truth of the content of the documents; only to assist the
19 court in understanding his opinion.
20 Q (By Mr. Tebbutt) Showing you what's been marked as
21 Plaintiffs' Exhibit 1001. Is this another document you
22 reviewed, sir, in coming to your opinion about the viability
23 of coal car covers?
24 A Yes.
25 Q And do you know if these are -- you don't know whether

1 these are individuals from BNSF that are mentioned in the
2 email, do you?
3 A No, I don't, not off the top of my head.
4 MR. TEBBUTT: Your Honor, plaintiffs move for 1001 on
5 the same grounds as a business record. Mr. Dalquist's
6 deposition will reveal that these are BNSF employees that are
7 emailing about this particular issue.
8 MR. KLEIN: That, again, wasn't in the designated
9 testimony.
10 THE COURT: I'll consider its admissibility when I
11 consider the designated portions of the depositions.
12 MR. TEBBUTT: Yes.
13 Q (By Mr. Tebbutt) And then, sir, Plaintiffs' Exhibit 1222.
14 Is this a document that -- this is dated -- I don't see the
15 date on it. It looks like March 19, 2014, down at the
16 bottom. Do you see that?
17 A Yes.
18 Q Is this a document that you reviewed in coming to your
19 conclusion that, in part, coal car covers are a viable
20 solution?
21 A Yes.
22 MR. TEBBUTT: Again, moving for that same limited
23 purpose.
24 MR. KLEIN: Same objection.
25 THE COURT: It will be admitted for that purpose.

(Exhibit 1222 admitted.)

Q (By Mr. Tebbutt) Sir, in your experience, is there -- and we talked about this earlier -- you are an engineer, correct?

A Correct.

Q And a physicist as well, a scientist?

A Yes.

Q Is there any reason to believe, from your experience, that finding a solution that involves putting car covers on coal cars is an impossibility?

A There are no show-stoppers here, in my opinion. It is an engineering design problem. Engineers solve problems. This is a typical engineering problem, and I don't see any show-stoppers.

Q We put a man on the moon, right?

A We did.

Q And we are sending spaceships to Mars?

A We have already.

Q You've studied black holes?

MR. KLEIN: Objection.

THE COURT: We left Matt Damon on Mars, too.

MR. TEBBUTT: I didn't want to say that. Elon Musk is next.

Q (By Mr. Tebbutt) Is there any reasonable speculation or thought why we can't put covers on coal cars?

MR. KLEIN: Objection to the extent that he

1 explicitly just called for speculation.
2 THE COURT: Overruled.
3 A No, I see no reason why it can't be done.
4 MR. TEBBUTT: If I may just confer for one moment
5 with my counsel.
6 We're good, Your Honor. Thank you.
7 THE COURT: All right. Cross?
8 CROSS-EXAMINATION
9 BY MR. KLEIN:
10 Q Good afternoon, Dr. Breidenthal.
11 A Good afternoon.
12 MR. KLEIN: Ms. Mendoza, will you display Docket No.
13 315 for me, please, at page 120?
14 Q (By Mr. Klein) Dr. Breidenthal, your testimony is that
15 coal cars discharge coal dust typically at train speeds.
16 When you testified that these emissions are continuous, just
17 to be clear, we're not talking necessarily about large
18 amounts of coal dust, right?
19 A Of course, "large" is a relative term. But certainly
20 these $PM_{2.5}$ particles that I spoke extensively about are
21 microscopic.
22 Q Yes. That, actually, is where I was going.
23 You spoke extensively in your testimony about fine
24 particulate matter, $PM_{2.5}$, the size particle that would be a
25 30th of the width of human hair. So that's really the focus

1 of what you're talking about when you're saying you believe
2 coal car emissions are ubiquitous and continuous and are
3 necessarily discharged to all waterbodies near trains, right?
4 MR. TEBBUTT: Objection; mischaracterizes his
5 testimony.
6 THE COURT: Overruled.
7 A I've tried to make clear that there are two types of
8 discharge. There is the episodic discharge and this
9 continuous low-level discharge.
10 The continuous low-level discharge is at least $PM_{2.5}$
11 particles. Those were what Jaffe studied. Jaffe's tests
12 were the most scientific and thorough I've been able to find.
13 He measured things that other people didn't measure. But he
14 only looked at the relatively small stuff. So I wouldn't
15 limit the continuous discharged $PM_{2.5}$ only, but we know that
16 it continuously discharges.
17 Q I'm showing you a document the plaintiffs filed in this
18 case. This is Document 350 on this court's electronic
19 docket, and I'm showing you Footnote 4, and I'll direct your
20 attention to the first sentence.
21 "Plaintiffs' expert, Dr. Breidenthal, will testify that
22 all not all coal discharged from cars is visible or
23 measurable."
24 Were the Sierra Club and the other plaintiffs being
25 truthful and accurate with this court when it represented

1 your views in this way?
2 A Well, of course, the issue about whether something is
3 measurable or not depends on the diagnostics.
4 Processor Jaffe used very sensitivity diagnostics. If you
5 used less sensitive diagnostics, you may well miss a lot of
6 emissions. If you can't pick up these tiny particles, you'll
7 miss that.
8 So I suppose it depends on whether you read the word
9 "measurable" to mean measurable by the finest possible
10 techniques, or measurable by something that is not so fine.
11 Q So your testimony is that "measurable" here doesn't
12 necessarily just mean completely undetectable? It means it
13 might be hard to measure, but it's possible, depending on how
14 good your equipment is?
15 A Well, I'm not going to speak to who wrote this. I don't
16 know what was in their mind when they used the word
17 "measurable."
18 But certainly Jaffe measured -- I think he said almost all
19 cars were emitting a $PM_{2.5}$ particles. And he only had a probe
20 on one side of the tracks, so if the wind was blowing hard
21 enough to push these Gaussian profiles that we've talked
22 about away from the probes, the probes would miss the wake.
23 Q I'm still trying to figure out exactly what you mean.
24 Do you think that there is some coal dust emissions
25 that are so small as to be undetectable?

