

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

Birchtech Corp.

Patent Owner

IPR2025-00687
Patent No. 10,933,370

PETITION FOR *INTER PARTES* REVIEW

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1001	U.S. Patent No. 10,933,370 to Olson et al. (filed April 12, 2018) (“370 Patent” or “Challenged Patent”)
1002	Declaration of Dr. Stephen Niksa in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,933,370 (“370 Niksa Decl.”)
1003	Curriculum Vitae of Dr. Stephen Niksa
1004	Family Tree of ME2C Patents
1005	U.S. Patent Publication No. 2004/0013589 to Vosteen et al. (filed July 24, 2002) (“Vosteen589”)
1006	U.S. Patent Pub. No. 2008/0107579 to Downs et al. (published May 8, 2008) (“Downs-Boiler”)
1007	U.S. Patent Prov. App. No. 60/555,353 (filed Mar. 22, 2004) (“Downs-Boiler-Provisional”)
1008	Travis Starns, “Full-Scale Test of Mercury Control with Sorbent Injection and an ESP at Wisconsin Electric’s Pleasant Prairie Power Plant,” Session AE1-C, Paper No. 43249, AIR & WASTE MANAGEMENT’S ASSOCIATION’S 95 TH ANNUAL CONFERENCE (Baltimore, MD: June 23-27, 2002) (“Starns”)

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1010	Sharon Sjostrom, “Full Scale Evaluations of Mercury Control Technologies with PRB Coals,” Track A, Session A3 (Mercury – Control), Presentation A3b, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (“Sjostrom”)
1011	Craig Eckberg et al., “Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler,” Track A, Session A3 (Mercury – Control), Presentation A3c, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (“Eckberg”)
1012	U.S. Patent Pub. No. 2006/0048646 to Olson et al. (published Mar. 9, 2006) (“Olson-646”)
1013	U.S. Patent No. 6,953,494 to Nelson (filed May 6, 2003) (“Nelson”)
1014	U.S. Patent No. 7,514,052 to Lissianski et al. (filed Apr. 7, 2009) (“Lissianski”)

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1015	U.S. Patent Publication No. 2011/0030592 to Baldrey (filed Feb. 10, 2011) (“Baldrey”)
1016	RESERVED
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1018	RESERVED
1019	File History of U.S. Patent Application No. 15/974,343, which ultimately issued as U.S. Patent No. 10,668,430 (“430 Patent File History”).
1020	File History of U.S. Patent Prov. App. No. 60/605,640 (“Provisional”)
1021	File History of U.S. Patent Application No. 11/209,163, which ultimately issued as U.S. Patent No. 7,435,286 (“163 Application File History”)
1022	File History of U.S. Patent Application No. 12/201,595, which ultimately published as 2009/0062119 and was abandoned (“595 Application File History”)
1023	Excerpts of File History of U.S. Patent Application No. 15/951,970, which ultimately issued as U.S. Patent No. 10,933,370 (“370 Patent File History”)

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1024	RESERVED
1025	File History of U.S. Patent Application No. 12/419,219, which ultimately issued as U.S. Patent No. 8,168,147 (“ 147 Patent File History ”)
1026	File History of U.S. Patent Application No. 15/978,760 (issued as U.S. Patent No. 10,343,114) (“ 114 Patent File History ”)
1027	Babcock & Wilcox, STEAM: ITS GENERATION AND USE, 40th ed. (The Babcock & Wilcox Company: 1992) (“ B&W: Steam ”)
1028	J. Bustard, S. Sjostrom, et al., “Full Scale Evaluation of Sorbent Injection for Mercury Control on Coal-Fired Power Plants,” International Conference on Air Quality III, Paper No. A5-4 (Sept. 9-12, 2002: Arlington, VA) (“ Bustard ”)
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1030	Electric Utilities Environment Conference 2005 Handout (“ EUEC Handout ”)
1031	Scan of jacket/cover of CD mailed to conference attendees from EUEC: 8th Electric Utilities Environmental Conference (Tucson, Arizona: January 23-26, 2005) (“ EUEC CD Scan ”)
1032	Redline comparison between U.S. Patent Pub. No. 2008/0107579 (Downs-Boiler, EX1006) and U.S. Patent Prov. Appl. No. 60/555,353 (Downs-Boiler-Provisional, EX1007), using Downs-

