UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Berkshire Hathaway Energy Company, Interstate Power & Light Company,
MidAmerican Energy Company, PacifiCorp, WEC Energy Group, Inc., and
Wisconsin Power & Light Company

Petitioners

v.

Birchtech Corp.
(d/b/a Midwest Energy Emissions Corp.)

Patent Owner

Case IPR2025-00422
Patent 10,668,430

PATENT OWNER'S PRELIMINARY RESPONSE

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I. Introduction

The Board should deny institution because (1) Petitioners fail to establish the required reasonable likelihood of success on their priority date challenge; and (2) the Petition is time-barred based on a 2019 patent infringement case that ME2C filed against real-parties-in-interest of Petitioners.

The Petition relies on two primary references—Vosteen and Downs-Boiler. Vosteen was already distinguished during prosecution of a related patent, and Petitioners fail to demonstrate material error in that decision. Indeed, their conclusory assertions of obviousness should fail as a matter of law. With regard to Downs-Boiler, Petitioners fail to qualify this reference as prior art as the inventors reduced the invention to practice prior to the asserted § 102(e) date for this reference. Inventor John Pavlish explained this in his prior trial testimony before Patent Owner obtained a judgment of no invalidity, and Petitioners fail to justify a different result in this proceeding.

In addition, this petition is time-barred under 35 U.S.C. § 315(b). All of the Petitioners or their privies own power plants that were accused of infringement in a prior patent infringement case that ME2C filed in Delaware in 2019 ("the 2019 Delaware Action"). That litigation ultimately resulted in settlement and supply agreements valued at over $30 million dollars and a judgment of willful infringement, no invalidity and damages of $57 million dollars. While Petitioners were not named in that lawsuit, their co-owners and/or suppliers were named in that lawsuit, defended that lawsuit, and settled the case.[1]

II. Summary of the Technology

A. Background of the Patented Technology

The story of the ’430 Patent begins with the Clean Air Act Amendments of 1990. That law required the U.S. Environmental Protection Agency (EPA) to study the environmental and health effects of toxic metals, and to devise regulations for reducing those metals, including mercury. To assist in the research, in 1992, the EPA established a National Center for Excellence at the Energy & Environmental Research Center (“EERC”) referred to as the Center for Air Toxic Metals (“CATM”). The EERC’s research focused heavily on developing new methods for detecting, measuring, and ultimately, removing mercury from coal-fired power plant exhaust gas. Ex. 2018, Pavlish Decl. ¶¶ 8–10.

By 1990, the EPA already had significant experience regulating power plant emissions. Since the 1970s, coal-burning power plants had been required to install equipment for controlling acid gas and particulate matter emissions. The industry had developed a number of technologies to address those requirements such as

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[1] ME2C is currently litigating follow-on cases against Petitioners for additional power plants and time periods not covered in the 2019 Delaware Action.

electrostatic precipitators, fabric filters, and scrubbers. However, those systems were not designed to capture mercury. Ex. 2025, EPA, Clean Air Act Overview.

In addition, since the mid-1990s, the EPA had required waste incinerators to reduce mercury emissions by over 90%. However, as compared to coal plant emissions, incinerator emissions contain a different chemical makeup and a significantly higher amount of mercury. Thus, reducing incinerator mercury emissions to less than 90% resulted in emissions that could still have a higher concentration of mercury than coal plant emissions. Ex. 2035, EPA, Mercury and Air Toxics Standards.

In short, the removal of extremely small amounts of mercury from large volumes of coal plant flue gas presented a daunting scientific and engineering challenge. By 1998, the EPA found that no existing technologies were up to the task of significantly reducing the mercury emissions from the country's coal plant fleet. Ex. 2024, EPA, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units—Final Report to Congress" at ES-19 ("Regarding potential methods for reducing mercury emissions, the EPA has not identified any demonstrated add-on control technologies currently in use in the U.S. that effectively remove mercury from utility emissions.").

In the wake of the EPA's conclusion, various governmental and industry organizations injected millions of dollars into research and experimental studies in the search for new mercury removal technologies. Ex. 2018, Pavlish Decl. ¶ 10. Because increased regulation of mercury emissions was expected to require significant upgrades to the country's fleet of coal-fired plants, much of the research focused on retrofit technologies that could be adopted at relatively low cost.

B. Development of the '430 Technology

The EERC—including the '430 inventors John Pavlish, Edward Olson, and Michael Holmes—was at the forefront of the mercury capture research effort. In the 1990s and 2000s, the EERC developed mercury sampling and testing methodologies, and experimental test systems for simulating coal plant flue gases and characterizing and measuring the various species of mercury present in coal plant flue gas. Ex. 2018, Pavlish Decl. ¶ 8. During that time, the inventors identified various avenues of research for developing broadly applicable mercury capture solutions. Ex. 2018, Pavlish Decl. ¶ 8; *see also* Exs. 2029–30, EERC Kickoff Meeting Presentation. This included research into dozens of different additives, sorbents, and other techniques for mercury capture. Ex. 2018, Pavlish Decl. ¶¶ 16–20.

That work would eventually lead to the development of the '430 Patented technology. In particular, the inventors discovered that by providing a bromine based additive upstream of a boiler and injecting activated carbon into the flue gas downstream of the boiler, they could capture more than 90% of the emitted mercury. Ex. 2018, Pavlish Decl. ¶¶ 44–47. These results were described in their 2004 provisional application and in various reports to the Department of Energy ("DOE"). Ex. 2012 at 73; Ex. 2013 at 49. The results were later confirmed for a variety of coal types and plant configurations in follow-up testing performed for the DOE. The DOE and National Energy Technology Laboratory would later recognize this technology as a significant advancement in the field of mercury capture for coal-fired power plants. Ex. 2034. Because the EERC is a non-profit organization, it selected ME2C to commercialize the technology. Ex. 2017.

C. Summary of the Asserted Art

1. Vosteen

Vosteen is a patent developed in Germany that describes the use of bromine as a fuel additive for waste incinerators. In particular, Vosteen teaches that bromine may be added to fuel to completely ("100%") oxidize the elemental mercury to ionic mercury (commonly referred to as oxidized mercury). Ex. 1005 ¶ 15. This oxidized mercury can then be collected using conventional particulate matter and/or sprayer equipment already known to capture oxidized forms of mercury. Vosteen fails to teach or describe the use of activated carbon injection for this process.

Vosteen's description of bromine oxidation also fails to account for the insights and teachings of the '430 Patent. In particular, the '430 Patent teaches a chemical model whereby bromine and activated carbon are both provided into, and mixed with, a fast-moving mercury-containing gas stream. These molecules and ions dynamically interact with mercury atoms to capture the mercury in an activated carbon/mercury/bromine structure, *i.e.*, the bromine alone does not oxidize all of the mercury. Ex. 1001 at 29:8–33 (describing the carbene edge site on activated carbon and explaining "as the mercury electrons are drawn toward the positive carbon, the halide anion electrons are pushing in from the other side, which stabilizes the positive charge developing on the mercury and lowers the energy requirement for the oxidation process"). This process occurs during the few seconds when those materials are intermixed in the mercury-containing gas being transported. *See* Ex. 1026 at 348–49 (testifying that activated carbon injection provides only a few seconds of reaction time in a dynamic environment). Because Vosteen mistakenly believed that bromine alone provides complete oxidation, he failed to appreciate or teach the critical role of activated carbon injection.

2. Downs-Boiler

The earliest filing date for this reference is after the '430 inventors conceived of and reduced their invention to practice.

3. Starns and Mass-EPA

These references also fail to demonstrate unpatentability of the challenged claims. However, because Petitioners only cite these references with regard to a subset of limitations, Patent Owner need not address them for purposes of this preliminary response.

III. Claim Construction

Patent Owner does not presently propose any constructions, but it notes that the Board previously provided the following construction: "'injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber' does not encompass blowing activated carbon into a filter, placing the filter in a structure, and then transporting mercury containing gas to the structure." IPR2020-00834, Paper 18 at 7–8. This proposal is also consistent with the specification. For example, in describing figure 3, the specification identifies "injection point 116" and "injection point 119," where powdered sorbent is provided into the flue gas. Ex. 1001 at 8:61–9:15. These injection points provide a location where the sorbent comes into contact with a gas stream that is moving due to a source of transport energy such as a compressor or blower. *Id.* at 9:11–15. The patent does not describe "injecting" as placing a sorbent-coated filter in a passageway and later opening that passageway to a mercury-containing gas.

The Board provided this construction and then relied on this ruling to conclude that a nearly identical child patent of Vosteen (U.S. Patent No. 6,878,358) did not anticipate the asserted claims because it fails to disclose injecting activated carbon. IPR2020-00834, Paper 18 at 18. That construction is not strictly necessary here because Petitioners do not assert Vosteen as an anticipation reference.

IV. Petitioners Have Failed to Demonstrate a Reasonable Likelihood of Prevailing on the Merits.

Asserted grounds 1 and 2 are based on Vosteen as the primary reference. Asserted grounds 3–5 are based on Downs-Boiler as the sole or primary reference.

A. Grounds 1 and 2: Petitioners Have Failed to Demonstrate Obviousness Based on Vosteen.

All of the challenged claims of the ’430 Patent require the use of a bromine additive added to the coal and/or combustion chamber, and activated carbon injection downstream of the combustion chamber. According to Petitioners, Vosteen discloses all of the claim limitations except injection of activated carbon. Petitioners contend that it would have been obvious to modify Vosteen to arrive at this limitation. However, Petitioners fail to provide evidence of a motivation to combine and instead just rely on the fact that various mercury control techniques were known in the art. This approach fails as a matter of law. Moreover, during prosecution of a related patent, the examiner found substantial evidence that a

POSITA would not modify the prior art as petitioners propose. Petitioners have no response to that evidence and provide no basis for the Board to reach a different conclusion now.

Obviousness is a question of law based on underlying facts. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1326 (Fed. Cir. 2016). Obviousness requires a showing that each of the claim elements was known in the prior art and evidence that a POSITA would have combined those elements in the specific way that they are recited in the challenged claim. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) ("[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. . . . [I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does."). In other words, "obviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention." *See Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015). "[The Board] must make a finding of a motivation to combine when it is disputed." *In re Nuvasive, Inc.*, 842 F.3d 1376, 1382 (Fed. Cir. 2016).

The Federal Circuit recently addressed the level of proof required to demonstrate obviousness in an IPR. In *Virtek Vision Int'l ULC v. Assembly*

Guidance Sys., Inc., 97 F.4th 882, 886 (Fed. Cir. 2024), the Petitioner identified a reference that disclosed all of the limitations of the challenged claims except the requirement that the system employ a 3D coordinate system. The asserted primary reference instead disclosed the use of an angular direction system, and the petitioner argued that it would have been obvious to replace that system with a 3D coordinate system based on a secondary reference. The Board agreed with petitioners, but the Federal Circuit reversed. It explained:

> The mere fact that these possible arrangements existed in the prior art does not provide a reason that a skilled artisan would have substituted the one-camera angular direction system in Keitler and Bridges with the two-camera 3D coordinate system disclosed in Briggs. There was no argument in the petition regarding why a skilled artisan would make this substitution—other than that the two different coordinate systems were "known to be used."

Id. at 887; *see also Dish Network LLC v. Entropic Commc'ns, LLC*, IPR2024-00560, Paper 11 at 17–18 (PTAB Aug. 15, 2024) (denying institution where petition proposed replacing twisted pair cable in a system with coaxial cable without providing a motivation to combine); *GCE Control Equipment Inc. v. VBOX Inc.*, IPR 2023-00326, Paper 27 at 53 (PTAB June 18, 2024) ("Under the particular facts at hand, we detect the unmistakable taint of impermissible hindsight reconstruction in Petitioner's conclusory proposition"). As explained below, Petitioners' asserted grounds suffer from the same flaw.

Moreover, a petitioner must provide sufficient evidence to rebut evidence of teaching away in the prior art. *See Kerry Grp. Servs. Int'l Ltd. v. Fla. Food Prods., LLC*, No. 2023-2092, 2025 WL 582881, at *5 (Fed. Cir. Feb. 24, 2025) (reversing Board finding of unpatentability for failure to address evidence of teaching away). Conclusory expert testimony cannot satisfy this burden. *Id.*

1. Response to Petitioners' Arguments

Petitioners assert that all of the claim limitations are taught by Vosteen, except for activated carbon injection. Petition at 25–26. However, Petitioners offer no evidence to support their conclusion other than the fact that the references qualify as prior art. Petitioners argue: "*A POSITA would have been motivated to use activated-carbon injection (as in Starns and Mass-EPA) with Vosteen589*, with a reasonable expectation of success, *because activated carbon injection was well-known*, as admitted by the '430 Patent." Petition at 26 (emphasis added). This is precisely the type of conclusory analysis that the Federal Circuit found insufficient to demonstrate obviousness in *Virtek Vision*. For example, Petitioners identify no problem to be solved in Vosteen or other reason as to why a POSITA would be motivated to modify Vosteen. Petitioners' expert declaration does not fill this gap as he merely copies and pastes the same argument. Ex. 1002 at 262.

Petitioners and Dr. Niksa also state, "Though Vosteen589 discloses activated-carbon sorbent and particle-control devices (*e.g.*, ESPs), Vosteen589 does not fully disclose certain implementational details, such as how sorbent is introduced" Petition at 26. That is incorrect; as the Board previously found with respect to a nearly identical child patent of Vosteen (U.S. Patent No. 6,878,358) ("Vosteen358"), Vosteen teaches the use of activated carbon in a fixed form, *i.e.*, coated on a fabric filter rather than being injected into a gas stream. *See* IPR2020-00834, Institution Decision, Paper 18 at 17–18. Thus, Petitioners propose that a POSITA would modify Vosteen to replace one known use of activated carbon, with a different use of activated carbon. But they provide no evidence or analysis to support this conclusion. Again, the Federal Circuit has held that, as a matter of law, this approach is insufficient to demonstrate obviousness. *See Virtek*, 97 F.4th at 886.

Regardless, Dr. Niksa's testimony is entitled to little weight. He previously testified that Vosteen358discloses activated carbon injection, but the Board found that his testimony lacked support for that conclusion. IPR2020-00834, Institution Decision, Paper 18 at 17–18. Dr. Niksa has now changed his testimony to state that the virtually identical Vosteen589 is actually ambiguous on how activated carbon is used and that a POSITA would be motivated to add activated carbon injection to Vosteen's approach. It may be that the Board persuaded him that his prior testimony was incorrect, but he does not actually explain why he changed his testimony. Expert testimony that merely parrots attorney argument (particularly where that attorney argument is a do-over of a previously considered invalidity theory) is entitled to little weight.

2. Additional Evidence Demonstrates that a POSITA Would Not Combine the Asserted References in a Manner that Arrives at the Claimed Invention.

As explained above, Petitioners have not met their burden with respect to this obviousness theory. In addition, there is strong objective evidence that the proposed combinations do not invalidate the challenged claims.

As an initial matter, this precise obviousness issue was extensively considered during prosecution of the related U.S. Patent No. 10,343,114 (the "'114 Patent") and rejected by the examiner. The inventors explained that activated carbon injection was known in the art ('114 Patent at 1:55–2:9), and the use of halogen additives were also known in the art ('114 Patent at 2:60–3:5 (citing Vosteen358)). The examiner initially rejected the claims on that basis. *See, e.g.*, Ex. 1026 at 413, December 26, 2018 Final Rejection at 15 (responding to argument that "the applicant contends that there is no way a person of ordinary skill in the art could predict from the cited references that in-flight promotion of a sorbent with bromide promoters is more effective for mercury removal").

Patent Owner provided substantial evidence and multiple declarations rebutting this assertion, and the examiner ultimately found this evidence persuasive:

> For claims 2-19 and 22-28, as shown within the declarations, in flight promotion with HBR or Br promoters is more effective for mercury removal than treating the sorbent with HBr, Br or Br2 outside the mercury-containing gas. Further the Nelson reference seems to teach away from inflight promotion as it states that the bromide is extremely corrosive. Lastly one having ordinary skill in the art would not have looked to in-flight promotion because for the prior a rt the contact time between the bromine promoter and the activated carbon is about 15 min, while when the promoter is contacted with the activated carbon in-flight, the contact time is generally less than 10 s.

Ex. 1026 at 203–04, April 19, 2019 Office Action at 8–9. Petitioners provide no basis for the Board to reach a different result here.

To understand the problems with Petitioners' obviousness theories, it is helpful to understand the context of the claimed invention.