1 A By "small," do you mean small in amount or small in size?
2 Q Either.
3 A And when you say "undetectable," do you mean by the finest
4 possible diagnostics, or what might be commercially available
5 to someone?
6 Q Well, let's start by you answering the question as I've
7 asked it, and then we can explore further.
8 Is this document correct that it's your view that
9 you'll testify that not all coal discharge is measurable?
10 MR. TEBBUTT: Your Honor, I might just interpose an
11 objection.
12 Mr. Klein is asking for someone -- for Dr. Breidenthal to
13 interpret a lawyer's brief, and I don't think that is
14 appropriate examination.
15 THE COURT: Overruled.
16 A Well, certainly there can be some subset of all the
17 discharge, which is not measurable; for example, particles
18 that are much smaller than $PM_{2.5}$ are probably not detectable
19 by currently available sensors.
20 Q (By Mr. Klein) Now, the collection of data about airborne
21 particulate matter is outside of your area of expertise,
22 right?
23 A I would say that that's true, yes.
24 Q Does dust-monitoring equipment exist that would be
25 adequate to definitely detect the coal dust emissions that

1 you're suggesting in your testimony?
2 A Yeah. Jaffe did it.
3 Q So if equipment with the same sensitivity as Dr. Jaffe
4 used failed to detect dust particles, you would agree that
5 there was no material dust particles to be measured in that
6 case?
7 A No. I just told you that if the wind blew the turbulent
8 wake of the train away from Jaffe's probe, his probe wouldn't
9 see the turbulent wake other than dust. The terminal wake,
10 the dust is still there.
11 If Jaffe had had probes on both sides of the track, of
12 course, he could have detected the wake no matter which way
13 that Gaussian profile was pushed. But he only had one probe.
14 Q So your testimony is that if you had an aerosol particle
15 monitor mounted on both sides of a track that was equally
16 sensitive to Dr. Jaffe's equipment and that equipment didn't
17 measure coal dust emissions, that there would be no coal dust
18 emissions to measure; is that fair?
19 A No. I think the lack of a detectable signal only tells
20 you that the signal didn't reach up to whatever the
21 detectable threshold was. You can't know what happens below
22 that -- that floor.
23 Q So you are saying that some coal dust emissions are simply
24 undetectable?
25 A Some fraction of the coal dust emissions; for example,

1 there is a spectrum of particles coming off of those coal
2 trains, and if some of those particles are so tiny they can't
3 be detected, while at the same time larger ones are being
4 discharged, it's just being 2.5, you won't get all of the
5 particles detected. You'll only get the subset that you're
6 sensor can respond to.
7 Q How do you go about falsifying a theory that says some
8 coal dust will be emitted below the ability of equipment to
9 detect it?
10 A I don't think you can. Once you're below the detecting
11 limit, you simply don't know.
12 Q So you testified to collection of data about airborne
13 particulates like $PM_{2.5}$ is outside of your area of expertise,
14 right?
15 A I've been involved in a lot of atmospheric science
16 research. I used to be an affiliate professor in the
17 Department of Atmospheric Sciences at the University of
18 Washington. And we use anemometers and other diagnostics to
19 measure tiny, little particles. I would not hold myself up
20 as the world's expert on it, but I know something about it.
21 Q And, in fact, you're not an expert in the detection and
22 analysis of airborne particulates, right?
23 A Certainly not the analysis. As you know, I'm not a
24 chemist.
25 Q But the focus of your testimony here today is that

1 invisible and often undetectable small particles are being
2 discharged from trains into water in violation of the Clean
3 Water Act?
4 A I don't think I said they were undetectable. Jaffe
5 detected particles. In fact, he said almost all trains were
6 discharging these particles.
7 Q Okay. I want to ask you a hypothetical question that
8 will, I hope, help the court understand how far-reaching your
9 testimony is here today.
10 MR. KLEIN: Ms. Mendoza, can we display the photo of
11 the chimney smoke?
12 Q (By Mr. Klein) Dr. Breidenthal, you agree that $PM_{2.5}$ can
13 be produced by wood-burning fires, right?
14 A Yes.
15 Q I'm going to ask you to assume for this purpose that this
16 smoke that you see in this picture is the result of a
17 wood-burning fire in the fireplace of this home.
18 Now, you'd agree with me that the smoke we see here
19 contains $PM_{2.5}$, right?
20 A I think that's highly likely, yes.
21 Q Are these homeowners going to need a Clean Water Act
22 permit?
23 A I'm not a lawyer. I --
24 MR. TEBBUTT: Objection; calls for a legal
25 conclusion.

1 THE COURT: Sustained.
2 Q (By Mr. Klein) Under your theory of fine particle
3 emissions, are the $PM_{2.5}$ particles in that smoke reaching this
4 water?
5 A This is a buoyant plume, so the buoyancy lifts the cloud
6 up from the surface. The coal dust emissions from train are
7 non-buoyant. I think I mentioned earlier that you could
8 imagine this cloud of $PM_{2.5}$ particles to be like smoke, except
9 for the buoyancy.
10 So -- but having said that, these tiny -- if, for the sake
11 of argument, we assume this has $PM_{2.5}$ particles in it,
12 eventually they will settle out. Whether or not there is
13 water underneath them when they settle out depends on where
14 the water is, but they'll eventually settle out of the
15 atmosphere.
16 Q Let me just make sure I understand your testimony.
17 You said you're not an expert in the collection and
18 analysis of data of fine particulate matter, but your
19 testimony is that the fine particles in this smoke behave
20 differently than the fine particles that would be emitted
21 from a coal train, under your theory; is that right?
22 A Different in two respects. As I said earlier, one is,
23 they are buoyant.
24 I imagine this fire is hot, and so the gases coming out of
25 it, including the particles, are white. In spite of the mass