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1034	U.S. Patent No. 8,821,819
1035	U.S. Patent No. 9,757,689
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1039	Thomas J. Feeley, et al., “A Review of DOE/NETL’s Mercury Control Technology R&D Program for Coal-Fired Power Plants,” <i>DOE/NETL Hg R&D Program Review</i> (April 2003) (“Feeley”)
1040	Oxtoby et al., PRINCIPLES OF MODERN CHEMISTRY, 4 th ed (Saunders College Publishing: 1999) (“Oxtoby”)

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1042	B.R. Puri, <i>Surface Complexes on Carbons</i> , in CHEMISTRY AND PHYSICS OF CARBON 191 (Philip L. Walker, ed.) (Marcel Dekker: 1970) (“ Puri ”)
1043	Frank E. Huggins et al., “XAFS Examination of Mercury Sorption on Three Activated Carbons,” <i>Energy & Fuels</i> 1999(13), p. 114-121 (1999) (“ XAFS ”)
1044	S. Niksa et al., <i>Predicting Complete Hg Speciation Along Coal-Fired Utility Exhaust Systems</i> , MEGA SYMPOSIUM, Paper # 45 (Washington, DC: Aug. 2004) (“ Hg Speciation ”)
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1046	U.S. Patent No. 4,196,173 to DeJong (“ DeJong ”)
1047	U.S. Patent No. 5,695,726 to Lerner (“ Lerner ”)
1048	Carey, T. R., Jr., O. W. H., Richardson, C. F., Chang, R., & Meserole, F. B. (1998). Factors Affecting Mercury Control in Utility Flue Gas Using Activated Carbon. <i>Journal of the Air & Waste Management Association</i> , 48(12), 1166–1174. https://doi.org/10.1080/10473289.1998.10463753 (“ Carey ”)

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1049	NETL - Mercury Emissions Control, February, 2003, available at https://web.archive.org/web/20030315093905fw_/http://www.netl.doe.gov/coalpower/environment/mercury/control-tech/inactive.html (“U.S. DOE, Completed Mercury Projects, February, 2003”)
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1052	U.S. EPA, “Mercury Study Report to Congress Volume 1: Executive Summary,” EPA-452/R-97-003 (Dec. 1997), available at https://www.epa.gov/sites/production/files/2015-09/documents/volume1.pdf (“U.S. EPA – Exec. Summary Vol. 1 Dec. 1997”)
1053	U.S. EPA, AP-42: External Combustion Sources, Chapter 1: Fifth Edition, Volume I (Sep. 1998), available at https://www3.epa.gov/ttn/chief/ap42/ch01/index.html (last visited Nov. 20, 2024) (“Chapter 1 of AP-42”)
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1058	EPA Newsroom, “EPA Supplements Proposal to Reduce Power Plant Mercury Emissions,” (Feb. 24, 2004), available at https://archive.epa.gov/epapages/newsroom_archive/newsreleases/5810096dabfc9eba85256e440078905f.html (“ 2/24/2004 EPA Press Release ”)
1059	Sharon Sjostrom et al., “Field Studies of Mercury Control Using Injected Sorbents,” AWMA ANNUAL MEETING, Session Ae-1b (2002) (“ Field Studies of Mercury Control ”)
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1062	Charlene R. Crocker et al., “Mercury Control with the Advanced Hybrid Particulate Collector Technical Progress Report,” U.S. DOE-NETL (Nov. 2003) (“ Crocker ”)
1063	Redline Comparison, showing changes from ’163 Application (as published at 2006/0048646) to ’970 Application (as published at 2018/0229182)
1064	Redline Comparison, showing changes from ’558 Application (as published at 2015/0246315) to ’970 Application (as published at 2018/0229182)
1065	U.S. Patent No. 8,168,147
1066	RESERVED
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1071	<i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB, Dkt. No. 440 (D. Del. June 24, 2022) (“Dkt No. 440”)
1072	<i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB, Dkt. No. 447 (D. Del. July 12, 2022) (“Dkt No. 447”)
1073	Welcome Page of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 th Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“AWMA CD Scan”)
1074	Main Menu of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 th Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“AWMA CD Scan, Main Menu”)
1075	Author Index of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 th Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“AWMA CD Scan, Author Index”)
1076	Papers by Session of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 th Annual Conference