In 1990, Congress amended the Clean Air Act and law required the U.S. Environmental Protection Agency (EPA) to study the impact of various air pollutants, including mercury.[2] To assist in the research, in 1992, the EPA established a National Center for Excellence at the Energy & Environmental Research Center (EERC) referred to as the Center for Air Toxic Metals (CATM).

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[2] Ex. 2025, United States Environmental Protection Agency, *1990 Clean Air Act Amendment Summary: Title III* (last updated, Nov. 12, 2024), https://www.epa.gov/clean-air-act-overview/1990-clean-air-act-amendment-summary-title-iii.

In 1997 and 1998, the EPA issued two reports to Congress: *Mercury Study Report to Congress* (issued December 1997)[3] and *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam* (issued February 1998).[4] As an outcome of these studies, the EPA found a pressing need for regulation of mercury pollution from power plants.[5] Unfortunately, it also found that no existing technologies were up to the task of significantly reducing the mercury pollution from those plants.[6]

With that said, the EPA did provide some indications as to promising areas for future research. For example, the EPA noted a connection between the chlorine

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[3] Ex. 2026, United States Environmental Protection Agency, *Mercury Study Report to Congress, Volume I: Executive Summary*, EPA-452/R-97-003, December 1997, https://www.epa.gov/mercury/mercury-study-report-congress.

[4] Ex. 2024, United States Environmental Protection Agency, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units—Final Report to Congress, United States Office of Air Quality*, EPA-453/R-98-004a, Environmental Protection Planning and Standards, February 1998, https://www.epa.gov/mats/study-hazardous-air-pollutant-emissions-electric-utility-steam-generating-units-final-report.

[5] On March 15, 2005, the EPA issued the Clean Air Mercury Rule to significantly reduce mercury emissions from coal-fired power plants, with a goal of reducing utility emissions of mercury from 48 tons/year to 15 tons/year, a reduction of nearly 70 percent. *See Mercury regulation in the United States*, WIKIPEDIA, https://en.wikipedia.org/wiki/Mercury_regulation_in_the_United_States.

[6] Ex. 2024 at 51 ("Regarding potential methods for reducing mercury emissions, the EPA has not identified any demonstrated add-on control technologies currently in use in the U.S. that effectively remove mercury from utility emissions.").

content in coal and potential ways to remove mercury.[7] It also identified activated carbon injection as a potential control technology for mercury removal.[8] Nonetheless, it acknowledged that much more research was needed:

> Research continues on the chemistry and interactions of flue gas, fly ash, and mercury species. This fundamental research is needed at various flue gas conditions encountered across the utility industry in order to develop low cost mercury strategies for full-scale utility operation. Thus, while AC injection shows promise as a mercury control technology, more data and research are needed to understand the factors that affect mercury removal.[9]

In the wake of these reports, various governmental and industry organizations injected millions of dollars into basic scientific research and experimental studies in the search for new mercury removal technologies.[10] Because increased regulation of mercury emissions was expected to require significant upgrades to the country's fleet of coal-fired plants, much of the research focused on retrofit technologies that could be adopted at relatively low cost, including sorbent injection systems.[11]

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[7] Ex. 2024 at 467–68.

[8] Ex. 2024 at 470–71.

[9] Ex. 2024 at 473.

[10] *See* Ex. 1026 at 347.

[11] *See id.*

In 2002, the EPA surveyed the state of research in this field and produced a follow-up report.[12] It noted that the complex chemistry of the coal combustion process was still not fully understood but that progress had been made. It described how coals with higher halogen content (specifically, chlorine) were better able to oxidize mercury and promote its capture.[13] However, it noted that this oxidation reaction could be inhibited by other chemicals present during combustion in the boiler.[14] The EPA also described promising experiments being performed with halogen-treated sorbents.[15]

Notably, the EPA did not recommend in-flight sorbent enhancement in the flue gas by spraying additives on coal or injecting halogens into the boiler. Rather, it described research into methods for *pre-treating* sorbents with various additives, including chlorine, and then injecting those pre-treated sorbents downstream from the boiler.[16] This approach ensured that, *e.g.*, chlorinating agents could react with

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[12] Ex. 2043, J. D. Kilgroe, C. B. Sedman, R. K. Srivastava, J. V. Ryan, C. W. Lee, S. A. Thorneloe, *Control of Mercury Emissions from Coal-Fired Electric Utility Boilers: Interim Report*, U.S. Environmental Protection Agency, Office of Research and Development, EPA-600/R-01-109, April 2002.

[13] *Id.* at 6-7.

[14] *Id.* at 5-7 ("It is speculated that SO_2 and water vapor may inhibit gas-phase oxidation of Hg^0 by scavenging the chlorinating agent.").

[15] *Id.* at ES-8 ("Impregnation of carbons with sulfur, iodine, or chlorine can increase the reactivity and capacity of sorbents.").

[16] *See id.* at 5-33 to 5-34.

the sorbent material without being "scavenged" by other chemicals present in the boiler.[14] This approach also ensured that the sorbent additive would have plenty of time to react with the sorbent—the EPA explained that, for many plants, injected sorbents would have only a few seconds to find and react with mercury present in the flue gas, with high and costly carbon-to-Hg ratios needed to achieve adequate mercury removal.[17] This is consistent with the general understanding in the industry that sorbent additives such as halogens or halides should be mixed with sorbents *before* coming in contact with mercury-containing flue gas.

Thus, at the time of the patented invention, conventional wisdom taught that bromine additives and activated carbon sorbents were separate technologies. If they were to be combined at all, this would be done by pre-treating the activated carbon with bromine before injecting the carbon downstream of the boiler. Indeed, during prosecution, the examiner found that conventional wisdom taught that activated carbon would need at least 15 minutes to react with activated carbon to be effective, and that this amount of pre-treatment time could not be achieved

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[17] *Id.* at 5-33 ("Activated carbon duct injection seems to be the most promising Hg control technology for coal-fired electric utility boilers equipped with ESPs. In this technology, the injected activated carbon removes Hg only while contacting the flue gas during very limited sorbent/gas contact time (<3 seconds)."). Note that this section of the report refers to the reaction between pre-treated chlorinated sorbent and mercury as occurring "in-flight." To be clear, it describes only the use of a pre-treated sorbent, not the claimed invention.

when bromine is added to coal or the combustion chamber before injecting activated carbon. Ex. 1026 at 203–04.

Thus, the objective evidence demonstrates a long-felt need for the claimed invention, failure of others, and conventional teaching away from the claimed invention. It further demonstrates that Petitioners' conclusory assertions of a motivation to combine and expectations of success are erroneous. Accordingly, Patent Owner requests that the Board deny institution with respect to grounds 1 and 2.

B. Grounds 3–5: Petitioners Have Failed to Demonstrate That Downs-Boiler Qualifies as Prior Art.

Petitioners contend that Downs-Boiler qualifies as prior art under 35 U.S.C. § 102(e), with a priority date of March 22, 2004. However, the inventors actually reduced the claimed invention to practice by at least September 2003. Accordingly, Petitioners have failed to meet their burden and the Board should deny institution.

"In an *inter partes* review, the burden of persuasion is on the petitioner to prove 'unpatentability by a preponderance of the evidence,' 35 U.S.C. § 316(e), and that burden never shifts to the patentee." *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Thus, while the burden of production may shift to a patentee (*e.g.*, when arguing that a reference does not qualify as prior art), the burden of persuasion remains with the petitioner. *Id.* at 1379.

A patent owner may antedate a reference by showing actual reduction to practice prior to the effective date of the adverse reference. *In re Steed*, 802 F.3d 1311, 1316 (Fed. Cir. 2015); *see* MPEP 2138.01(II) (example 3). "The principles are legal, but the conclusions of law focus on the evidence, for which the Board's factual findings are reviewed for support by substantial evidence." *Steed*, 802 F.3d at 1316; *see NFC Tech., LLC v. Matal*, 871 F.3d 1367, 1371 (Fed. Cir. 2017).

To establish actual reduction to practice of a claimed invention, "an inventor must prove that he constructed his claimed invention and that it would work for its intended purpose." *Mazzari v. Rogan*, 323 F.3d 1000, 1005 (Fed. Cir. 2003). Actual reduction to practice requires testing or demonstration of the device in operation. *Streck, Inc. v. Research & Diagnostic Sys., Inc.*, 659 F.3d 1186, 1195 (Fed. Cir. 2011). A Petition should be denied if the Petitioner fails to qualify a reference as prior art in light of evidence of an earlier invention date. *See Freebit AS v. Bose Corp.*, No. IPR2017-01308, 2017 WL 5202106 at *6 (PTAB Nov. 8, 2017).

The inventors of the '430 Patent have testified that they conceived of the invention at least by August 2002, and, after obtaining DOE funding for testing, they reduced the challenged claims to practice at least as early as September 2003.

See Ex. 2018 (declarations of inventors John Pavlish, Edwin Olson, and Michael Holmes). These dates are corroborated by contemporaneous meeting presentations, testing logbooks, and post-testing reports. *See generally* Exs. 2013–15, 2017, 2024–33.

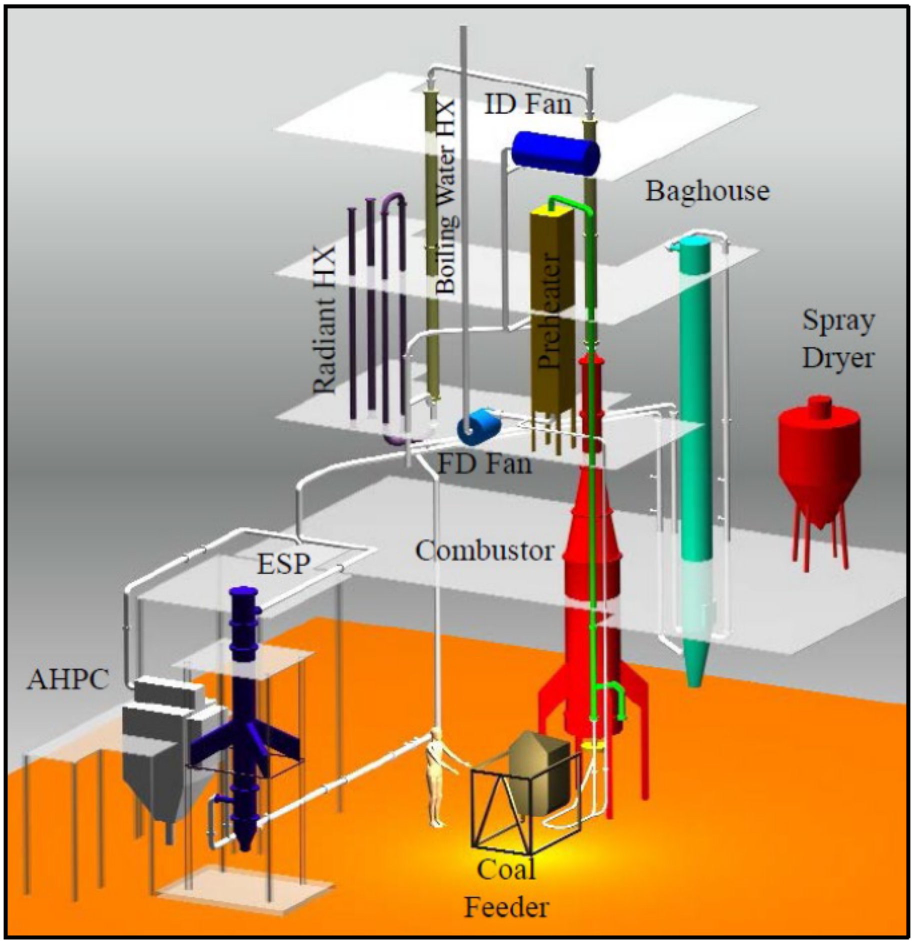
1. The Inventors' Research Efforts Lead to Conception of the '430 Invention.

Inventor John Pavlish has testified that the '430 technology was developed by the inventors as part of a research project into mercury capture at the EERC. He described the beginning of this project:

> The EERC held a kickoff meeting to discuss the project on February 28, 2002. During this meeting we discussed the project timeline and overall strategy. As shown below, part of the focus of the project was to identify sorbents and oxidation options. In particular, we had identified a potential reaction between chlorine and activated carbon that we intended to study further.

Ex. 2018 ¶ 19. This description is corroborated by slides from that kickoff meeting that identify their plan to test various additives and sorbents. Ex. 2029, Ex. 2030.

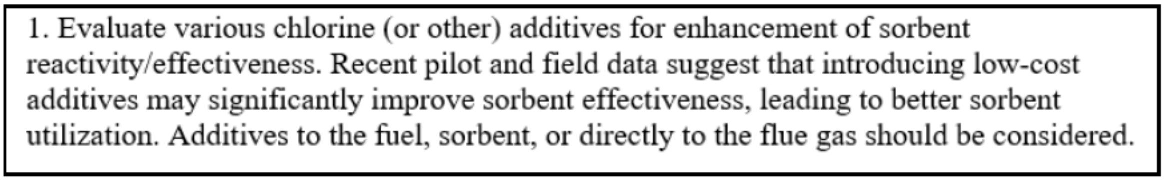
After receiving DOE funding, the inventors were able to test various sorbents and additives at the EERC's Pilot Test Combustor ("PTC"). The PTC is a coal combustion chamber with various testing and pollution control equipment designed to simulate larger, commercial power plants. Ex. 2018, Pavlish Decl. ¶ 11. A representation of the PTC is shown below:



Ex. 2018, Pavlish Decl. ¶¶ 11–14. Because of the cost associated with operating the PTC, Mr. Pavlish explained that the EERC typically did not allow testing without third party or government funding. Ex. 2018, Pavlish Decl. ¶ 16.

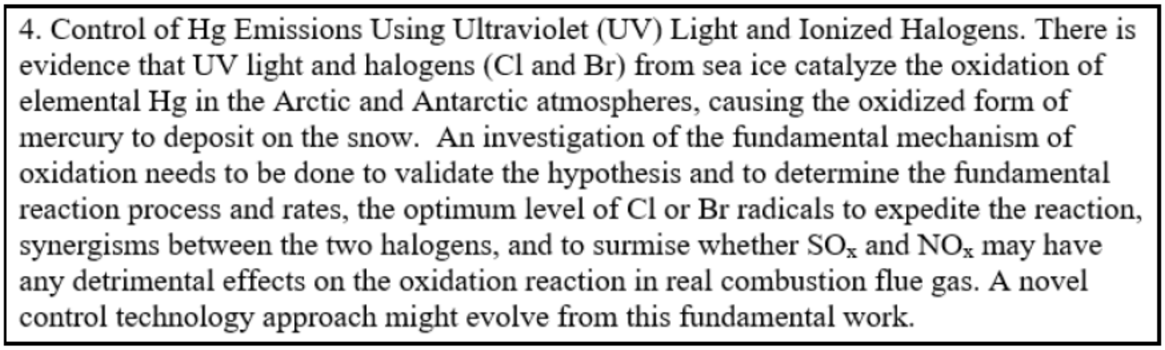
By the end of 2002, the inventors had completed various tests using pre-combustion chamber additives, and post combustion sorbents. These test results were reported to the DOE. Ex. 2032. While these results provided useful data, they demonstrated that more work was needed to develop a viable mercury control strategy for the entire U.S. coal fleet.

While the inventors were conducting the DOE-funded testing, they also continued to theorize as to alternative techniques for mercury control. By August 2002, they had conceived of using bromine as the pre-combustion additive. Ex. 2018, Pavlish Decl. ¶¶ 25–30. This is corroborated by the "research ideas" file that Mr. Pavlish maintained. Ex. 2015. It describes the inventors' current work using additives to enhance the effectiveness of sorbents:



1. Evaluate various chlorine (or other) additives for enhancement of sorbent reactivity/effectiveness. Recent pilot and field data suggest that introducing low-cost additives may significantly improve sorbent effectiveness, leading to better sorbent utilization. Additives to the fuel, sorbent, or directly to the flue gas should be considered.

Ex. 2015 at 3. It also indicates that they should study the use of bromine:



4. Control of Hg Emissions Using Ultraviolet (UV) Light and Ionized Halogens. There is evidence that UV light and halogens (Cl and Br) from sea ice catalyze the oxidation of elemental Hg in the Arctic and Antarctic atmospheres, causing the oxidized form of mercury to deposit on the snow. An investigation of the fundamental mechanism of oxidation needs to be done to validate the hypothesis and to determine the fundamental reaction process and rates, the optimum level of Cl or Br radicals to expedite the reaction, synergisms between the two halogens, and to surmise whether SO_x and NO_x may have any detrimental effects on the oxidation reaction in real combustion flue gas. A novel control technology approach might evolve from this fundamental work.