1 of the particles, the air or the combustions upon it are so
2 warm there's a net point force, and that's why you see this
3 thing rising.
4 The second reason why smoke is not exactly like $PM_{2.5}$ is,
5 as I said earlier, the smoke particles are about one-tenth
6 the diameter -- typical smoke particles, like from cigarette
7 smoke, are like a tenth of a diameter of $PM_{2.5}$ particles. And
8 the physical consequences of that are that they're
9 sedimentation speed is even lower than this .01 inch per
10 second sedimentation speed of $PM_{2.5}$ coal particles.
11 Q Now, you have testified that this smoke contains $PM_{2.5}$,
12 right?
13 A Well, I haven't made any measurements, but I suspect among
14 the distribution of particle sizes, it will have something in
15 the 2.5 area. But at least cigarette smoke is known to be,
16 on average -- again, there's a distribution of particle
17 sizes, but on average, something like in order of magnitude
18 smaller than $PM_{2.5}$.
19 Q The $PM_{2.5}$ in this smoke is the same size as the $PM_{2.5}$
20 anywhere, right?
21 A Yes. Although let me just make sure that we're clear.
22 $PM_{2.5}$ consists of particles that have a diameter of 2.5
23 and below. So if there is a spectrum of particle sizes, you
24 could have particles with different groups of particles with
25 different spectra. They would both be called $PM_{2.5}$ because

they are at or below this 2.5 micron upper limit.

MR. KLEIN: Ms. Mendoza, can we see Exhibit A43, please?

Q (By Mr. Klein) While we're waiting this video, is it your testimony that the continuous coal dust emissions that you believe occur from coal trains happen at typical speeds, right?

A Yes.

Q So a stopped train won't be doing the continuous emissions that you're discussing here, correct?

A I don't know that that's true. I think stopped trains probably have some emission, whether or not it is a hundred percent continuous or not.

Let me explain.

Because of the production and liberation of these really tiny particles throughout the volume of the coal, it takes a long time to flush those out, even after the train quits moving.

And even if the train is just sitting there, any temperature changes that cause the steel or the aluminum of a car to lengthen or decrease, those metals have different thermal expansion coefficients than coal.

And so just sitting there, there will be disturbances acting on this coal pile. If there is any wind at all, and I've indicated earlier how tiny that wind test can be, any

1 liberation of coal particles down to the $PM_{2.5}$ size would be
2 blown out like smoke.
3 So I think the discharge of $PM_{2.5}$ particles, even for a
4 train sitting stationary, that can persist for a long time.
5 If you keep the temperature exactly constant and the moisture
6 exactly constant, eventually, if the wind stays exactly
7 constant, ambient wind, you would flush out these particles.
8 That could be many hours of sitting there while conditions
9 are perfectly steady.
10 Q Now, you haven't done any analysis whatsoever in this case
11 about thermal contraction of metals in coal cars, right?
12 A Not analysis. I just know that the thermal expansion
13 coefficients of aluminum and steel are different than coal.
14 Q Okay.
15 And your theory is that vibration of a car, even if
16 caused by thermal expansion of the car wall, is what prepares
17 coal to be lofted by aeolian erosion or wind, and emitted,
18 right?
19 A Yeah, among other things.
20 You might have to repeat that question. I'm not sure
21 I --
22 Q It's fair to say that the vibration of a train car is sort
23 of the engine underneath your theory here, right, that coal
24 cars are emitting coal all the time, even while stopped?
25 A Presumably there is some $PM_{2.5}$ particles that were

1 initially loaded into the coal car at the mine. And the
2 Jaffe data indicates that -- well, there are two
3 possibilities: Either you make and/or liberate more of those
4 particles by the time you get to Jaffe's observation point,
5 and some of those newer or freshly liberated particles that
6 are being discharged, or the original coal car had such a
7 large supply of those particles, that even getting more than
8 halfway to Blaine, Washington, there's still plenty there for
9 the discharge.
10 Q I want to respectfully ask you to answer my next question
11 directly.
12 Is vibration of a train car one of the fundamental
13 mechanisms by which you posit coal dust emissions from coal
14 cars?
15 A Yes, it is one of them, yes.
16 Q And you have done nothing in this case to actually study
17 train car vibration, right?
18 A That's correct.
19 Q And before this case you had never studied train car
20 vibration, right?
21 A Correct.
22 Q You don't know the frequency that a train car vibrates at?
23 A Correct. I've measured no vibration.
24 Q Let's show this video.
25 MR. KLEIN: Are we ready?

(Video is played.)

Q (By Mr. Klein) I'll represent to you that is a BNSF coal train shown at the speed the video was taken. The speed has not been altered, and the location is not relevant to this question.

Do you see coal dust emissions happening here?

A No, I don't.

Q But it's your testimony that particles are being emitted and reaching this water?

A You'd have to know the winds. As I said, if you have a strong enough wind, it will push these Gaussian wakes off to one side.

Q You would have to know the winds, wouldn't you?

A That's right, you do.

Q And your studying this case and the analysis did not involve you looking at wind data in Wyoming or Washington, with the exception of, I believe, one location Pasco; is that right?

A I think it was actually somewhere in the Gorge. I looked at the data of the Gorge.

Q But you can agree with me that actually analyzing what the winds are in Wyoming or throughout Washington, either the strength of the winds, the direction of the winds seasonally or at any given time, was not part of the work you did in this case, right?