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1077	Scan of jacket/cover of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95th Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“AWMA CD Photo”)
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1079	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020527005933/http://www.awma.org/ (“AWMA Homepage”, advertising AWMA 2002 Conference)
1080	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020604012426/http://www.awma.org:80/about/ (“AWMA About Page”)
1081	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020601173851/http://www.awma.org/ACE2002/tech-program/MondayPM.asp#AE-1c (“AWMA Technical Program Schedule for June 24, 2002 for Session AE-1C”)
1082	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020616091740/http://www.awma.org/ACE2002/exhibition/list.asp (“AWMA 2002 Conference list of exhibitors”)

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1083	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020601121532/http://www.awma.org/ACE2002/top10list.asp (“AWMA 2002 Conference Top Ten Reasons”)
1084	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020610093515/http://www.awma.org/ACE2002/welcome.asp (“AWMA 95th Annual Conference and Exhibition Welcome Page”)
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1086	AWMA Website (Internet Archive), available at https://web.archive.org/web/20020806041256/http://www.awma.org:80/pubs/bookstore/ (“AWMA Bookstore Homepage”)
1087	State of Massachusetts Mass-EPA (Internet Archive) (dated Jan. 6, 2003), available at https://web.archive.org/web/20030106044457/http://www.state.ma.us/dep/bwp/about.htm (describing mission of Mass Department of Environmental Protection, Bureau of Waste Prevention)
1088	State of Massachusetts Mass-EPA (Internet Archive) (dated Dec. 21, 2002), available at https://web.archive.org/web/20021221040816/http://www.state.ma.us/dep/bwp/bwpprogs.htm (describing the divisions and programs of the Mass Bureau of Waste Prevention)

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1089	State of Massachusetts Mass-EPA (Internet Archive) (dated Jan. 6, 2003), available at https://web.archive.org/web/20030106024342/http://www.state.ma.us/dep/bwp/bwppubs.htm (describing the publications by program of the Mass Bureau of Waste Prevention)
1090	State of Massachusetts Mass-EPA (Internet Archive) (dated Dec. 20, 2002), available at https://web.archive.org/web/20021220143210/http://www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#ecp (describing the Air Program Planning Unit Publications of the Mass Bureau of Waste Prevention)
1091	Internet Archive Standard Affidavit, explaining how to interpret hyperlinks, available at https://archive.org/legal/affidavit.php
1092	Expert Report of Philip J. O’Keefe, PE Regarding Infringement (Oct. 25, 2022) (excerpted), submitted by Patent Owner in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB
1093	Deposition Transcript of Phillip O’Keefe Vol. 1 (Mar. 2, 2023), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1094	Deposition Transcript of Phillip O’Keefe Vol. 2 (Mar. 3, 2023), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.

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1095	Deposition Transcript of Edwin Olson (Aug. 26, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1096	Deposition Transcript of Michael Holmes (Aug. 24, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1097	Deposition Transcript of John Pavlish (Aug. 25, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1098	Affidavit of Tanya Zeif, Custodian of Records for Internet Archive (1/10/2025), sponsoring Exhibits 1078-1086
1099	Affidavit of Tanya Zeif, Custodian of Records for Internet Archive (1/13/2025), sponsoring Exhibits 1009, 1061, 1087-1090
1100	RESERVED
1101	RESERVED
1102	RESERVED
1103	RESERVED