Ex. 2015 at 2. His conclusion that a "novel control technology approach might evolve from this fundamental work" was prescient. The metadata for this file indicates that it was last modified on August 30, 2002. Thus, the inventors had conceived of the invention at least by that date.

2. The Inventors Prove the Viability of the Claimed Invention by Reduction to Practice at the EERC.

By 2003, the EERC had obtained funding for further rounds of PTC testing. Ex. 2018, Pavlish Decl. ¶ 24. During tests conducted in September 2003, December 2003, and February 2004, the inventors reduced the claims of the ’430 Patent to practice by performing tests using sodium bromide as the pre-combustion chamber additive and activated carbon as a post-combustion sorbent. *See generally* Ex. 2018, Pavlish Decl. Claim chart exhibit.

These tests were described in reports provided to the DOE. For example, the September testing was described as follows:

> The pilot-scale test was started on September 8, 2003, and was completed on September 19, 2003. A 550,000-Btu/hr pulverized coal (pc)-fired unit, known as the PTC, was used to fire lignites and test mercury control options. The coal combustion flue gas exiting the PTC was cooled down to a nominal temperature of 149°C (300°F) and then was introduced into a single-wire tubular ESP unit. Figure 4 shows the schematic diagram of the system. Furnace additives were added to coal prior to introduction to the furnace. Mercury sorbents were fed with a K-Tron dual-screw feeder upstream of the ESP.

Ex. 2012 at 10; *see also* Exs. 2013, 2014 (describing December and February testing). A simplified diagram of the test setup is illustrated below:

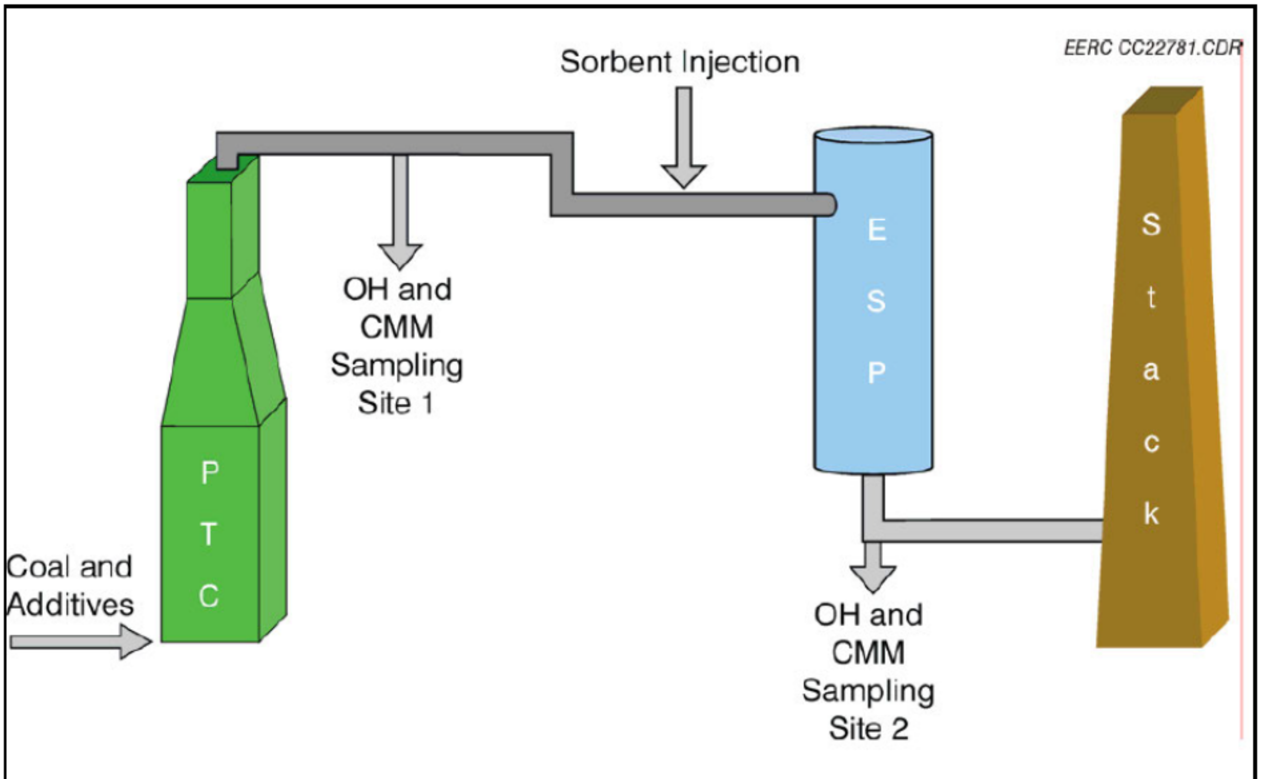


Figure 4. Injection and sampling schematic of the PTC with an ESP.

Ex. 2018, Pavlish Decl. ¶¶ 41–42; Ex. 2012 at 11. These tests were also recorded in logbooks maintained by the EERC. *See* Ex. 2017 (testimony of non-inventor Tom Erickson confirming that the logbooks were maintained by the EERC and entries recorded at the time of the actual testing).[18] [redacted]

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[18] Moreover, the test title recorded in the logbook matches the test title provided in the DOE reports. *Compare* Ex. 2017, logbook entries [redacted] *with* Ex. 2013, Feb. 2005 Report at 10 (providing coal analysis for "PTC-FM-639"); *id.* at 9 (explaining that this testing occurred in September 2003).

[redacted]

Ex. 2017, Erickson Decl.; *see also* Ex. 2018, Pavlish Decl. ¶¶ 31–39. The use of various coal additives and sorbents tested are also listed in the DOE report:

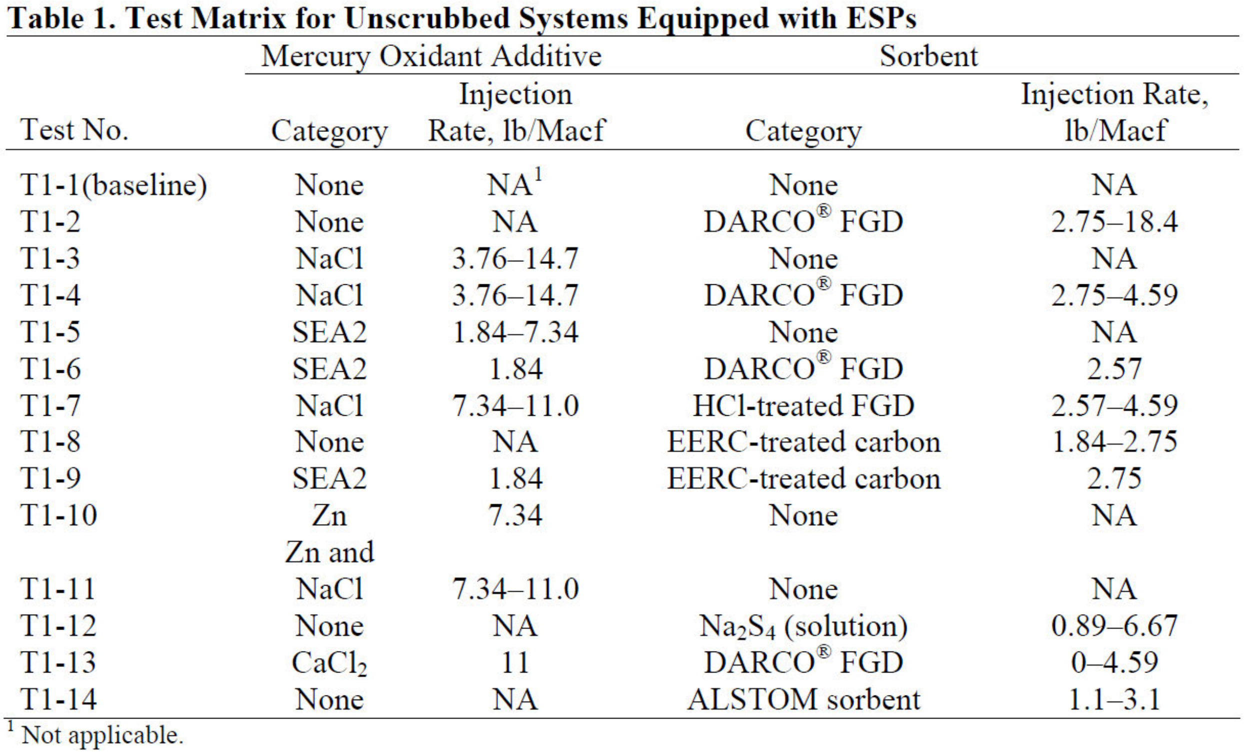

Table 1. Test Matrix for Unscrubbed Systems Equipped with ESPs

	Mercury Oxidant Additive		Sorbent	
Test No.	Category	Injection Rate, lb/Macf	Category	Injection Rate, lb/Macf
T1-1(baseline)	None	NA[1]	None	NA
T1-2	None	NA	DARCO® FGD	2.75–18.4
T1-3	NaCl	3.76–14.7	None	NA
T1-4	NaCl	3.76–14.7	DARCO® FGD	2.75–4.59
T1-5	SEA2	1.84–7.34	None	NA
T1-6	SEA2	1.84	DARCO® FGD	2.57
T1-7	NaCl	7.34–11.0	HCl-treated FGD	2.57–4.59
T1-8	None	NA	EERC-treated carbon	1.84–2.75
T1-9	SEA2	1.84	EERC-treated carbon	2.75
T1-10	Zn	7.34	None	NA
T1-11	Zn and NaCl	7.34–11.0	None	NA
T1-12	None	NA	Na_2S_4 (solution)	0.89–6.67
T1-13	$CaCl_2$	11	DARCO® FGD	0–4.59
T1-14	None	NA	ALSTOM sorbent	1.1–3.1

[1] Not applicable.

Ex. 2012 (describing September 2003 testing); *see also* Ex. 2004, Trial Tr. at 292:9–293:22 ("So it's a logbook and it basically has records or entries if you want to call them, as to actually how the tests were done, the time, what conditions, what rates we are adding. Pretty much all the details of how the test was actually performed."). The test matrix indicates that test T-6 employed the additive SEA2 (sodium bromide)[19] and the sorbent DARCO FGD (activated carbon).[20] Inventor John Pavlish has described similar documentation for the December 2003 and February 2004 tests. Ex. 2018 ¶¶ 31–49.

The results of these tests confirmed the significance of the inventors' discovery. *See* Ex. 2013 at xiv ("The combination of DARCO® FGD injection at 1.84 lb/Macf and SEA2 addition provided exceptional SDA–FF Hg(g) capture, >90%, even at the lower addition rate of 1.84 lb/Macf."). The inventors also noted the synergistic effect between SEA2 and activated carbon:

> The significant improvement by DARCO® FGD–SEA2 is not merely an additive effect but more a synergistic response. The SEA2 addition in the combustion zone not only enhances gaseous mercury conversion to particulate-associated mercury, but also improves DARCO® FGD carbon reactivity with mercury species.

Ex. 2013 at 18. Inventor John Pavlish further explained the results at trial:

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[19] The term SEA2 is used because, at the time this report was provided to the DOE, the EERC had not yet received patent protection. Ex. 2013 at 24 ("The chemical composition of this compound is currently not being reported because of proprietary concerns. This additive has been termed SEA2."). Nonetheless, the report does describe "SEA2" as "an inorganic halide compound that effectively promotes the formation of Hg2+ and Hg(p) as well as enhances sorbent mercury capture performance." Ex. 2018, Pavlish Decl. ¶ 43; Ex. 2013 at 24. [redacted] [redacted], the halide was sodium bromide.

[20] DARCO FGD is the trade name for a powdered activated carbon product from Cabot (formerly Norit Americas). Ex. 2012 at xiii; *see also* Ex. 2013 at 23 (describing Darco FGD as a "LAC," *i.e.*, "lignite-based activated carbon"); Ex. 1002, Niksa Decl. ¶ 149 (describing Norit activated carbon).

> Q. If counsel for the defendants has maybe left the impression that it is only recently you have considered adding the additives directly to the fuel, the coal, what would you say in response to that?
>
> A. I guess I would say definitely not. I mean, our first test was adding bromine on the coal, and the coal was then fed into the combustor, and it's stated newly in the last paragraph, we added additives to the fuel.
>
> Listen we wanted to know and we had already done adding bromine to the fuel, coal.
>
> Q. Thank you. What was your level of optimism at this point where you're seeking to continue researching the issues?
>
> A. Well, the initial tests were astounding. So, I mean, we were very, I guess, optimistic that this technology that we'd invented would continue to prove out.

Ex. 2004, Trial Tr. at 260:5–20. A claim chart mapping this evidence to the claims is attached to the declaration of inventor John Pavlish. Ex. 2018.

3. Analysis

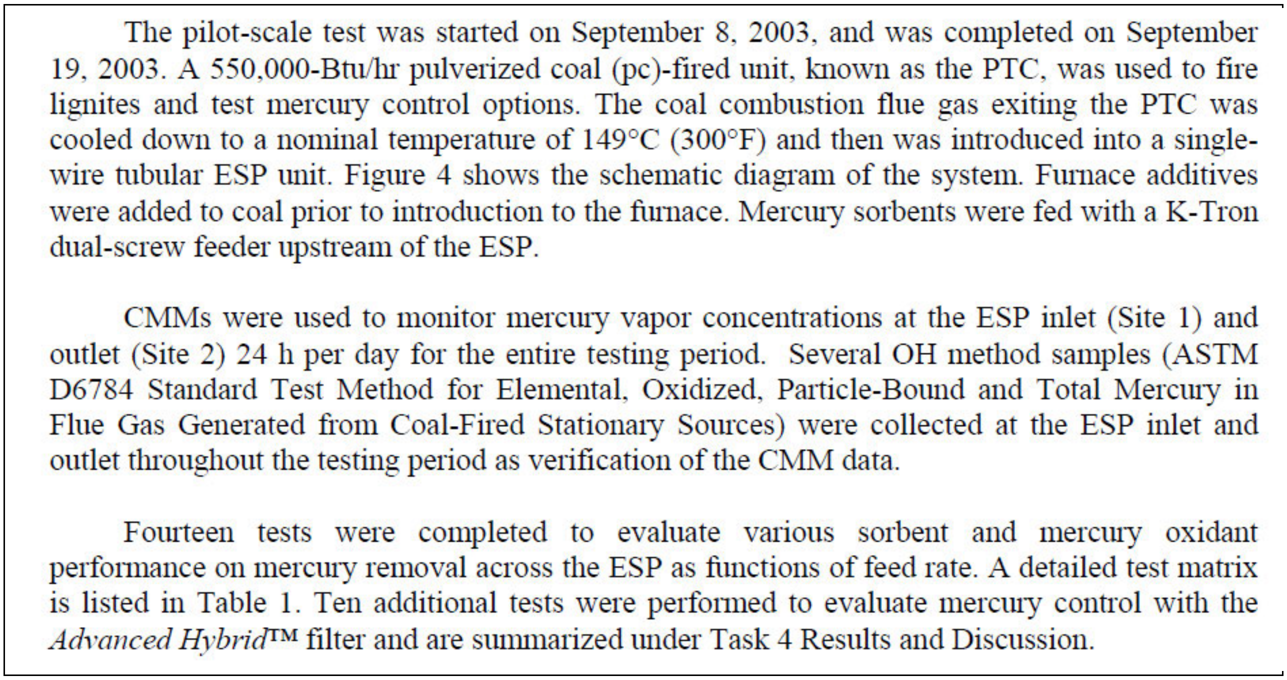
As explained above, the inventors actually reduced the claims of the '430 Patent to practice through pilot scale testing conducted in September 2003, December 2003, and February 2004. This reduction to practice is confirmed by testimony from all three inventors (Exs. 2003, 2018) and corroborated by non-inventor testimony (Ex. 2017), logbook entries (Ex. 2017), and DOE reports (Exs. 2012–2014). Additional documentation (Exs. 2027–2032, 2015, 2033) from the inventors' meetings and development efforts confirms that, under the "rule of reason," their story is credible. *See NFC Technology*, 871 F.3d at 1371.