1 A Correct.
2 But let me clarify one point. For the wake of this
3 train not to make it to the water in the proximity that
4 you're showing now in the video would require a relatively
5 strong wind from the left.
6 And so looking at the near-mirror reflections on the
7 water, I would judge that, in this particular case, the one
8 you're talking about, the onshore -- I guess it's called
9 "onshore" -- the flow of wind from the water towards the land
10 here would not prevent particles from getting to this...
11 Q And you'd agree with me that, through most of this stretch
12 that we're watching, there are trees standing in between the
13 water and the train that are taller than the top of the
14 train?
15 A It looks like it.
16 Q Has your analysis in this case factored in where there
17 might or might not be trees, tunnels, roads or other barriers
18 that stand between trains and water in Washington?
19 A To the extent that turbulent wake grows larger than
20 obstacles, the first order you don't expect any effect of
21 those obstacles in the propagation and dispersement of
22 particles.
23 Q So it's your testimony, to be clear, that the turbulent
24 wake of this train that we're watching at this speed is
25 probably carrying invisibly small coal particles to the water

1 even as we sit and watch this?
2 A Yes.
3 MR. KLEIN: Okay. We can stop this one, Ms. Mendoza.
4 Q (By Mr. Klein) Let's talk about the Jaffe study. First,
5 would you mind turning back to your calculations on the prior
6 page of that white sheet there?
7 Just one question to set the stage for this.
8 Do you have students that you teach that, if you showed
9 them that, you would expect them to be able to fully digest,
10 comprehend, and critique it in an hour or two?
11 A This is exactly the kind of question that we give to our
12 students for oral exams, for the exams for the Ph.D., the
13 candidacy exam. This is the kind of question I give to
14 either my juniors in my beginning aerodynamics class. We
15 talked about turbulent flow a week before the trial started.
16 Q You filed your first report in this case in May of this
17 year, right?
18 A I suspect that's when.
19 Q Then you gave a deposition?
20 A I did.
21 Q And you filed another report. It was a rebuttal?
22 A Yes.
23 Q And you filed a supplemental report in September, just
24 about six weeks ago, which you discussed with Mr. Tebbutt a
25 few moments ago, right?

1 A Correct.
2 Q And this has to do with the Jaffe study, correct, the
3 study by Dr. Daniel Jaffe, your colleague at the University
4 of Washington?
5 A Correct.
6 Q That study is not new, is it?
7 A I can't remember the date. It might be 2014. I forgot.
8 Q And it was discussed in your original report that you
9 submitted back in May, right?
10 A Yes, it was.
11 Q But it didn't occur to you to do any of this work until at
12 some point in the last six weeks, since your last supplement
13 was filed; is that right?
14 A It was obvious in the original reading of the Jaffe report
15 that there were a lot of $PM_{2.5}$ particles coming out of the
16 train.
17 Q Now, I presume you are not telling the court that that is
18 obvious what's written up there, or am I wrong?
19 A It's obvious to Dr. Jaffe and it's obvious to me.
20 Q Okay.
21 A Let me just expand on that.
22 Do you recall earlier I talked about how much a
23 microgram was, taking a sugar cube and chopping it up with a
24 very fine knife into a million pieces. And that it takes ten
25 to the fifth, that's 100,000 $PM_{2.5}$ particles, just to add up

1 to the mass of this microgram of this one-millionth of a
2 sugar cube. I'll say it one more time. $PM_{2.5}$ particles are
3 really tiny. If you have anything like -- and remember,
4 Jaffe's threshold is three micrograms. All of his data are
5 three micrograms and above. That responds to a whole bunch
6 of $PM_{2.5}$ particles.
7 Q How many trains -- how many coal trains went by
8 Dr. Jaffe's equipment for which he measured a spike of more
9 than three micrograms per cubic meter?
10 A I'd have to look it up, but I think it was 97 or a
11 hundred. Something like that.
12 Q Would you agree with me that it was 74?
13 A That sounds plausible.
14 Q How many coal trains actually passed Dr. Jaffe's equipment
15 during the coal study?
16 A I don't know. He doesn't say.
17 Q He doesn't say, does he? Fortunately, we know.
18 MR. KLEIN: Ms. Mendoza, would you pull up ECF No.
19 359 in this case, and can we go to page 5?
20 With the court's permission, I'd like to read a
21 stipulation.
22 THE COURT: That's fine.
23 MR. KLEIN: And I'm here at line 4.
24 "Traveling from Pasco, Washington, to Vancouver,
25 Washington, between June 7th and August 10th, 2014, 159 coal

1 trains, six trains that included coke cars."
2 Q (By Mr. Klein) Those dates were the dates of Dr. Jaffe's
3 study, weren't they?
4 A I'd have to look it up, but probably.
5 Q Okay. Let's assume they were.
6 A Okay.
7 Q 159 coal trains passed his equipment. 74 were measured to
8 have at least a tiny spike of three micrograms per cubic
9 meter or more, right?
10 A Correct.
11 Q So we'll do some simpler math than that.
12 How many trains passed and did not cause even a spike
13 of three micrograms per cubic meter in his equipment?
14 A For starters, all the ones passed at night. Because in
15 order to get the effective wind speed over the cars, a
16 relative wind -- that's another term we use -- he had a wind
17 anemometer that measured the wind speed. And he also needed
18 the ground speed of the train.
19 Well, this was a federally designated sensitive zone of
20 some type, and so he wasn't at liberty to set up, or he
21 didn't feel at liberty to set up lights.
22 And so the camera that he used to measure the ground speed
23 of the train couldn't see anything at night. So all of the
24 night trains are automatically excluded from his survey
25 because he could not get the effective wind speed over the

1 train.
2 Q And how many was that?
3 A I don't know.
4 Q He didn't tell us, did he?
5 A If night is roughly half of 24 hours, you'd expect the
6 total number of trains to be doubled or so, the ones that he
7 measured, and according to my math, that's about right.
8 Q You're from around here, right?
9 A I've been in Seattle for 36 years.
10 Q Night, meaning darkness, in the state of Washington in
11 June, July, and August is not half of 24 hours, is it?
12 A I think it's a lot less than that. He would have needed
13 sufficient light to have a good reading. I don't know what
14 his light threshold was.
15 Q So while we've been talking, I just did the math. Is it
16 correct that 85 trains -- coal trains passed his equipment,
17 whether at night or during the day, and either were not
18 recorded by him or did not leave a mark on his equipment?
19 Did I do my math right?
20 A I can take the time to do the math, but I'm happy to
21 accept your mathematics.
22 Q Okay.
23 Do you agree that it's good scientific process to just
24 exclude data like that without even reporting the amount of
25 data you're excluding?