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1104	<i>IN RE: MIDWEST ENERGY EMISSIONS CORP. PATENT LITIGATION</i> , No. 4:24-md-03132-SHL-WPK, Dkt. No. 60 (S.D. Iowa Mar. 7, 2025) (“ Dkt No. 60 ”)
1105	<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00926, Paper 13 (P.T.A.B. Sep. 4, 2020)
1106	Clarion Energy Content Directors, “A Variety of Hg Capture Solutions Are Available” (June 1, 2009), available at https://www.power-eng.com/environmental-emissions/a-variety-of-hg-capture-solutions-are-available/ (“ Variety of Hg Capture Solutions ”)
1107	Modern Power Systems, “Full scale tests show KNXTM is effective for mercury control” (October 1, 2009), available at https://www.modernpowersystems.com/analysis/full-scale-tests-show-knxtm-is-effective-for-mercury-control/ (“ KNXTM is effective ”)

Other than prosecution histories, EX1019-EX1023, EX1025-EX1026, all citations to exhibits reference original page numbers found in the underlying document, and all emphases are added.

TABLE OF CHALLENGED CLAIMS

Claim Element	Claim Language from '370 Patent
1(Preamble)	1(pre). A method for separating mercury from a mercury-containing gas, the method comprising:
1(a)	combusting a mixture of coal and an additive in a combustion chamber, to form the mercury-containing gas, wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof;
1(b)	adding a particulate sorbent material comprising activated carbon into the mercury-containing gas,
1(c)	wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;
1(d)	contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and
1(e)	separating the mercury-sorbent from the mercury-containing gas.
2	2. The method of claim 1, further comprising adding the additive to the coal before combusting the coal.
3	3. The method of claim 2, wherein the additive mixed with the coal is in a liquid.
4	4. The method of claim 3, wherein the liquid is a hydrocarbon, supercritical carbon dioxide, water, salt solution, or a combination thereof.
5	5. The method of claim 1, wherein carbocations in the activated carbon of the mercury-sorbent accept electrons from mercury atoms of the mercury-sorbent.

Claim Element	Claim Language from '370 Patent
6	6. The method of claim 1, wherein the additive is substantially in vapor form in the mercury-containing gas.
7	7. The method of claim 1, wherein the additive is chosen from Cl ₂ , HCl, sodium chloride, calcium chloride, and a combination thereof.
8	8. The method of claim 1, wherein the additive is chosen from Br ₂ , HBr, sodium bromide, calcium bromide, and a combination thereof.
10	10. The method of claim 1, wherein the additive is chosen from I ₂ , HI, sodium iodide, calcium iodide, potassium iodide, and combinations thereof.
11	11. The method of claim 1, wherein the activated carbon is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof.
12	12. The method of claim 1, further comprising adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth elements, alkali salts, alkaline earth salts, and combinations thereof.
13	13. The method of claim 1, further comprising contacting the sorbent material with a mercury-stabilizing reagent chosen from S, Se, H ₂ S, SO ₂ , H ₂ Se, SeO ₂ , CS ₂ , P ₂ S ₅ , and combinations thereof.
14	14. The method of claim 1, further comprising contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.

Claim Element	Claim Language from '370 Patent
15	15. The method of claim 14, wherein the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.
16	16. The method of claim 14, wherein the secondary component is chosen from I ₂ , HI, and combinations thereof.
17(preamble)	17. A method for separating mercury from a mercury-containing gas, the method comprising:
17(a)	combusting coal comprising an additive in a combustion chamber, wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof, to form the mercury-containing gas, wherein the additive comprises a and b, b and c, a and c, or a, b, and c: a) I ⁻ and/or I ₂ , b) Br ⁻ and/or Br ₂ , c) Cl ⁻ and/or Cl ₂ ;
17(b)	injecting a sorbent material comprising activated carbon into the mercury-containing gas,
17(c)	wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;
17(d)	contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and
17(e)	separating the mercury-sorbent from the mercury-containing gas.

Claim Element	Claim Language from '370 Patent
18	18. The method of claim 1, wherein the additive comprises a and b, b and c, a and c, or a, b, and c: a) I^- and/or I_2 , b) Br^- and/or Br_2 , c) Cl^- and/or Cl_2 .