This evidence satisfies ME2C's burden of production on the issue of reduction to practice; Petitioners have failed to meet their burden of persuasion on this issue. Because the inventors reduced to practice before the asserted § 102(e) date for Downs-Boiler—March 22, 2004, nothing more is required to swear behind this reference. Nonetheless, below is a summary of evidence on an element-by-element basis:

1. Independent Claim 1

a) Claim 1: A method for separating mercury from a mercury-containing gas, the method comprising:

The February 2004 Report describes the September 2003 testing (Ex. 2012 at 10):

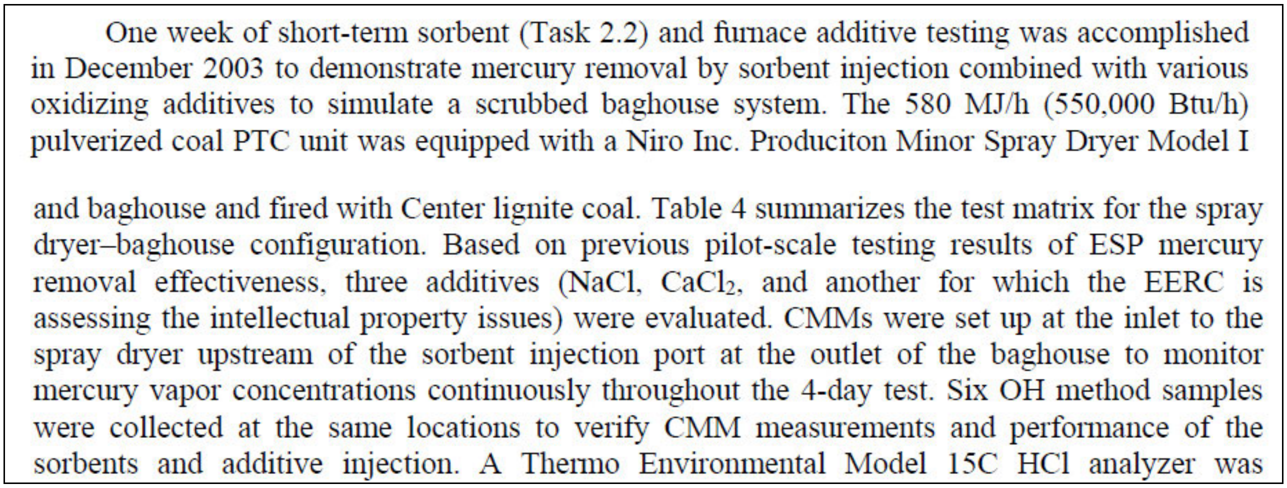


The pilot-scale test was started on September 8, 2003, and was completed on September 19, 2003. A 550,000-Btu/hr pulverized coal (pc)-fired unit, known as the PTC, was used to fire lignites and test mercury control options. The coal combustion flue gas exiting the PTC was cooled down to a nominal temperature of 149°C (300°F) and then was introduced into a single-wire tubular ESP unit. Figure 4 shows the schematic diagram of the system. Furnace additives were added to coal prior to introduction to the furnace. Mercury sorbents were fed with a K-Tron dual-screw feeder upstream of the ESP.

CMMs were used to monitor mercury vapor concentrations at the ESP inlet (Site 1) and outlet (Site 2) 24 h per day for the entire testing period. Several OH method samples (ASTM D6784 Standard Test Method for Elemental, Oxidized, Particle-Bound and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources) were collected at the ESP inlet and outlet throughout the testing period as verification of the CMM data.

Fourteen tests were completed to evaluate various sorbent and mercury oxidant performance on mercury removal across the ESP as functions of feed rate. A detailed test matrix is listed in Table 1. Ten additional tests were performed to evaluate mercury control with the *Advanced Hybrid*™ filter and are summarized under Task 4 Results and Discussion.

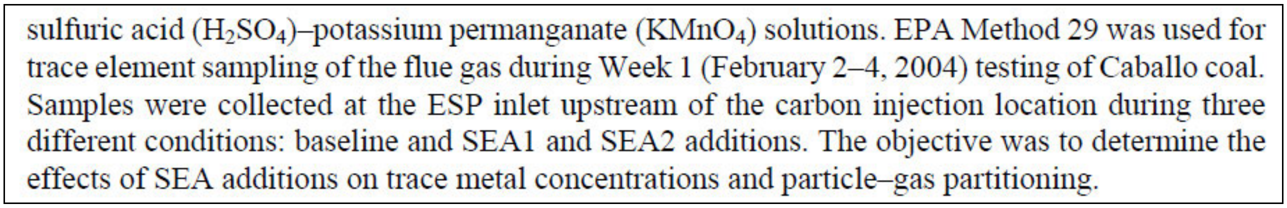
The February 2004 Report also describes additional testing in December 2003 (Ex. 2012 at 14–15):



One week of short-term sorbent (Task 2.2) and furnace additive testing was accomplished in December 2003 to demonstrate mercury removal by sorbent injection combined with various oxidizing additives to simulate a scrubbed baghouse system. The 580 MJ/h (550,000 Btu/h) pulverized coal PTC unit was equipped with a Niro Inc. Produciton Minor Spray Dryer Model I

and baghouse and fired with Center lignite coal. Table 4 summarizes the test matrix for the spray dryer–baghouse configuration. Based on previous pilot-scale testing results of ESP mercury removal effectiveness, three additives (NaCl, $CaCl_2$, and another for which the EERC is assessing the intellectual property issues) were evaluated. CMMs were set up at the inlet to the spray dryer upstream of the sorbent injection port at the outlet of the baghouse to monitor mercury vapor concentrations continuously throughout the 4-day test. Six OH method samples were collected at the same locations to verify CMM measurements and performance of the sorbents and additive injection. A Thermo Environmental Model 15C HCl analyzer was

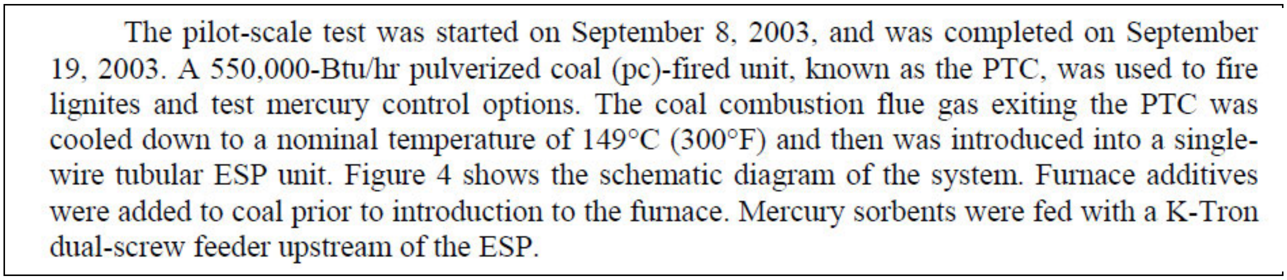
The October 2005 Report describes additional testing in February 2004 (page 20):



sulfuric acid (H_2SO_4)–potassium permanganate ($KMnO_4$) solutions. EPA Method 29 was used for trace element sampling of the flue gas during Week 1 (February 2–4, 2004) testing of Caballo coal. Samples were collected at the ESP inlet upstream of the carbon injection location during three different conditions: baseline and SEA1 and SEA2 additions. The objective was to determine the effects of SEA additions on trace metal concentrations and particle–gas partitioning.

b) combusting coal in a combustion chamber,

The February 2004 Report explains that coal was combusted in a 550,000-Btu/hr pc-fire combustor (known as the PTC) (Ex. 2012 at 10):



The pilot-scale test was started on September 8, 2003, and was completed on September 19, 2003. A 550,000-Btu/hr pulverized coal (pc)-fired unit, known as the PTC, was used to fire lignites and test mercury control options. The coal combustion flue gas exiting the PTC was cooled down to a nominal temperature of 149°C (300°F) and then was introduced into a single-wire tubular ESP unit. Figure 4 shows the schematic diagram of the system. Furnace additives were added to coal prior to introduction to the furnace. Mercury sorbents were fed with a K-Tron dual-screw feeder upstream of the ESP.

c) the coal comprising an additive comprising Br_2, HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and

The February 2004 Report describes adding coal and additives (including SEA 2) to the combustion chamber during the September 2003 testing (page 18):

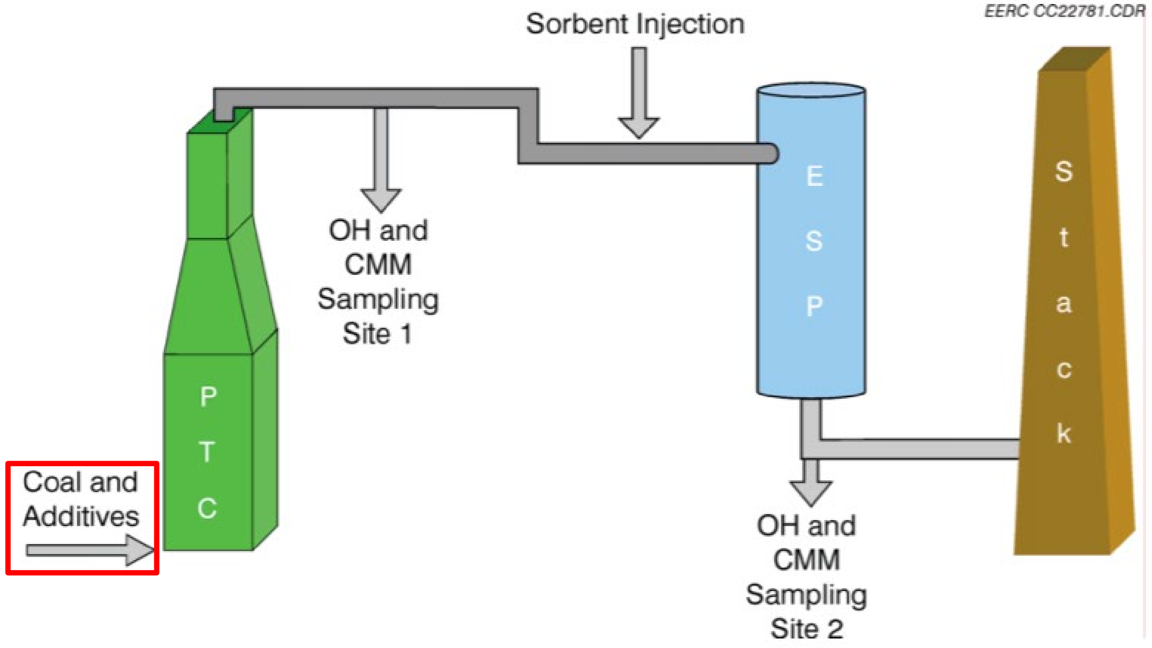


Figure 4. Injection and sampling schematic of the PTC with an ESP.

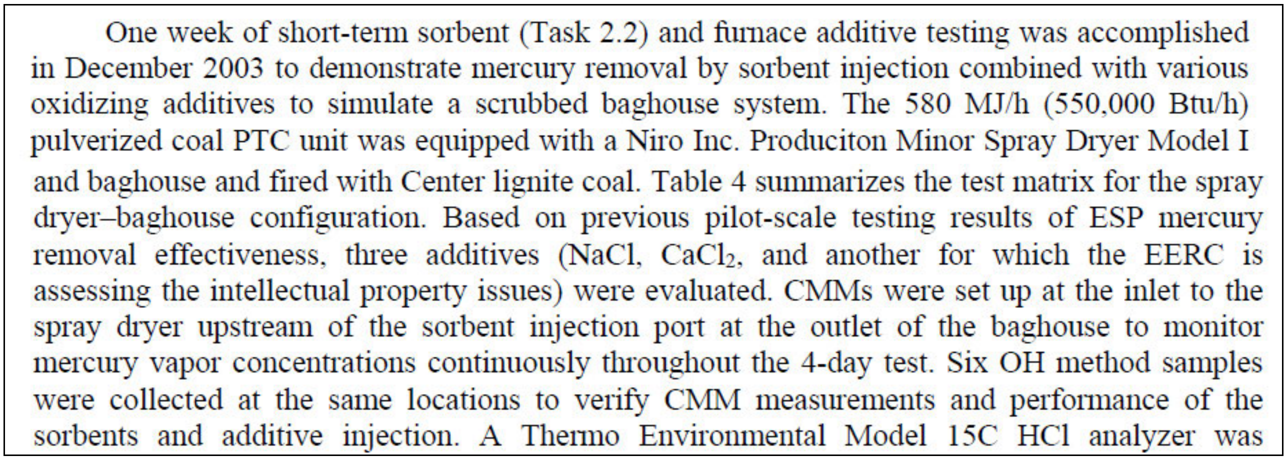
See also Ex. 2012, Feb. 2004 Report at 17 ("[M]ercury oxidants including NaCl, SEA 2, and zinc were examined for their impacts on mercury removal."); 15 ("Based on previous pilot-scale testing results of ESP mercury removal effectiveness, three additives (NaCl, CaCl2, and another for which the EERC is assessing the intellectual property issues) were evaluated."); Final Report at 25 ("SEA2 is a proprietary Hg^0 oxidizing agent effective at addition rates on the order of 1/10 of those for SEA1.")

[redacted]

[redacted] Thus, the mercury-containing gas, the coal, and the combustion chamber comprised Br$^-$.

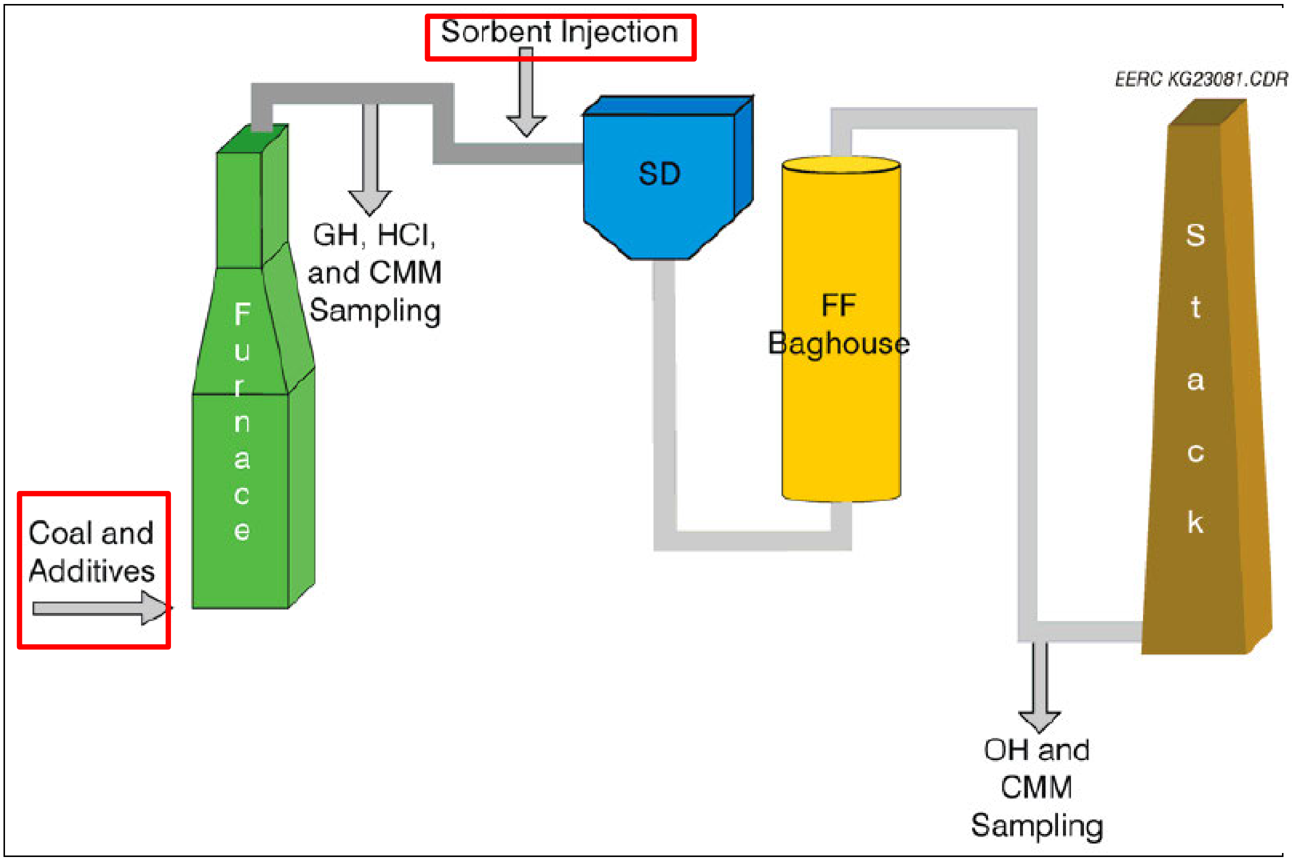
[redacted]