1 A You have to remember the motivation for Jaffe was not to
2 determine what fraction of trains generated continuous
3 discharge of coal. And I would have liked to have had more
4 information from him. In fact, I called him up last Friday
5 to see if he had any more information than was published in
6 his paper, and he said no.
7 Q So you do think he probably should have included a little
8 bit more than he did, enough to at least call him about it,
9 right?
10 A I was just curious, is there anything else, and he said
11 no.
12 Q One more factor I want to talk about.
13 His measurements of the trains he didn't exclude from
14 his data, his 74 trains he measured an average $PM_{2.5}$ spike of
15 16.7 micrograms per cubic meter, right?
16 A I'd have to look at it, but that's probably right.
17 Q So you don't dispute that number that I would suggest to
18 you?
19 A No.
20 Q Now, we should probably, if we could, add in the zeros to
21 make that number smaller, but we can't do that, right,
22 because we don't know actually how many there were, right?
23 A I don't know what you mean by that question.
24 Q We don't know exactly how many trains passed where the
25 detection was zero micrograms per cubic meter because he

1 doesn't tell us, right?
2 A He said almost all did, so that tells me the fraction of
3 the trains that did not produce a detectable signal that he
4 bothered to look at it because the light wasn't good enough,
5 or for whatever reason, was a lot less than 50 percent.
6 Q Are you sure he said almost all did?
7 A I can look up the --
8 Q Let's not take the time. Let's talk about --
9 A I'm pretty sure it was language like that.
10 Q Let's assume that he concluded that there was an average
11 spike of $PM_{2.5}$ of 16.7 micrograms per cubic meter. Fine
12 particulates in the air, right?
13 What I want to discuss with you is your understanding
14 of how significant that number is, whether it's a lot to you
15 or a little. And here's how I want to ask you this question.
16 I will give you -- I will tell you about an experience
17 I had. It is not evidence, it is in the form of a
18 hypothetical, really, but I want you to comment on it.
19 As I was prepping this cross-examination a week ago, I
20 looked at the $PM_{2.5}$ level in the air at the monitoring station
21 a few blocks away from here, and it was 30 micrograms per
22 cubic meter. Does that sound wrong to you?
23 A It turns out, from what I've read, downtown Seattle is
24 about the most polluted place around here because of the
25 diesel-powered ships in the harbor, a lot of diesel buses.

1 THE COURT: A lot of lawyers, too.
2 MR. KLEIN: I was indoors when this happened.
3 Q (By Mr. Klein) You don't have any reason to say that
4 number sounds wrong, right?
5 A Correct.
6 Q Okay.
7 And then I checked again an hour later. I was still
8 working on this, and I looked again. It had fallen to 14
9 micrograms per cubic meter. Does that sound wrong, that it
10 could fall by 15 micrograms per cubic meter in an hour at the
11 same station?
12 A My life is turbulence. I'm used to big fluctuations of
13 measured quantities. We live at the bottom of a turbulent
14 boundary layer here in the atmosphere, and you can get big
15 fluctuations.
16 Q So that's the long way of saying it doesn't sound wrong to
17 you, right?
18 A Correct.
19 Q If that's the case, isn't it true, then, that the amount
20 of particulate change in the air that Dr. Jaffe found in the
21 average passing coal train is right in line with the
22 difference between how much fine particulates might change in
23 the air right outside this courthouse in an hour for no
24 reasons that we can even pinpoint?
25 A I would agree. The magnitude of the $PM_{2.5}$ measurements he

1 measured from a single train are a lot less in the center of
2 the city of -- I don't know what kind of population -- with a
3 lot of buses, a lot of ships and so forth.
4 Q Are you aware that BNSF has actually conducted its own
5 version of the Jaffe study for years now?
6 A No, I'm not.
7 MR. KLEIN: So, Ms. Mendoza, can we see Exhibit A28,
8 please?
9 Q (By Mr. Klein) So you're not aware that BNSF has operated
10 track side monitors in the Powder River Basin since the
11 mid-2000s?
12 A I am aware of that, yeah.
13 Q And do you recognize that these three red stars on this
14 map of the Powder River Basin are the three locations where
15 BNSF has set up track side monitors?
16 A Yes, I recall that.
17 MR. KLEIN: Can we see Exhibit 600, please, page 3,
18 Ms. Mendoza?
19 Q (By Mr. Klein) Now, when I say "track side monitor," you
20 know what I mean by that?
21 A Yeah. Obstacle detection of aerosols.
22 Q BNSF did what just what Dr. Jaffe did, didn't they? They
23 set up a particle detector on a tower right next to a rail
24 line, and they took data from passing trains, didn't they, at
25 three different locations in Wyoming?

A Well, some type of detector, yeah.
Q Do you recognize these on the screen as BNSF's track side monitors?
A Yes.
Q And you agree with me that they set them up about 50 or 60 feet from the rail line, and that's right around where Dr. Jaffe put his, too?
A Correct. As I recall, Jaffe's was only a couple of meters above the ground surface. I can't recall how high these are.
Q Okay.
Do you know what the particle detection threshold of BNSF's particle monitors were?
A No, I do not.
Q Do you have any reason to doubt me if I tell you that they were one microgram cubic meter identical to what Dr. Jaffe used?
A No.
Q Now, you were testifying earlier that Dr. Jaffe's measurements and the threshold his equipment were capable of detecting were more than adequate for this job, right? You were telling me how small those levels were; is that right?
A Yeah. And also he measured the carbon dioxide concentration, so he was able to subtract out the effect of the locomotive diesel exhaust. That's why his measurements are the best scientific measurements I've seen.