I. INTRODUCTION

Petitioners request IPR of Claims 1-8 and 10-18 of U.S. Patent 10,933,370 (“**370 Patent**” or “**Challenged Patent**”). EX1001. The Petition is supported by the expert declaration of Dr. Stephen Niksa.¹ EX1002 (declaration); EX1003 (CV).

II. MANDATORY NOTICES [37 C.F.R. §42.8(A)(1)]

A. REAL PARTY-IN-INTEREST [37 C.F.R. §42.8(B)(1)]

The real parties-in-interest are the Petitioners: PacifiCorp; Interstate Power & Light Company; MidAmerican Energy Company; WEC Energy Group, Inc.; and Wisconsin Power & Light Company (collectively, “**Petitioners**”).

Petitioners also identify the following real-parties-in-interest (in addition to the Petitioners themselves): Alliant Energy Corporation; Alliant Energy Corporate Services, Inc; and Berkshire Hathaway Energy Company. These entities were previously parties to the lawsuit in the Southern District of Iowa where they have been accused of infringing the Challenged Patent.

Petitioner PacifiCorp identifies the following additional real-parties-in-interest: Berkshire Hathaway Energy Company; MidAmerican Funding, LLC; MHC Inc.; and PPW Holdings LLC.

¹ Named inventor of the Challenged Patent, Mr. Pavlish, admitted that Dr. Niksa is knowledgeable in the field. EX1097, 253:21–254:17.

Petitioner Interstate Power & Light Company identifies the following additional real-parties-in-interest: Alliant Energy Corporation and Alliant Energy Corporate Services, Inc.

Petitioner MidAmerican Energy Company identifies the following additional real-parties-in-interest: MidAmerican Funding, LLC and MHC Inc.

Petitioner Wisconsin Power & Light Company identifies the following additional real-parties-in-interest: Alliant Energy Corporation; Alliant Energy Corporate Services, Inc.; and Madison Gas and Electric Company.

Other than Petitioners and the above-identified real-parties-in-interest, no other person or entity is funding this petition, advising on strategy for this petition, or exercising any control over Petitioners' decision to file the petition (or the arguments included therein).

Petitioner WEC Energy Group, Inc., out of an abundance of caution, also identifies Wisconsin Public Service Corporation as a potential real party-in-interest to the Petitioner WEC Energy Group, Inc. This potential real-party-in-interest is not funding this petition, advising on strategy for this petition, or exercising any control over Petitioners' decision to file the petition (or the arguments included therein).

B. RELATED MATTERS [37 C.F.R. §42.8(B)(2)]

Petitioners are concurrently filing a second petition against the Challenged Patent. The current petition assumes *arguendo* that the Challenged Claims of the

'370 Patent have priority to August 30, 2004, the earliest-filed Provisional Application, and that the pre-AIA statute applies. The second petition asserts a priority date of no earlier than April 12, 2018, the filing date of the '370 Patent (EX1066), because the earlier-filed applications to which the '370 Patents claims priority do not contain written-description support for the Challenged Claims.

Petitioners previously filed two petitions against U.S. Patent No. 10,343,114 (“the '114 Patent”), a counterpart with substantially similar claims. Petitioners also filed two petitions against U.S. Patent No. 10,596,517 (“the '517 Patent”), two petitions against U.S. Patent No. 10,668,430 (“the '430 Patent”), and two petitions against U.S. Patent No. 10,589,225 (“the '225 Patent”)—counterpart patents with substantially similar claims:

- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00274, Paper 1 (P.T.A.B. Jan. 17, 2025).
- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00278, Paper 1 (P.T.A.B. Jan. 17, 2025).
- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00280, Paper 1 (P.T.A.B. Jan. 24, 2025).
- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00281, Paper 1 (P.T.A.B. Jan. 24, 2025).
- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00422, Paper 1 (P.T.A.B. Feb. 11, 2025).
- *Berkshire Hathaway Energy Co. et al. v. Birchtech Corp.*, IPR2025-00423, Paper 1 (P.T.A.B. Feb. 11, 2025).