SEA2 and activated carbon were similarly used during the December 2003 testing. *See* Ex. 2012, Feb. 2004 Report at 15:

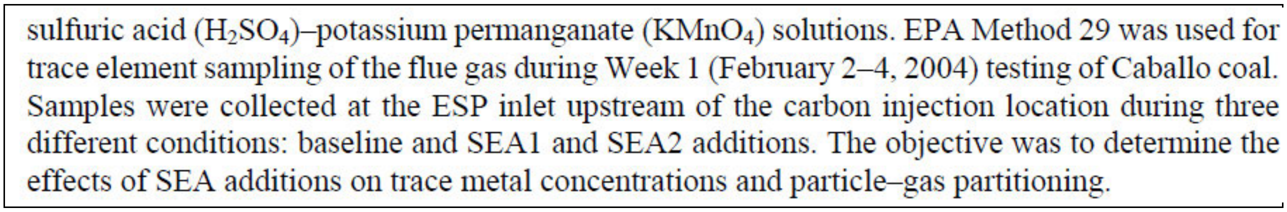


One week of short-term sorbent (Task 2.2) and furnace additive testing was accomplished in December 2003 to demonstrate mercury removal by sorbent injection combined with various oxidizing additives to simulate a scrubbed baghouse system. The 580 MJ/h (550,000 Btu/h) pulverized coal PTC unit was equipped with a Niro Inc. Produciton Minor Spray Dryer Model I and baghouse and fired with Center lignite coal. Table 4 summarizes the test matrix for the spray dryer–baghouse configuration. Based on previous pilot-scale testing results of ESP mercury removal effectiveness, three additives (NaCl, $CaCl_2$, and another for which the EERC is assessing the intellectual property issues) were evaluated. CMMs were set up at the inlet to the spray dryer upstream of the sorbent injection port at the outlet of the baghouse to monitor mercury vapor concentrations continuously throughout the 4-day test. Six OH method samples were collected at the same locations to verify CMM measurements and performance of the sorbents and additive injection. A Thermo Environmental Model 15C HCl analyzer was

See Ex. 2013, Feb. 2005 Report at 25 (“Pilot-scale Hg control testing was conducted December 8–11, 2003, using a 580-MJ/hr (550,000-Btu/hr) pc-fired unit equipped with a Niro Inc. Production Minor Spray Dryer Model I and baghouse.”); at 27 (“Nine tests were completed to evaluate the effectiveness of potential Hg sorbents (DARCO® FGD, EERC-treated FGD, and Amended Silicate™) and Hg0 oxidation and sorbent enhancement additives (NaCl, SEA2, and CaCl2) to remove Hg using a SDA and FF.”); at 25:

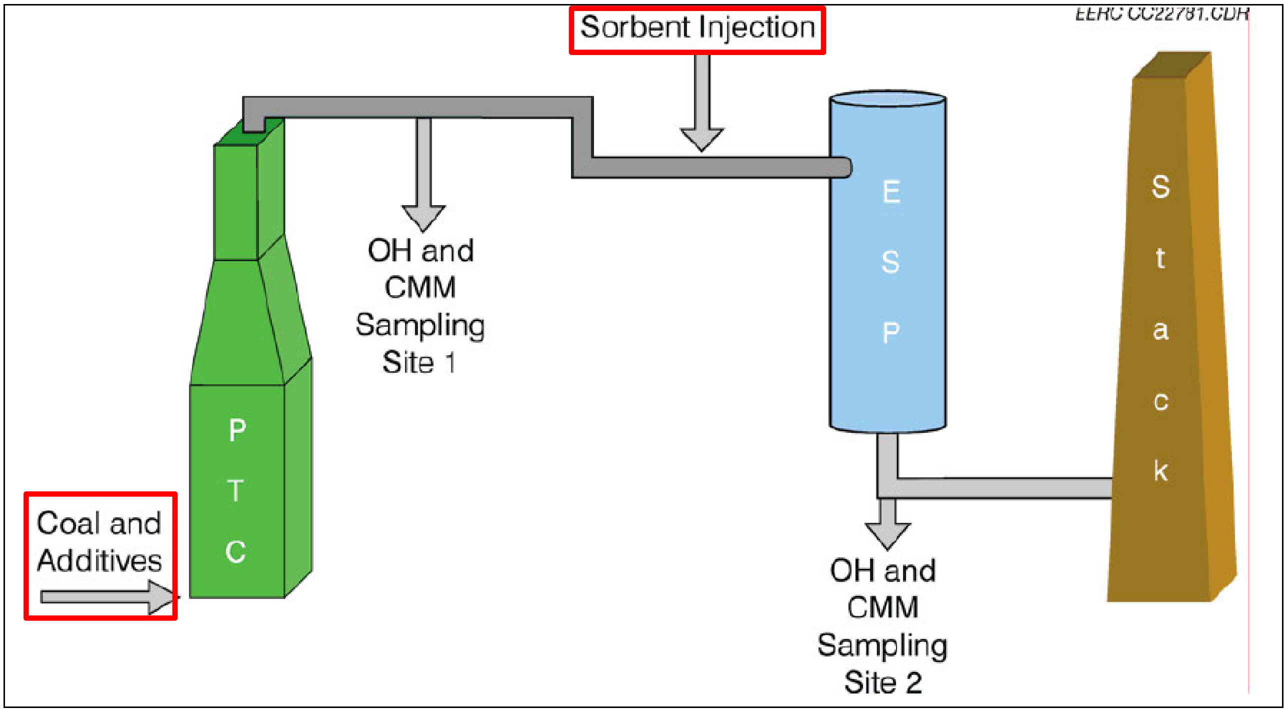


SEA2 and activated carbon were also used in the February 2004 testing. Ex. 2014, Oct. 2005 Report at 20:



sulfuric acid (H_2SO_4)–potassium permanganate ($KMnO_4$) solutions. EPA Method 29 was used for trace element sampling of the flue gas during Week 1 (February 2–4, 2004) testing of Caballo coal. Samples were collected at the ESP inlet upstream of the carbon injection location during three different conditions: baseline and SEA1 and SEA2 additions. The objective was to determine the effects of SEA additions on trace metal concentrations and particle–gas partitioning.

Ex. 2014, Oct. 2005 Report at 26:



d) collecting mercury in the mercury-containing gas with a sorbent added to the mercury-containing gas, the sorbent comprising activated carbon.

The February 2004 Report describes injecting Darco FGD activated carbon into the mercury-containing gas downstream of the combustion chamber during the September 2003 testing (Ex. 2012 at 11):

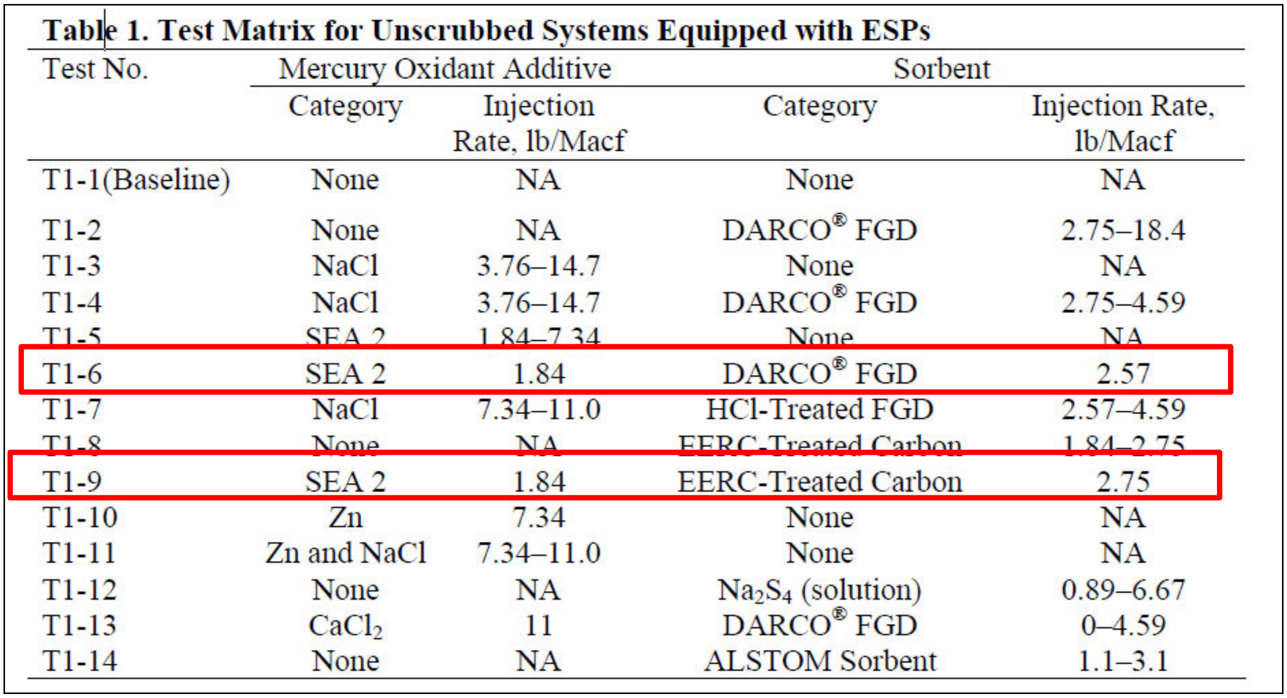


Table 1. Test Matrix for Unscrubbed Systems Equipped with ESPs

Test No.	Mercury Oxidant Additive		Sorbent	
	Category	Injection Rate, lb/Macf	Category	Injection Rate, lb/Macf
T1-1(Baseline)	None	NA	None	NA
T1-2	None	NA	DARCO® FGD	2.75–18.4
T1-3	NaCl	3.76–14.7	None	NA
T1-4	NaCl	3.76–14.7	DARCO® FGD	2.75–4.59
T1-5	SEA 2	1.84–7.34	None	NA
T1-6	SEA 2	1.84	DARCO® FGD	2.57
T1-7	NaCl	7.34–11.0	HCl-Treated FGD	2.57–4.59
T1-8	None	NA	EERC-Treated Carbon	1.84–2.75
T1-9	SEA 2	1.84	EERC-Treated Carbon	2.75
T1-10	Zn	7.34	None	NA
T1-11	Zn and NaCl	7.34–11.0	None	NA
T1-12	None	NA	Na_2S_4 (solution)	0.89–6.67
T1-13	$CaCl_2$	11	DARCO® FGD	0–4.59
T1-14	None	NA	ALSTOM Sorbent	1.1–3.1

See also Ex. 2012 at 15 (describing "DARCO® FGD activated carbon, supplied by NORIT Americas, Inc.; an EERC-treated activated carbon").

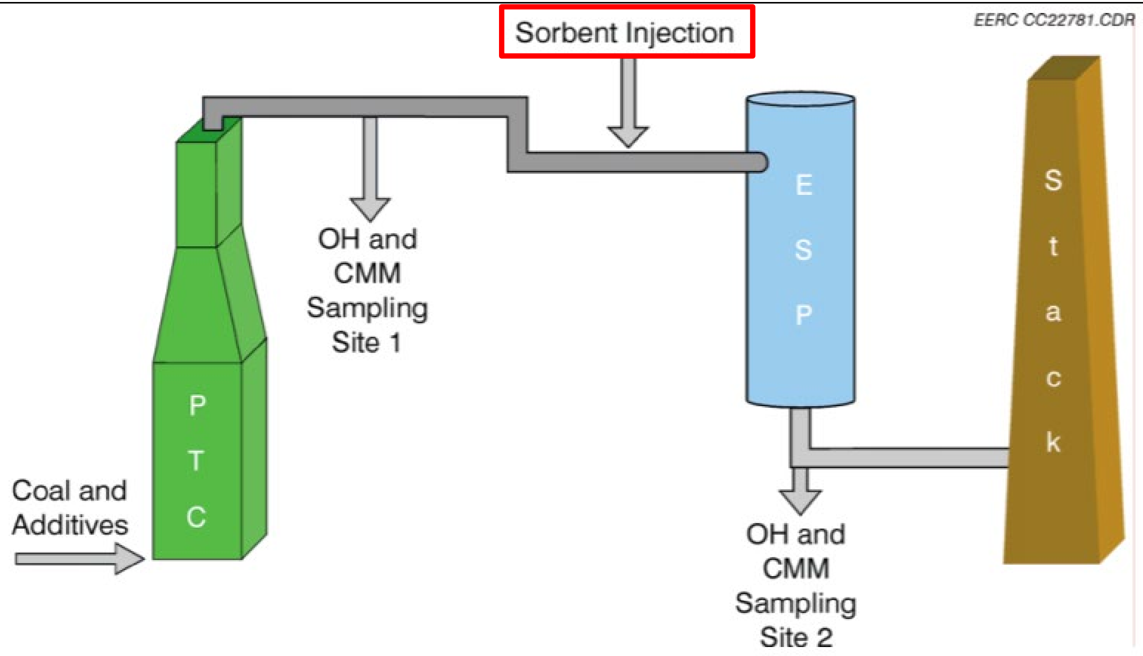


Figure 4. Injection and sampling schematic of the PTC with an ESP.

The February 2004 Report also describes injecting activated carbon sorbent during the December 2003 testing:[21]

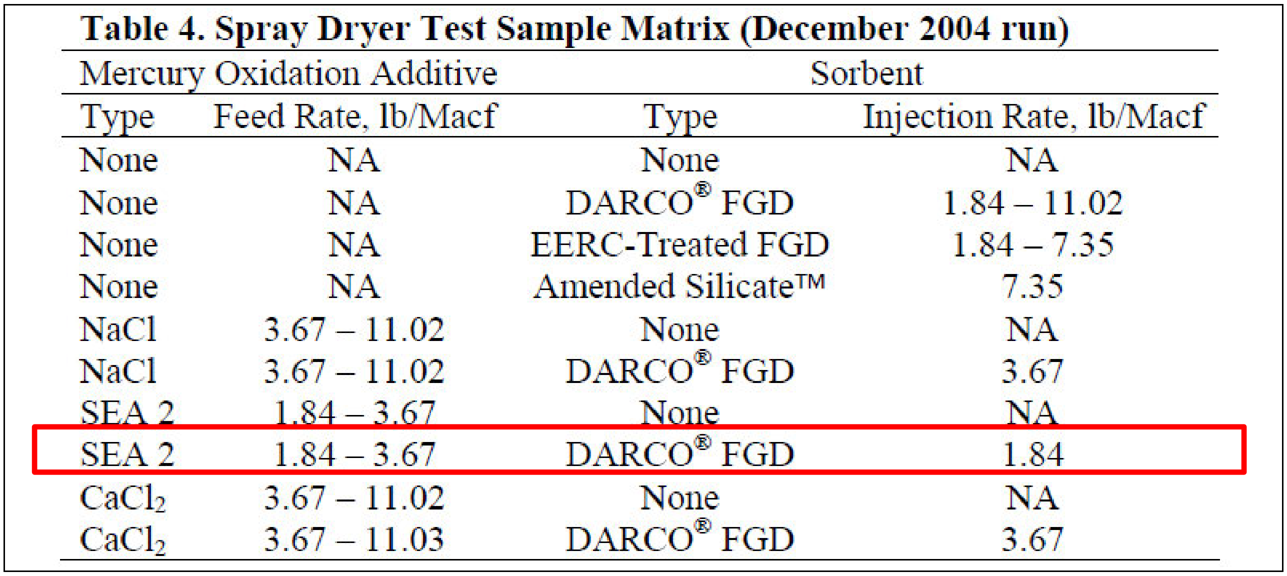


Table 4. Spray Dryer Test Sample Matrix (December 2004 run)

Mercury Oxidation Additive		Sorbent	
Type	Feed Rate, lb/Macf	Type	Injection Rate, lb/Macf
None	NA	None	NA
None	NA	DARCO® FGD	1.84 – 11.02
None	NA	EERC-Treated FGD	1.84 – 7.35
None	NA	Amended Silicate™	7.35
NaCl	3.67 – 11.02	None	NA
NaCl	3.67 – 11.02	DARCO® FGD	3.67
SEA 2	1.84 – 3.67	None	NA
SEA 2	1.84 – 3.67	DARCO® FGD	1.84
$CaCl_2$	3.67 – 11.02	None	NA
$CaCl_2$	3.67 – 11.03	DARCO® FGD	3.67

See also Ex. 2013, Feb. 2005 Report at 25:

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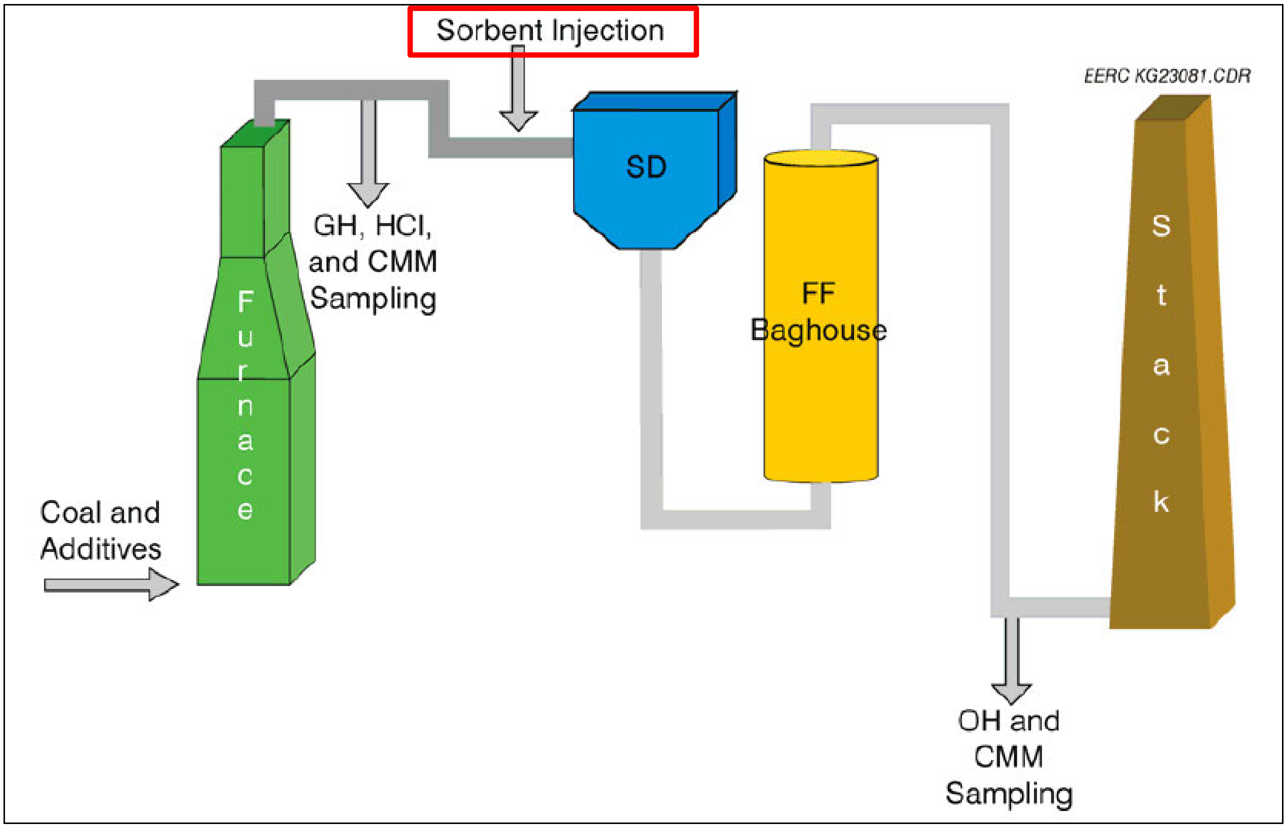
[21] This table refers to a "December 2004 run," which is a typo. It should refer to a December 2003 run as noted in the preceding paragraph. Final Report at 14 ("One week of short-term sorbent (Task 2.2) and furnace additive testing was accomplished in December 2003 to demonstrate mercury removal by sorbent injection combined with various oxidizing additives to simulate a scrubbed baghouse system."). This is also evidence based on the fact that the Final Report was prepared in February 2004.



The October 2005 Report describes injecting activated carbon sorbent during the February 2004 testing (Ex. 2014 at 26–27):

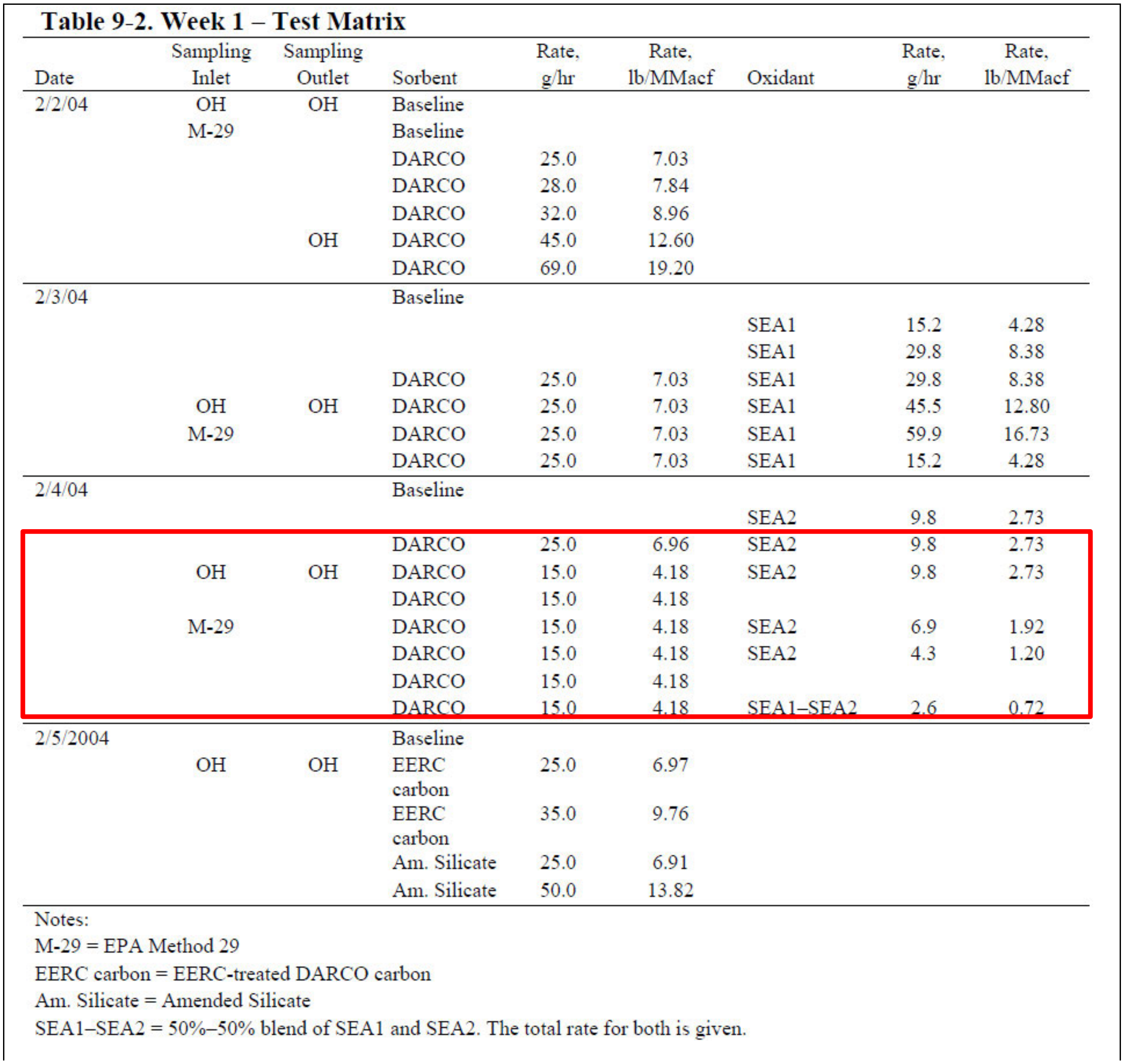
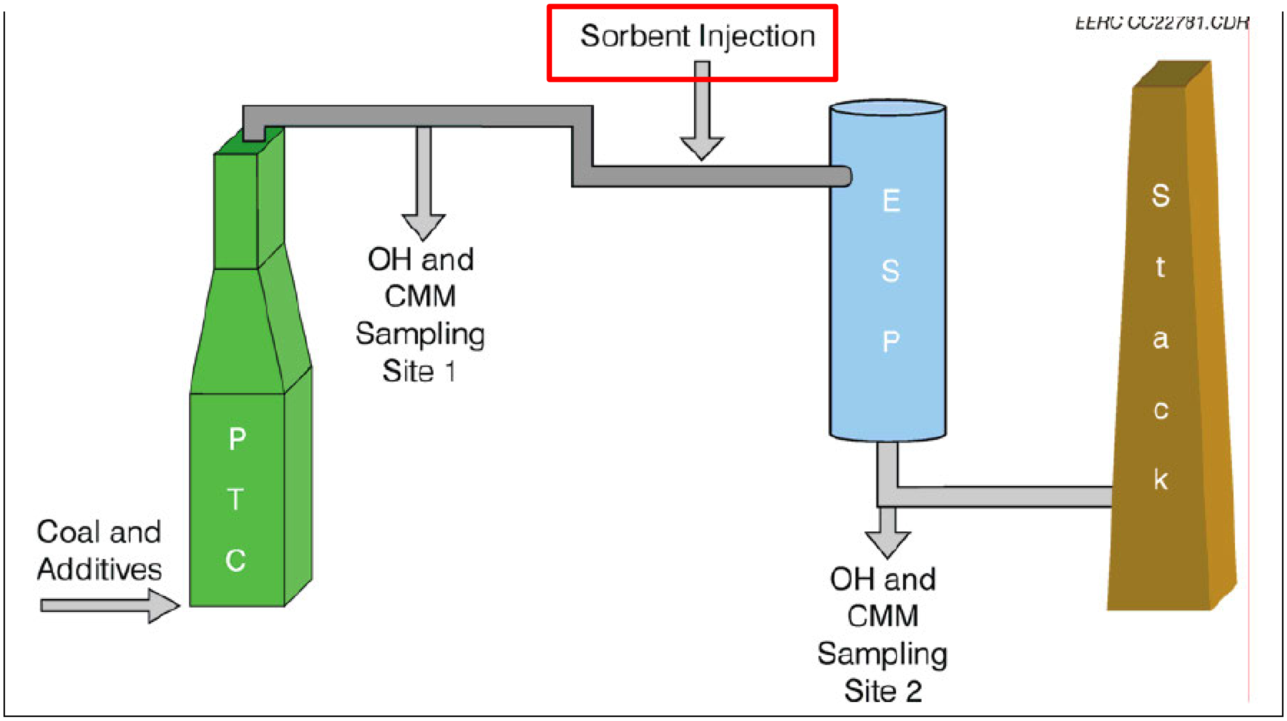


Table 9-2. Week 1 – Test Matrix

Date	Sampling Inlet	Sampling Outlet	Sorbent	Rate, g/hr	Rate, lb/MMacf	Oxidant	Rate, g/hr	Rate, lb/MMacf
2/2/04	OH	OH	Baseline					
	M-29		Baseline					
			DARCO	25.0	7.03			
			DARCO	28.0	7.84			
			DARCO	32.0	8.96			
		OH	DARCO	45.0	12.60			
			DARCO	69.0	19.20			
2/3/04			Baseline					
						SEA1	15.2	4.28
						SEA1	29.8	8.38
			DARCO	25.0	7.03	SEA1	29.8	8.38
	OH	OH	DARCO	25.0	7.03	SEA1	45.5	12.80
	M-29		DARCO	25.0	7.03	SEA1	59.9	16.73
			DARCO	25.0	7.03	SEA1	15.2	4.28
2/4/04			Baseline					
						SEA2	9.8	2.73
			DARCO	25.0	6.96	SEA2	9.8	2.73
	OH	OH	DARCO	15.0	4.18	SEA2	9.8	2.73
			DARCO	15.0	4.18			
	M-29		DARCO	15.0	4.18	SEA2	6.9	1.92
			DARCO	15.0	4.18	SEA2	4.3	1.20
			DARCO	15.0	4.18			
			DARCO	15.0	4.18	SEA1–SEA2	2.6	0.72
2/5/2004			Baseline					
	OH	OH	EERC carbon	25.0	6.97			
			EERC carbon	35.0	9.76			
			Am. Silicate	25.0	6.91			
			Am. Silicate	50.0	13.82			

Notes:
M-29 = EPA Method 29
EERC carbon = EERC-treated DARCO carbon
Am. Silicate = Amended Silicate
SEA1–SEA2 = 50%–50% blend of SEA1 and SEA2. The total rate for both is given.



The mercury/sorbent composition was collected using an electrostatic precipitator during the September 2003 testing to form a cleaned gas. Ex. 2012, Feb. 2004 Report at 10–11 ("Fourteen tests were completed to evaluate various sorbent and mercury oxidant performance on mercury removal across the ESP as functions of feed rate."):