Q In fact, a detector capable of measuring a single microgram per cubic meter could detect you lighting up a cigarette from here, couldn't it?

A If the plume of the cigarette smoke got there, it could -- well, I'd have to look at what the -- the -- as I said, cigarette smoke is about ten times smaller on average than $PM_{2.5}$ so you need more of those particles to add up to the same mass as you would if it was $PM_{2.5}$ --

Q Cigarettes contain plenty of $PM_{2.5}$, don't they?

A I'm not an expert on $PM_{2.5}$. I just recall an Internet search where it said the average size of cigarette smoke was about an order of magnitude below $PM_{2.5}$.

Q I'm sorry. Did you just say you are not an expert on $PM_{2.5}$?

A No, I did not. I said on cigarette smoke. I don't know the spectrum of particles in cigarette smoke except that the average is, according to an Internet search, about an order of magnitude smaller than $PM_{2.5}$.

Q I thought I heard you say you are not an expert on $PM_{2.5}$. If you had said that, would that be a mistake?

A I guess it depends on what you mean by "expert on $PM_{2.5}$." I understand the definition of it. I haven't made measurements of $PM_{2.5}$ particles before, myself.

Q I thought I heard you testify for hours earlier today about $PM_{2.5}$ emitted from coal trains and getting into water.

1 Is your testimony now that you're not an expert on $PM_{2.5}$?
2 A I know about two-phase flow and turbulence that transports
3 all particles, including $PM_{2.5}$ through the atmosphere. I
4 consider myself an expert on that.
5 MR. KLEIN: Ms. Mendoza, can we see Exhibit 1248,
6 please? And page 9 is what we need.
7 Q (By Mr. Klein) Is this your supplemental expert report?
8 A Yes, it looks like it.
9 Q And this is now in evidence.
10 Let me direct your attention to paragraph 21, the last
11 sentence. Did you write, "For instance, BNSF WA 0258115, the
12 TSM or track side monitor data from MP or Milepost 693.4 for
13 January 1, 2016, through March 30th, 2016, shows that more
14 than half of the trains which passed the monitoring station
15 lost coal that was measured by the track side monitor."
16 Did I read that right?
17 A Yes.
18 Q The point is -- tell me if I'm wrong here.
19 The point you were making here was saying during this
20 time period, the first three months of 2016, more than half
21 the trains passing this particle detector were detected to
22 have coal emissions. Is that what you were saying?
23 A Yes.
24 Q And by implication, you seem to be acknowledging that
25 somewhat less than half the trains did not have any sort of

1 coal detections by the track side monitors; is that fair?
2 A Yes.
3 MR. KLEIN: Ms. Mendoza, can we see --
4 Q (By Mr. Klein) And I should ask. Your citation here of
5 258115, is it possible that you meant 258155?
6 A It's possible. I'd have to double-check that.
7 MR. KLEIN: Can we see, Ms. Mendoza, Exhibit 258155,
8 which is called Exhibit 1360 here?
9 Q (By Mr. Klein) Is this the document you were referencing
10 when you wrote that sentence?
11 A It could well be. I can take more time to confirm that,
12 but it could well be.
13 Q In fact, it was this cell right here you were referencing,
14 wasn't it, when you said, "More than half of the trains had
15 coal detection." You were looking at this Cell B25, weren't
16 you, which shows that 46.7 percent of the trains passing that
17 monitor in that period had no coal detections whatsoever,
18 right?
19 A I'd have to double-check that, but that could be.
20 Q So this number that I've circled here, to be clear, this
21 represents the percent of trains passing this particle
22 detector during the first three months of this year that left
23 not a trace of coal dust, even on a machine that can measure
24 a microgram per cubic meter; isn't that right?
25 MR. TEBBUTT: Objection; assumes facts not in the

1 record. We haven't gotten there.
2 THE COURT: Overruled.
3 A I think that's right. And if there's only one side -- one
4 track side monitor or one Jaffe probe on one side of the
5 track and the wind is blowing such as to push this cloud
6 away, as I said earlier, you wouldn't expect the probe to
7 detect the particles.
8 Q (By Mr. Klein) In fact, these track side monitors have
9 probes on both sides, don't they?
10 A I'd have to look to double-check.
11 Q You have no reason to question me if I say that, do you?
12 A No.
13 Q And if you found out later in future testimony in this
14 case that they did, you'd agree, then, that was a more
15 thorough form of detection than Dr. Jaffe did, right?
16 A I'd have to know more about the characteristics of the
17 aerosol probe before I was confident that those measurements
18 were better than Jaffe's.
19 Jaffe has been doing this a very long time. He is an
20 expert on aerosols and air pollution, and I think his
21 expertise -- he is one of the top people in the world.
22 So in order to compare his diagnostic and his technique
23 with someone else, I'd need to know more about the probes --
24 the aerosol probes used in the study.
25 Q You cited this spreadsheet in your own supplemental

1 report, didn't you?
2 A Yes.
3 Q You must think it's reliable enough to cite in your work,
4 correct?
5 A Because I say something doesn't mean that I'm giving a
6 stamp of approval on it. I'm simply pointing out that this
7 is the literature. According to this measurement, these
8 quanties were --
9 Q So does that mean you'll cite anything that supports what
10 you think without putting your stamp of approval on it?
11 A No. And because I cite something doesn't mean it's what I
12 think. It's simply the literature out there.
13 Q Okay. This is the literature out there, and you agree
14 with that.
15 So would you feel the same way about similar
16 spreadsheets of the same form; that they would be in that
17 same category, the literature that's out there?
18 A Well, you said I agreed with, and I'm not quite sure I
19 agreed with it.
20 Q Let's do it this way.
21 MR. KLEIN: Ms. Mendoza, can we see 1358, please?
22 Q (By Mr. Klein) Now, this is the same form of data, isn't
23 it?
24 A Yes, it looks like it.
25 Q But this one here is Milepost 90.7 on the Orin line in the

1 Powder River Basin for January through March of this year,
2 right?
3 A Yes.
4 Q And you'd agree with me that this data shows that 80
5 percent of trains passing these two track side monitors did
6 not trigger that machine to detect a single particle of coal
7 dust, does it?
8 A Well, according to that number and that probe.
9 MR. KLEIN: Can we see Exhibit 1359, Ms. Mendoza?
10 Q (By Mr. Klein) Here, a different track side monitor at
11 Black Hills 558.2, same time period. This is data shows that
12 88.4 percent of trains that pass these monitors were not
13 detected to have a single particle of coal dust emissions,
14 right?
15 A I think that is true. I'd have had to go back and look at
16 these documents to make sure this is -- if these are trains
17 that are shown to dust or not to dust. If you represent that
18 that's what it means, I agree.
19 Q You cited it for that principle in your supplemental
20 report, didn't you?
21 A I looked at hundreds of documents, and I don't have
22 perfect recall. I'd have to go back to check and confirm.
23 Q All right. Let's assume for the moment that this data
24 means what it looks like it means.
25 This is not consistent with your theory that all trains

1 are emitting coal dust continuously all the time, does it?
2 A Well, because something is not measured doesn't mean it
3 doesn't exist. I'd want to go back, as I said, and look at
4 this.
5 The Jaffe data are unequivocal. The numbers of particles
6 that are implied by his measurements are so big that my views
7 are it's inevitable that these coal cars, every single one,
8 is discharging a lot per second.
9 THE COURT: All right. Let's stop there.
10 Are you at a point where you wanted to discuss the other
11 matter yet?
12 MR. WAGNER: Your Honor, we are awaiting word from
13 our client in Texas. We're confident we'll hear something
14 this evening, but I'm not able to represent anything not at
15 this moment.
16 THE COURT: All right. I've got sentencings tomorrow
17 morning at 9:00. Why don't you come here at 8:30 tomorrow
18 morning. Does that work?
19 MR. WAGNER: I can.
20 THE COURT: Okay. We'll see you then.
21
22 (Proceedings adjourned at 4:02 p.m.
23
24
25

C E R T I F I C A T E

I, Nancy L. Bauer, CCR, RPR, Court Reporter for the United States District Court in the Western District of Washington at Seattle, do hereby certify that I was present in court during the foregoing matter and reported said proceedings stenographically.

I further certify that thereafter, I have caused said stenographic notes to be transcribed under my direction and that the foregoing pages are a true and accurate transcription to the best of my ability.

Dated this 16th day of November 2016.

/S/ Nancy L. Bauer

Nancy L. Bauer, CCR, RPR
Official Court Reporter

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON AT SEATTLE

SIERRA CLUB, a California nonprofit corporation; PUGET SOUNDKEEPER ALLIANCE, a Washington nonprofit corporation; RE SOURCES FOR SUSTAINABLE COMMUNITIES, a Washington nonprofit corporation; COLUMBIA RIVERKEEPER, a Washington nonprofit corporation; FRIENDS OF THE COLUMBIA GORGE, INC., dba FRIENDS OF THE COLUMBIA GORGE, an Oregon nonprofit corporation; SPOKANE RIVERKEEPER; NATURAL RESOURCES DEFENSE COUNCIL, a New York nonprofit corporation,	CASE NO. C13-00967JCC SEATTLE, WASHINGTON November 15, 2016 STATEMENT OF SETTLEMENT
Plaintiffs,	
v.	
BNSF RAILWAY COMPANY, a Delaware corporation,	
Defendant.	

VERBATIM REPORT OF PROCEEDINGS
BEFORE THE HONORABLE JOHN C. COUGHENOUR
UNITED STATES DISTRICT JUDGE

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November 15, 2016 8:30 a.m.

PROCEEDINGS

THE COURT: So what's happening?

MR. WAGNER: Good morning, Your Honor.

The parties have consulted last night, and we do have an agreement in principle.

What I'd like to seek guidance and make request, there is a couple of ways to proceed. We can discuss the general parameters of any sort of agreement with you consistent with the seven protocols off the record, and then simply announce the generic agreement in principle on the record. I didn't know what you preferred.

THE COURT: You don't need to discuss the terms with me. If the parties are satisfied, I'm satisfied.

What I would suggest is that you state now the agreement in principle on the record, and then I'd like to make some comments that I think both of your clients might like to hear. Okay?

MR. WAGNER: All right. Very good. We just need one moment because we're just ironing out one or two phrases, and then I'll be ready to proceed.

THE COURT: Let me go ahead and make my comment.

When I first got this case, I confess I discussed it with my wife, and she said, "Well, it seems to me that there is a simple solution: Put covers on the cars." And when I first

1 started reading the briefs, I'm saying to myself, "Well, that
2 makes a lot of sense."
3 And I'm sure that for the plaintiffs, they will have a
4 hard time understanding any result, settlement or otherwise,
5 that doesn't include an immediate order from the court that
6 there be covers placed on the cars.
7 The fact of the matter is that as much as I might like to
8 have the power to order that, I don't. The law is such
9 that -- and as I studied it more, I understand why the law is
10 as it is. But the law is such that, for me, as a district
11 judge here in Washington State, to tell one railroad in a
12 national system of railroads how they have to run their
13 railroad is not what the law permits.
14 Having said that, the more I looked at the case, the more
15 I thought that if we finish this trial, neither side is going
16 to be very happy with the way it's going to end up, and that
17 the ability to do something that is a win-win for everybody
18 in the case is enhanced substantially through the process
19 that the lawyers and the clients have engaged in for the last
20 few days; that is to sit down as reasonable people and try to
21 come up with a solution that will help the rivers and the
22 Sound, but also be something that both sides can live with.
23 And what I wanted to say in particular, and I would urge
24 you to make these comments known to your clients, and use
25 them as you wish, I want to commend both sides. I want to