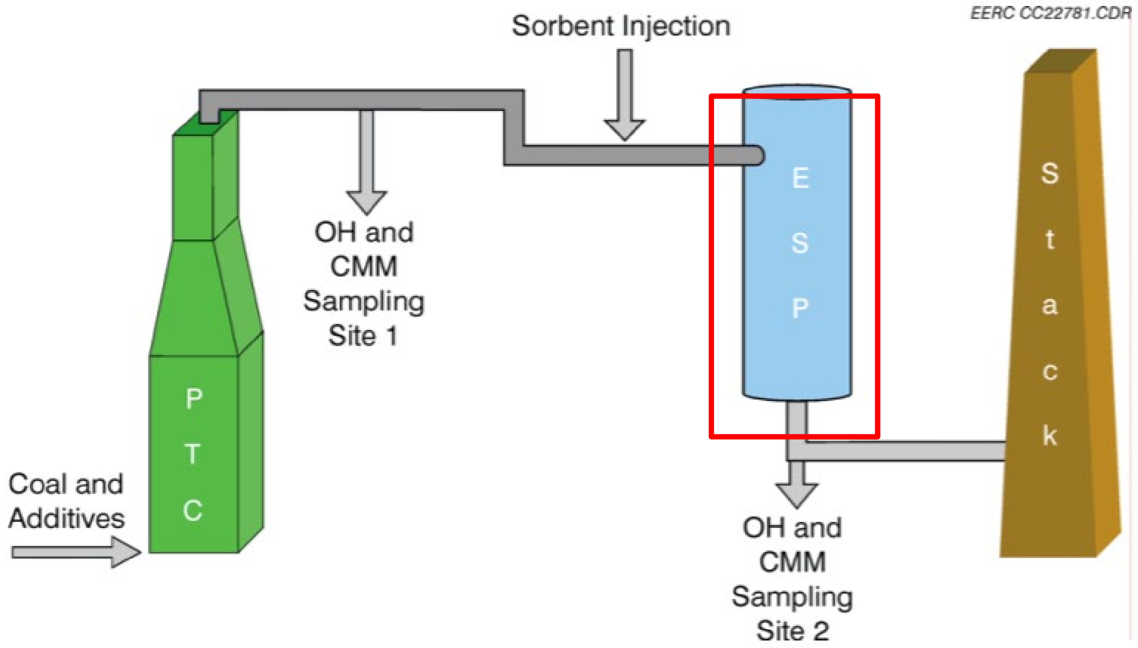
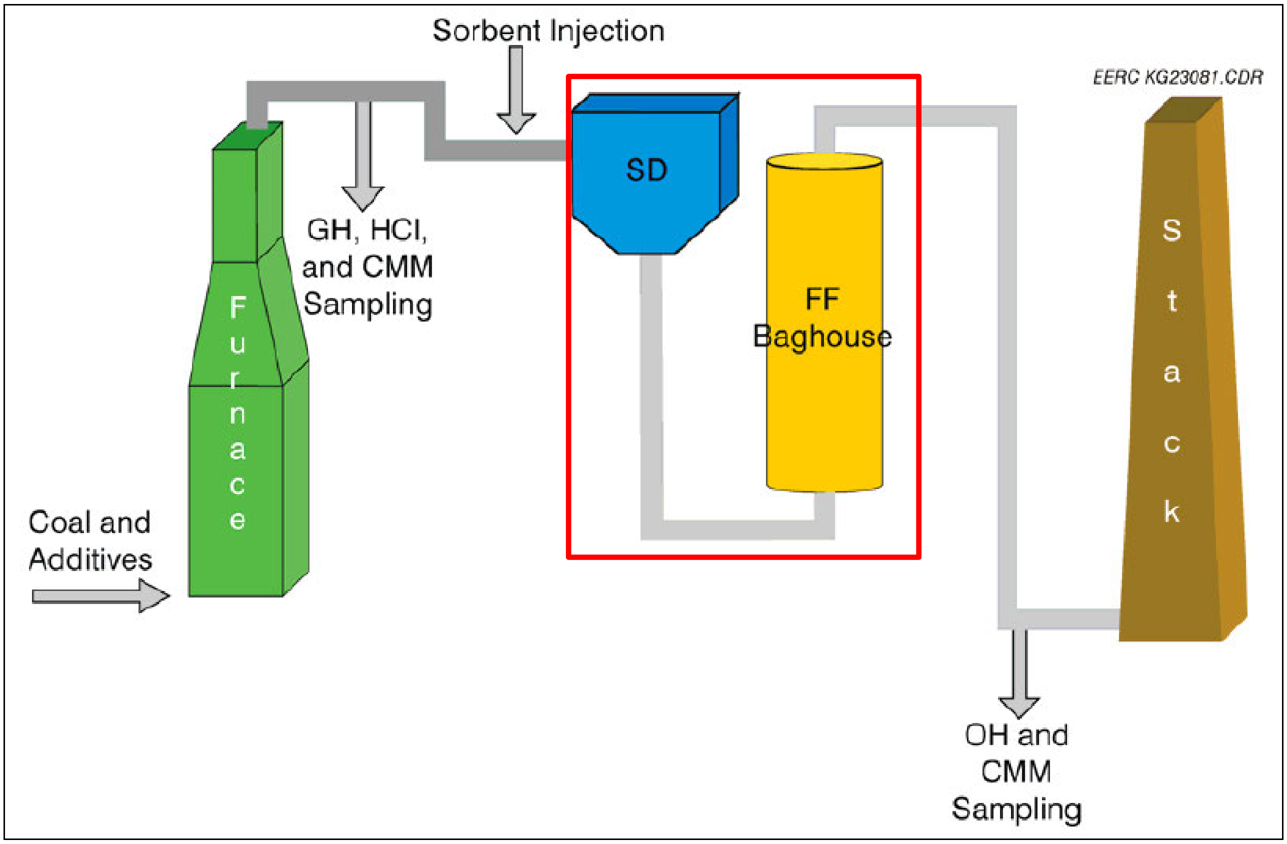
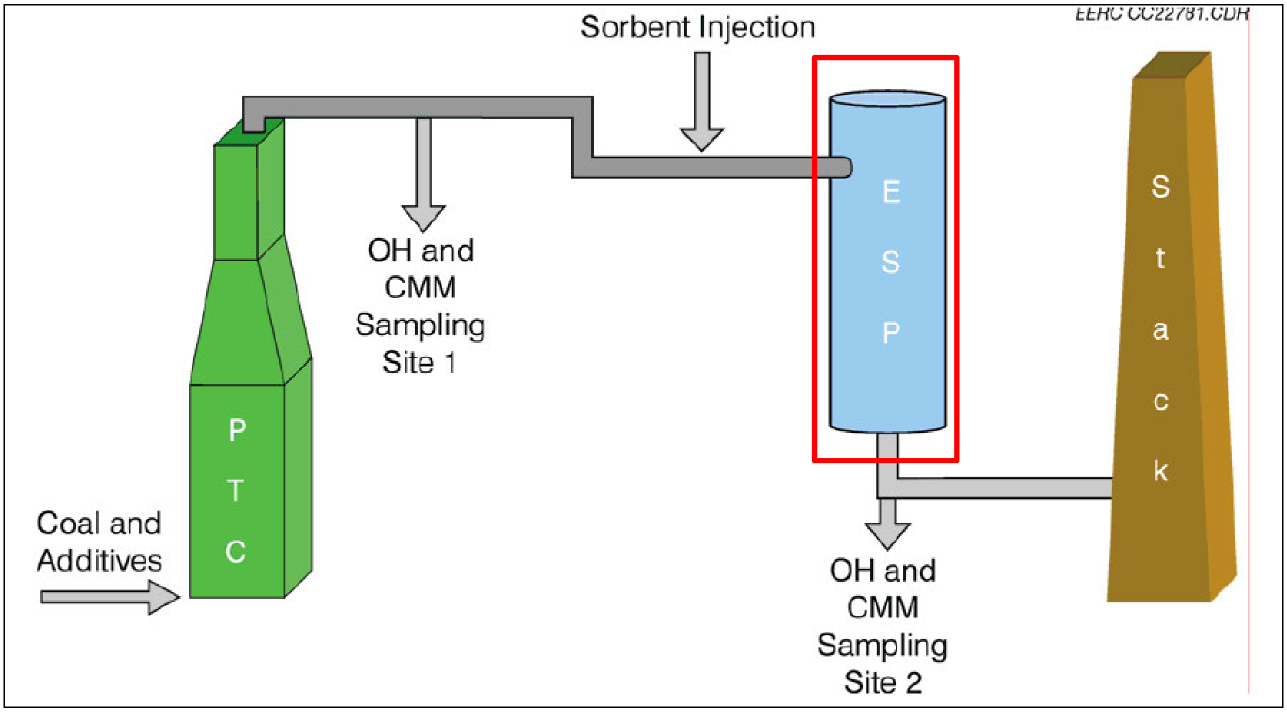


Figure 4. Injection and sampling schematic of the PTC with an ESP.

The mercury/sorbent composition was collected using a scrubbed baghouse system during the December 2003 testing. Ex. 2012, Feb. 2004 Report at 14 ("One week of short-term sorbent (Task 2.2) and furnace additive testing was accomplished in December 2003 to demonstrate mercury removal by sorbent injection combined with various oxidizing additives to simulate a scrubbed baghouse system."); *see also* Ex. 2013, Feb. 2005 Report at 25:



The mercury/sorbent composition was collected using an electrostatic precipitator during the February 2004 testing. Ex. 2014, Oct. 2005 Report at 26 ("ESP Hg removal testing was performed with the PTC firing Caballo subbituminous coal."):



2. **Claim 13: The method of claim 1, wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent. Claim 17: The method of claim 1, wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the added Br2, HBr, the bromide compound, or a combination thereof, per 100 g of the sorbent.**

The February 2004 testing used bromine injection rates within this range.

See Ex. 2014, Oct. 2005 Report at 27:

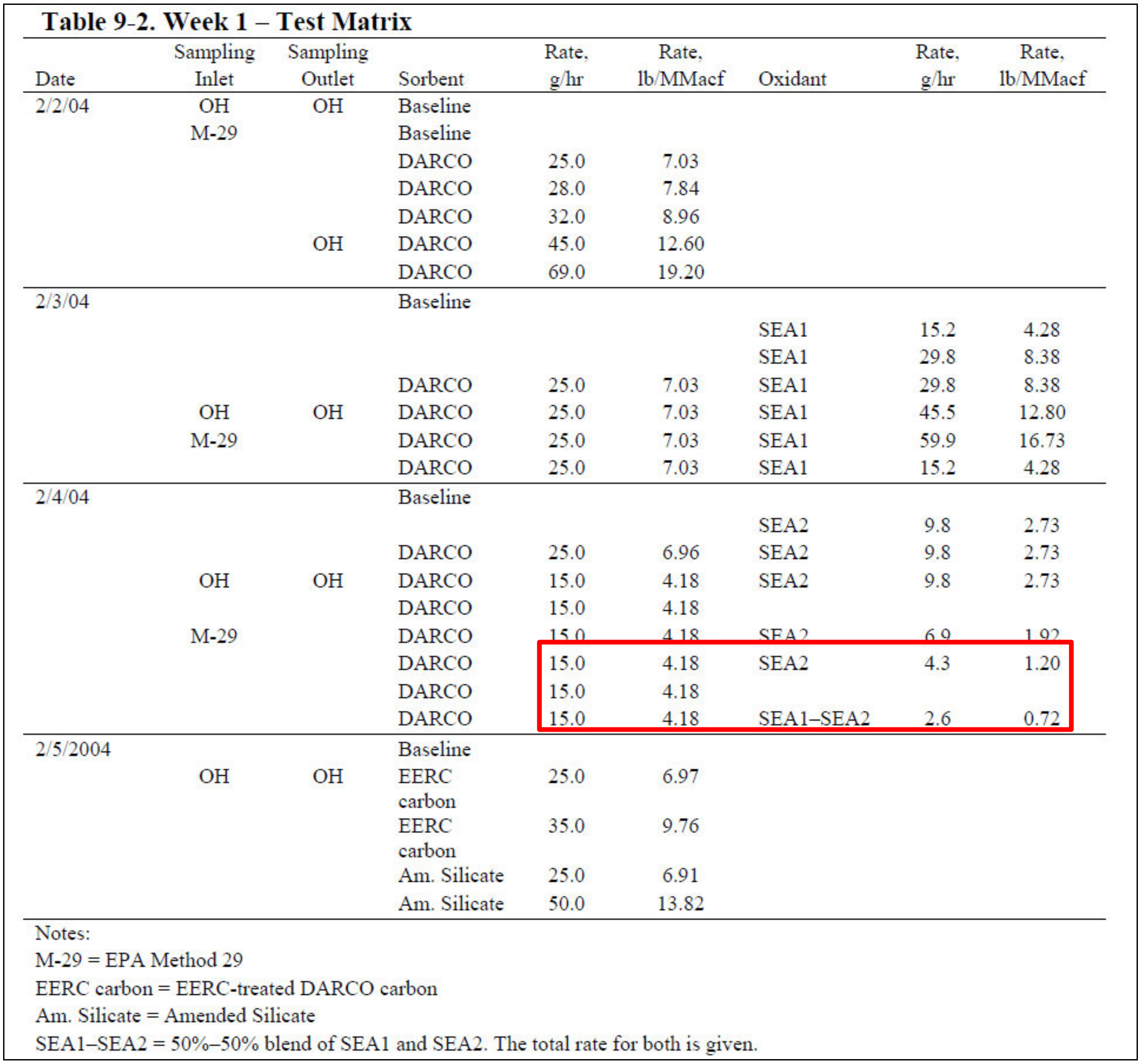


Table 9-2. Week 1 – Test Matrix

Date	Sampling Inlet	Sampling Outlet	Sorbent	Rate, g/hr	Rate, lb/MMacf	Oxidant	Rate, g/hr	Rate, lb/MMacf
2/2/04	OH	OH	Baseline					
	M-29		Baseline					
			DARCO	25.0	7.03			
			DARCO	28.0	7.84			
			DARCO	32.0	8.96			
		OH	DARCO	45.0	12.60			
			DARCO	69.0	19.20			
2/3/04			Baseline					
						SEA1	15.2	4.28
						SEA1	29.8	8.38
			DARCO	25.0	7.03	SEA1	29.8	8.38
	OH	OH	DARCO	25.0	7.03	SEA1	45.5	12.80
	M-29		DARCO	25.0	7.03	SEA1	59.9	16.73
			DARCO	25.0	7.03	SEA1	15.2	4.28
2/4/04			Baseline					
						SEA2	9.8	2.73
			DARCO	25.0	6.96	SEA2	9.8	2.73
	OH	OH	DARCO	15.0	4.18	SEA2	9.8	2.73
			DARCO	15.0	4.18			
	M-29		DARCO	15.0	4.18	SEA2	6.9	1.92
			DARCO	15.0	4.18	SEA2	4.3	1.20
			DARCO	15.0	4.18			
			DARCO	15.0	4.18	SEA1–SEA2	2.6	0.72
2/5/2004			Baseline					
	OH	OH	EERC carbon	25.0	6.97			
			EERC carbon	35.0	9.76			
			Am. Silicate	25.0	6.91			
			Am. Silicate	50.0	13.82			

Notes:
M-29 = EPA Method 29
EERC carbon = EERC-treated DARCO carbon
Am. Silicate = Amended Silicate
SEA1–SEA2 = 50%–50% blend of SEA1 and SEA2. The total rate for both is given.

See Ex. 2014 Oct. 2005 Report at 30:

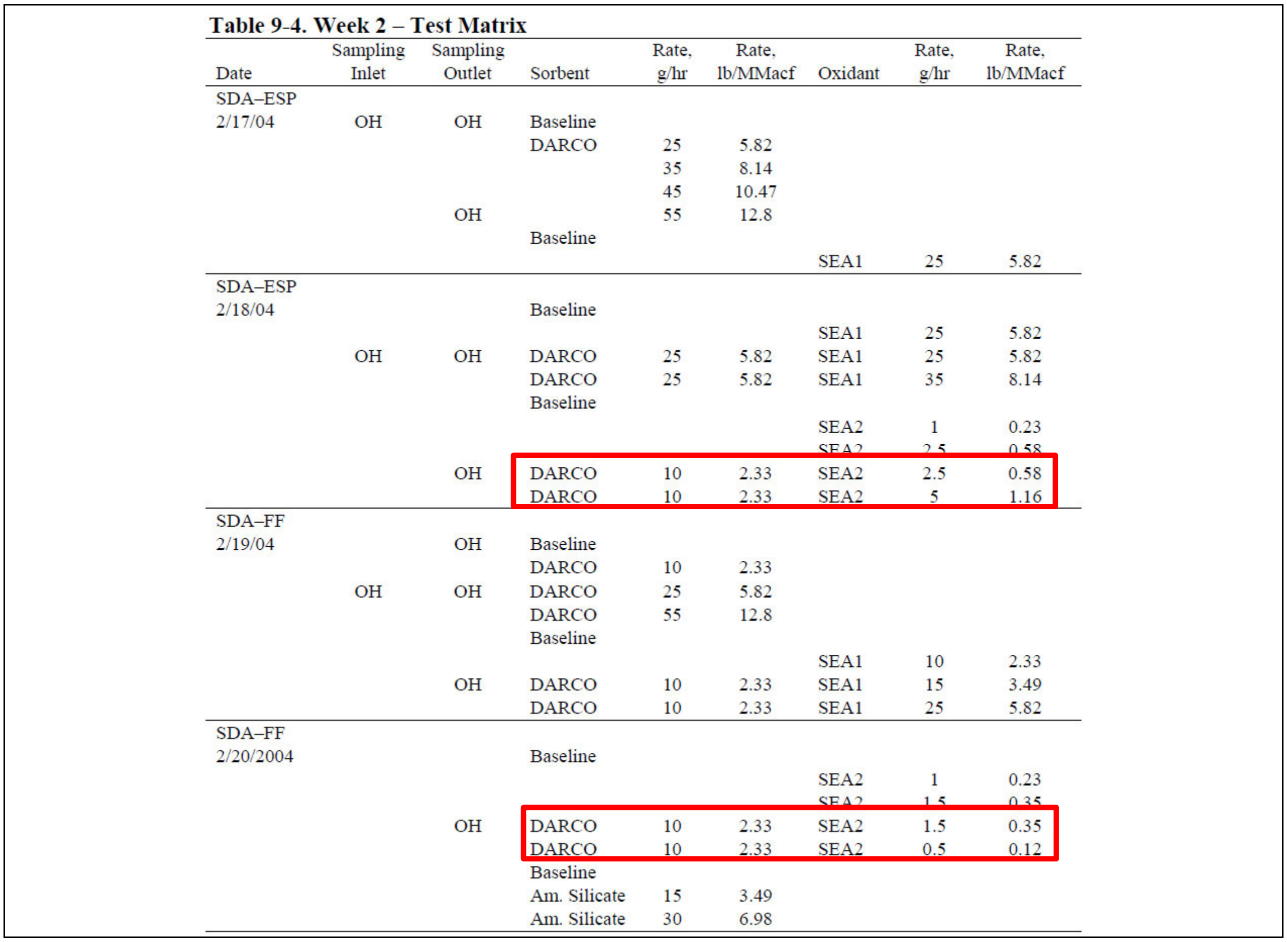
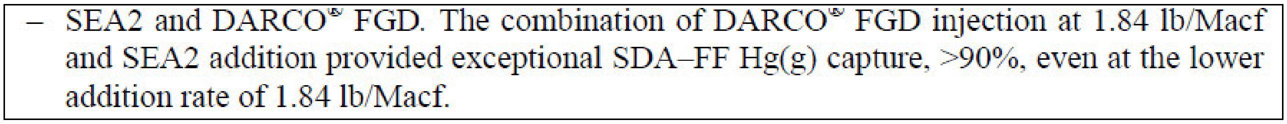