1 commend the BNSF and its leadership for being responsible and
2 working hard to come up with a solution that would satisfy
3 the important considerations that the plaintiffs have pursued
4 in the case.
5 And I also want to commend plaintiffs and their counsel
6 for the extraordinary amount of effort that has been expended
7 on this case and the quality of the representation that the
8 plaintiffs received from their attorneys. If we didn't have
9 good, high-quality lawyers on both sides, this case could
10 never have been resolved short of a judgment.
11 But the fact that we have the kind of lawyers that we've
12 had in this case made this possible, and I want to express
13 the appreciation of the court for the professional way that
14 all of you have behaved by and large in this case.
15 So work out your phrases, and then give me a call and I'll
16 come out, and we'll put it on the record.
17 (Court in recess.)
18 MR. WAGNER: Good morning once again, Your Honor.
19 Again, for the record, Fred Wagner for BNSF Railway Company.
20 If I can, just a word of thanks for the comments you
21 offered, and also thank you for your patience over the course
22 of the trial and also your patience for allowing our trial
23 team to get a full and fair opportunity to appear before you.
24 It is important to me to give everybody on our team a chance
25 to appear in court, and you expressed great patience for

1 that, and I really appreciate it.
2 Your Honor, the parties have reached an agreement in
3 principle, and the general contours have been set forth in a
4 brief agreement. This will be then memorialized in a more
5 formal consent decree that the parties will file with the
6 court, and then there is a period of review before entering,
7 as you're aware.
8 The parties have tentatively recommended a 60-day stay of
9 the litigation to allow us to conclude those negotiations in
10 writing, in part because of the holidays and things, to get
11 you something 60 days from adjournment, if that happens
12 today. So the procedural next step --
13 THE COURT: That's fine.
14 MR. WAGNER: The agreement in principle is that,
15 first, BNSF and the plaintiffs agree that BNSF Railway
16 Company is not admitting to any violations of the Clean Water
17 Act.
18 BNSF shall commit to a two-year cooperative study on the
19 commercial and operational feasibility of car covers for
20 open-top coal and petcoke cars.
21 BNSF will share information with plaintiffs, subject to
22 reasonable non-disclosure agreements.
23 Next, if BNSF determines that car covers are commercially
24 and operationally feasible after the study, then BNSF shall
25 add the option of car covers to the safe harbor provision of

1 the Coal Loading Rule.
2 And next, if BNSF determines that car covers are
3 commercially and operationally feasible after the study, BNSF
4 shall publicize the results at regular industry conferences
5 and events for two years thereafter. Plaintiffs will receive
6 copies of materials presented at those meetings.
7 MR. TEBBUTT: Those were the first four points, and
8 I'm going to just identify them by number moving forward just
9 so this isn't one run-on agreement.
10 THE COURT: All right.
11 MR. TEBBUTT: Item 5: BNSF shall pay $1 million for
12 supplemental environment projects in the state of Washington.
13 6: The parties will settle this matter through entry of a
14 consent decree.
15 7: BNSF shall remove coal and petcoke at locations to be
16 identified by the parties in the consent decree, as
17 established through trial and designated deposition testimony
18 and exhibits. The parties will create an appendix to the
19 final consent decree, describing those sites and locations.
20 Removal will focus only on areas with significant
21 accumulation at said sites using vacuuming or other
22 noninvasive techniques. The means and methods used by BNSF
23 to address significant accumulation are at its sole
24 discretion.
25 7A: BNSF shall remove coal and/or petcoke at the specific

locations one time upon entry of the consent decree and will provide documentation to plaintiffs concerning that removal. Plaintiffs retain the right to object to BNSF's cleanup efforts and, if not resolved by the parties, to be able to bring the matter to the court.

7B: BNSF shall conduct two annual inspections of the aforementioned sites after completing its original removal. If the sites have accumulated significant quantities of coal and/or petcoke, BNSF shall remove that material. BNSF will provide plaintiffs with a report of its inspection. Plaintiffs retain the right to object to BNSF's efforts, and if not resolved by the parties, to be able to bring the matter to the court.

8: Plaintiffs will release BNSF systemwide for all claims that were or could have been brought in this litigation and covenant not to sue under the Clean Water Act or analogous state law or any common law theory on the theory of material leaving open-top rail cars and entering waters of the United States or waters of any state for any events or occurrences arising over the next five years.

And ninth, the last term: BNSF will respond to any fee petition filed by plaintiffs after entry of the consent decree.

THE COURT: All right.

MR. TEBBUTT: And, Your Honor, I would like to, of

1 course, thank the court as well for its patience. We have
2 some -- you know, a team of attorneys here who we thank the
3 court for its words and who have done an excellent job in
4 helping to prepare the case, and some young attorneys who get
5 some trial experience. I believe Your Honor is always
6 enjoying to see young attorneys practice before this court,
7 and we thank you for your efforts.
8 THE COURT: All right. Well, thank you so much.
9 We'll be in recess.
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11 (The proceedings concluded at 8:51 a.m.)
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C E R T I F I C A T E

I, Nancy L. Bauer, CCR, RPR, Court Reporter for the United States District Court in the Western District of Washington at Seattle, do hereby certify that I was present in court during the foregoing matter and reported said proceedings stenographically.

I further certify that thereafter, I have caused said stenographic notes to be transcribed under my direction and that the foregoing pages are a true and accurate transcription to the best of my ability.

Dated this 15th day of November 2016.

/S/ Nancy L. Bauer

Nancy L. Bauer, CCR, RPR
Official Court Reporter