Table 9-4. Week 2 – Test Matrix

Date	Sampling Inlet	Sampling Outlet	Sorbent	Rate, g/hr	Rate, lb/MMacf	Oxidant	Rate, g/hr	Rate, lb/MMacf
SDA–ESP								
2/17/04	OH	OH	Baseline					
			DARCO	25	5.82			
				35	8.14			
				45	10.47			
		OH		55	12.8			
			Baseline					
						SEA1	25	5.82
SDA–ESP								
2/18/04			Baseline					
						SEA1	25	5.82
	OH	OH	DARCO	25	5.82	SEA1	25	5.82
			DARCO	25	5.82	SEA1	35	8.14
			Baseline					
						SEA2	1	0.23
						SEA2	2.5	0.58
		OH	DARCO	10	2.33	SEA2	2.5	0.58
			DARCO	10	2.33	SEA2	5	1.16
SDA–FF								
2/19/04		OH	Baseline					
			DARCO	10	2.33			
	OH	OH	DARCO	25	5.82			
			DARCO	55	12.8			
			Baseline					
						SEA1	10	2.33
		OH	DARCO	10	2.33	SEA1	15	3.49
			DARCO	10	2.33	SEA1	25	5.82
SDA–FF								
2/20/2004			Baseline					
						SEA2	1	0.23
						SEA2	1.5	0.35
		OH	DARCO	10	2.33	SEA2	1.5	0.35
			DARCO	10	2.33	SEA2	0.5	0.12
			Baseline					
			Am. Silicate	15	3.49			
			Am. Silicate	30	6.98			

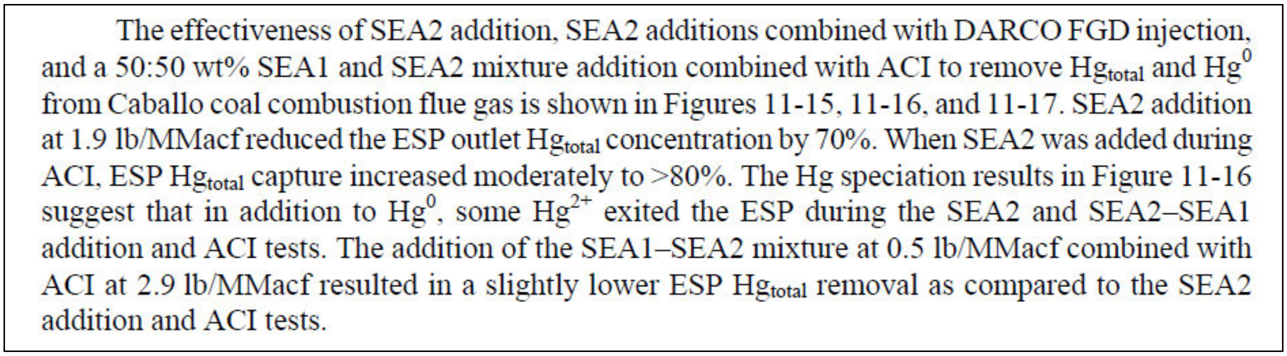
3. Claim 15: The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas. Claim 16: The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas with the sorbent.

This level of mercury capture was achieved during the September 2003, December 2003, and February 2004 testing. *See* Ex. 2013, Feb. 2005 Report at 73:



– SEA2 and DARCO® FGD. The combination of DARCO® FGD injection at 1.84 lb/Macf and SEA2 addition provided exceptional SDA–FF Hg(g) capture, >90%, even at the lower addition rate of 1.84 lb/Macf.

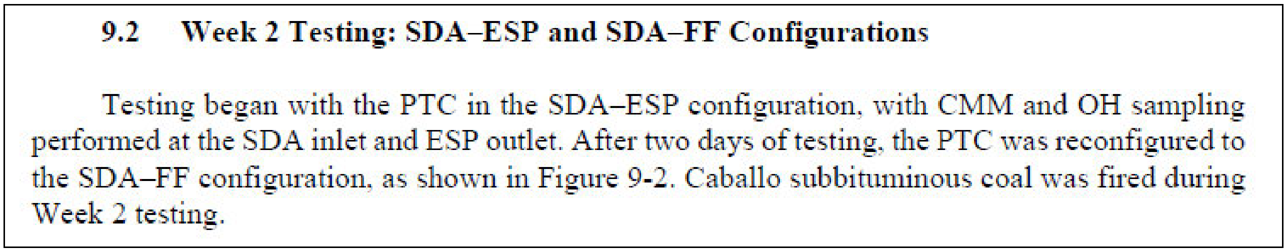
See Ex. 2014, Oct. 2005 Report at 49:



The effectiveness of SEA2 addition, SEA2 additions combined with DARCO FGD injection, and a 50:50 wt% SEA1 and SEA2 mixture addition combined with ACI to remove Hg_{total} and Hg^0 from Caballo coal combustion flue gas is shown in Figures 11-15, 11-16, and 11-17. SEA2 addition at 1.9 lb/MMacf reduced the ESP outlet Hg_{total} concentration by 70%. When SEA2 was added during ACI, ESP Hg_{total} capture increased moderately to >80%. The Hg speciation results in Figure 11-16 suggest that in addition to Hg^0, some Hg^{2+} exited the ESP during the SEA2 and SEA2–SEA1 addition and ACI tests. The addition of the SEA1–SEA2 mixture at 0.5 lb/MMacf combined with ACI at 2.9 lb/MMacf resulted in a slightly lower ESP Hg_{total} removal as compared to the SEA2 addition and ACI tests.

4. Claim 8: The method of claim 1, wherein the coal comprises a subbituminous coal.

The inventors' testing included tests with subbituminous coal. *See* Ex. 2014 Oct. 2005 Report at 28:

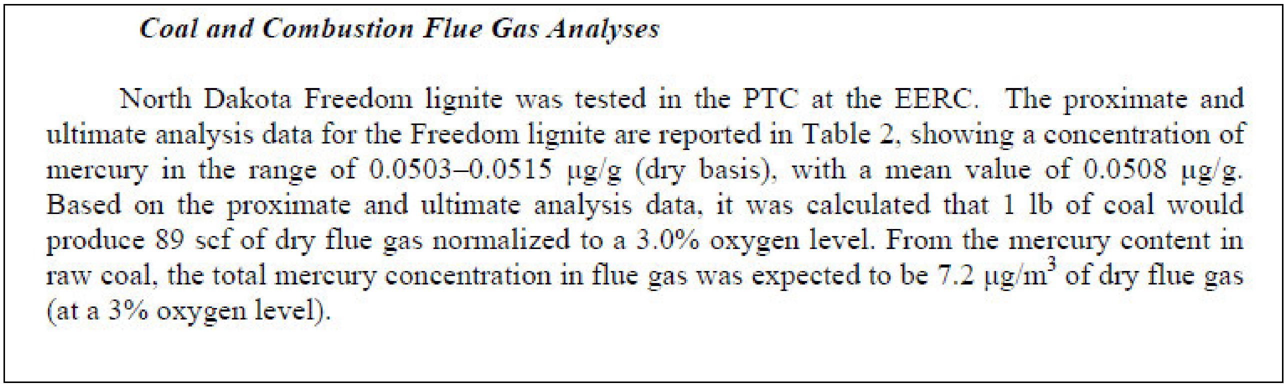


9.2 Week 2 Testing: SDA–ESP and SDA–FF Configurations

Testing began with the PTC in the SDA–ESP configuration, with CMM and OH sampling performed at the SDA inlet and ESP outlet. After two days of testing, the PTC was reconfigured to the SDA–FF configuration, as shown in Figure 9-2. Caballo subbituminous coal was fired during Week 2 testing.

5. Claim 9: The method of claim 1, wherein the coal comprises lignite coal.

The inventors' testing included tests with lignite coal. *See* Ex. 2012 Feb. 2004 Report at 10:



Coal and Combustion Flue Gas Analyses

North Dakota Freedom lignite was tested in the PTC at the EERC. The proximate and ultimate analysis data for the Freedom lignite are reported in Table 2, showing a concentration of mercury in the range of 0.0503–0.0515 µg/g (dry basis), with a mean value of 0.0508 µg/g. Based on the proximate and ultimate analysis data, it was calculated that 1 lb of coal would produce 89 scf of dry flue gas normalized to a 3.0% oxygen level. From the mercury content in raw coal, the total mercury concentration in flue gas was expected to be 7.2 $\mu g/m^3$ of dry flue gas (at a 3% oxygen level).

6. Claims 2–4, 6–7, 10–12, 14, and 18-29

These claims are reflected in the inventors' testing for the same reasons described above and also with respect to claim 1 of the '114 Patent as described in the Pavlish declaration. *See* Ex. 2018 at claim chart attached to Pavlish declaration.

V. This Petition Is Time-Barred

Petitioners bear the burden of demonstrating compliance with 35 U.S.C. § 312(a)(2) and § 315(b). *See, e.g.*, *Ventex Co., Ltd. v. Columbia Sportswear N. Am., Inc.*, IPR2017-00651, Paper 152 (PTAB Jan. 24, 2019) (precedential). According to the Federal Circuit, "[d]etermining whether a non-party is a 'real party in interest' demands a flexible approach that takes into account both equitable and practical considerations, with an eye toward determining whether the non-party is a clear beneficiary that has a preexisting, established relationship with the petitioner." *Applications in Internet Time, LLC v. RPX Corp.*, 897 F.3d 1336, 1351 (Fed. Cir. 2018) (emphasis added).

The Board follows this approach. *See, e.g.*, *Ventex*, IPR2017-00651, Paper 152, at 10 ("[T]he Court in *AIT* invites a 'flexible approach' in the real party in interest query that focuses on whether a 'non-party is a clear beneficiary that has a preexisting, established relationship with the petitioner.'"). In *Ventex*, the petitioner (Ventex) was a supplier to an accused infringer (Seirus) in parallel district court litigation and was obligated to indemnify and defend Seirus. Accordingly, the Board found that Seirus was a real party in interest with respect to Ventex. *Ventex*, IPR2017-00651, Paper 152, at 8.

Furthermore, privity may be demonstrated by "(1) an agreement between the parties to be bound; (2) pre-existing substantive legal relationships between the parties; (3) adequate representation by the named party; (4) the non-party's control of the prior litigation; (5) where the non-party acts as a proxy for the named party to relitigate the same issues; and (6) where special statutory schemes foreclose successive litigation by the non-party (*e.g.*, bankruptcy and probate)." *Applications in Internet Time*, 897 F.3d at 1360 (Reyna, J., concurring) (citing *Taylor v. Sturgell*, 553 U.S. 880, 894–95 (2008)). Any one factor or "category" can support a showing of privity. *Id.* Privity "prevent[s] successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation." *Id.* (quoting *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018)).

Here, Petitioner PacifiCorp is a co-owner of at least one of the Talen power plants accused of infringement in Patent Owner ME2C's Delaware action, *i.e.*, the Colstrip power plant. *See* Ex. 2023 (2020 First Amended Complaint alleging infringement of the '430 Patent by Talen). As the named operator of that power plant, Talen defended the lawsuit and settled the litigation. Indeed, Talen specifically identified PacifiCorp as a real party in interest in its 2020 IPR.[22] *See* IPR2020-00832, Petition at 3. Moreover, in ME2C's current lawsuit against PacifiCorp, PacifiCorp has alleged that Talen negotiated that settlement agreement on its behalf and for the benefit of PacifiCorp.[23] Because Petitioner PacifiCorp failed to identify Talen as a real party in interest in contravention of § 312(a)(2), and because Talen is time-barred under § 315, the present petition is time-barred.

As to the remaining Petitioners Berkshire Hathaway Energy Company, Interstate Power & Light Company ("IPL"), MidAmerican Energy Company ("MidAmerican"), WEC Energy Group, Inc. ("WEC"), and Wisconsin Power & Light Company ("WPL"), they and their-real parties-in-interest own power plants that used something called "the Chem-Mod Solution" to burn coal. This process involved the sale of refined coal (coal treated with bromine) to Petitioners under sales agreements that included indemnity provisions. This type of supply relationship can create privity. *See, e.g.*, *Semiconductor Components Indus., LLC*

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[22] Petitioners identified PacifiCorp as a "potential" real party in interest. Patent Owner objected to this designation as improper and requested that the petitions be denied for failure to clearly identify all real parties in interested as required by 35 U.S.C. § 312(a)(2). IPR2020-00832, POPR at 8-9. The Board overruled that objection and apparently treated the identified parties as real-parties-in-interest. IPR2020-00832, Paper 17 at 9–10 (PTAB Oct. 26, 2020).

[23] ME2C does not dispute that the Talen agreement includes a license covering infringing activity at the Colstrip power plant. ME2C does dispute PacifiCorp's broader claim that its other power plants are licensed.

v. Greenthread, LLC, IPR2023-01242, Paper 94, DR Decision at 3 (PTAB Apr. 24, 2025).

In its Delaware action, ME2C asserted that this Chem-Mod Solution caused direct infringement at Petitioners' power plants. Ex. 2003 at 12–13. Chem-Mod LLC and its various affiliates were named as Defendants in the Delaware Action. Ex. 2003.

In particular, WPL purchased refined coal from Chem-Mod LLC sub-licensee Portage Fuels Company, LLC for combustion at the Columbia power plant. That agreement provided indemnity to WPL as the Buyer of refined coal for infringement of intellectual property rights.

[redacted]

Ex. 2037 § 13.1.

MidAmerican purchased refined coal from Chem-Mod LLC sublicensees Louisa Refined Coal LLC, George Neal Refined Coal LLC, George Neal North

Refined Coal LLC, and Walter Scott Refined Coal LLC for combustion of refined coal at its Louisa, George Neal, and Walter Scott power plants. The agreements related to these sales also contain indemnity provisions. *See* Exs. 2038–2041. Petitioner Berkshire Hathaway Energy Company owns and controls MidAmerican, and Petitioner IPL co-owns the Louisa and George Neal power plants.

Wisconsin Public Service Corporation, the parent of Petitioner WEC, purchased refined coal from Chem-Mod LLC sublicensee Arbor Fuels Company, LLC for combustion of refined coal at its Weston power plant. The agreements memorializing this relationship also contain indemnity provisions. *See, e.g.*, Ex. 2042.

Beginning on July 17, 2019, Patent Owner sued and named as defendants Chem-Mod, Portage Fuels Company, LLC, Louisa Refined Coal LLC, Walter Scott Refined Coal LLC, and Arbor Fuels Company, LLC for infringement of the Challenged Patents in the United States District Court for the District of Delaware. Ex. 2003. On July 15, 2020, Patent owner amended its complaint to add the '430 Patent as well as Defendants George Neal Refined Coal LLC and George Neal North Refined Coal LLC. Ex. 2023.

These Petitioners have argued that Chem-Mod and its affiliates defended Patent Owner's infringement claims and negotiated a license on their behalf. *See* Ex. 2009 at 91. Other power plant operators such as Talen, NRG, and Vistra—the

2020 IPR petitioners—recognized that this relationship made Chem-Mod a real party in interest. *See, e.g.*, IPR2020-00832, Petition at 2.[24] For the exact same reason, Chem-Mod and its affiliates are real parties in interest with respect to Petitioners WPL Berkshire Hathaway Energy Company, MidAmerican, IPL, and WEC.

This is an additional reason why the present petition is time-barred under 35 U.S.C. § 315(b) and for failure to identify at least Chem-Mod, Portage Fuels Company, LLC, Louisa Refined Coal LLC, George Neal Refined Coal LLC, George Neal North Refined Coal LLC, Walter Scott Refined Coal LLC, and Arbor Fuels Company, LLC in violation of 35 U.S.C. § 312(a)(2).

VI. Conclusion

For the reasons stated above, Patent Owner respectfully requests that the Board deny the Petition.

---

[24] Talen and Vistra identified Chem-Mod as a "potential" real party in interest. NRG identified Chem-Mod as a real party in interest, and the Board agreed with NRG. IPR2020-00832, Paper 17 at 9–10 (PTAB Oct. 26, 2020).

Dated: July 9, 2025

Respectfully submitted,

Birchtech Corp.

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Patent Owner's Preliminary Response, exclusive of the exempted portions as provided in 37 C.F.R. § 42.24, contains 8,307 words and therefore complies with the type-volume limitations of 37 C.F.R. § 42.24. The word count was calculated by starting with Microsoft Word's total document word count and subtracting the words for the Cover Page, Table of Contents, Table of Authorities, Table of Exhibits, Table of Challenged Claims, Mandatory Notices, Certificate of Compliance, and Certificate of Service.

CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6(e)(4)

It is hereby certified that on this 9th day of July, 2025, a copy of the foregoing document was served via electronic mail, as consented to by Petitioner upon the following counsel of record:

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Date: July 9, 2025

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