- *PacifiCorp et al. v. Birchtech Corp.*, IPR2025-00424, Paper 1 (P.T.A.B. Mar. 4, 2025).
- *PacifiCorp et al. v. Birchtech Corp.*, IPR2025-00425, Paper 1 (P.T.A.B. Mar. 4, 2025)

Though no petitions for IPR have previously been filed against the '370 Patent, the Board previously granted institution of IPR on two petitions against the related '114 Patent that had been filed by NRG, Vistra, and Talen in the following proceedings:

- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00832, Paper 17, 2020 WL 6277239 (P.T.A.B. Oct. 26, 2020). EX1026, 16-63.
- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00834, Paper 18, 2020 WL 6277747 (P.T.A.B. Oct. 26, 2020). EX1026, 64-108.

Prior to institution, Vistra and Midwest Energy Emissions Corp. ("ME2C" or "Patent Owner" ("PO")) filed a joint motion to terminate as to Vistra as a result of settlement. Shortly after institution, before ME2C filed any patent owner response (37 CFR §42.120), the remaining petitioners (NRG and Talen) and ME2C jointly requested that the proceedings be terminated pursuant to a settlement. EX1026, 1-10.

After NRG, Vistra, and Talen filed the petitions in IPR2020-00832 and IPR2020-00834, AEP Generation Resources Inc. filed two petitions which it characterized as "copycat" petitions. AEP stated that if the petitions were granted

in IPR2020-00832 and IPR2020-00834, then AEP “will file a motion for joinder under 37 CFR §§42.22 and 42.122(b) to join the instituted prior IPRs.” IPR2020-01294 and IPR2020-01295, Paper 2 (July 15, 2020). AEP withdrew its petitions prior to institution. EX1026, 12-15.

The Board also granted institution of IPR on two petitions against U.S. Patent No. 8,168,147 (“the ’147 Patent”)—a parent patent to the ’370 Patent with overlapping priority-date issues—that had been filed by NRG, Vistra, and Talen in the following proceedings:

- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00926, Paper 19, 2020 WL 7061347 (P.T.A.B. Dec. 2, 2020).
- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00928, Paper 17, 2020 WL 7074473 (P.T.A.B. Dec. 2, 2020).

As with the IPR2020-00832 and IPR2020-00834 proceedings, the IPR2020-00926 and IPR2020-00928 proceedings were jointly terminated pursuant to settlement shortly after institution.

Patent Owner has asserted the Challenged Patent in district court in the following matters:

- *Midwest Energy Emissions Corp. v. Tucson Electric Power Co. et al.*, No. 3:24-cv-08145-DJH (D. Ariz.) (filed July 17, 2024).
- *Midwest Energy Emissions Corp. v. Berkshire Hathaway Energy Co. et al.*, No. 4:24-cv-00248 (S.D. Iowa) (filed July 17, 2024).
- *Midwest Energy Emissions Corp. v. Ameren Corp. et al.*, No. 4:24-cv-00980 (E.D. Mo.) (filed July 17, 2024).

- *In re Midwest Energy Emissions Corp. Pat. Litig.*, No. 4:24-md-3132 (S.D. Iowa) (consolidating the Iowa, Arizona, and Missouri cases on Dec. 17, 2024).
- *Midwest Energy Emissions Corp. v. Berkshire Hathaway Energy Co., et al.*, No. 2:25-cv-00015 (D. Wy.) (filed Jan. 14, 2025).
- *Midwest Energy Emissions Corp. v. Wisconsin Power & Light Co.*, No. 3:25-cv-00026 (W.D. Wis.) (filed Jan. 14, 2025).
- *Birchtech Corp. f/k/a/ Midwest Energy Emissions Corp. v. Evergy, Inc., et al.*, No. 4:25-cv-00050 (W.D. Mo.) (filed Jan. 23, 2025).
- *Midwest Energy Emissions Corp. v. Evergy, Inc. et al*, No. 4:25-cv-00046 (S.D. Iowa) (filed Feb. 6, 2025).

Other than WEC (who is not a defendant in any case), Petitioners have been defendants in the Iowa case. On January 10, 2025, the district court in Iowa granted a motion to dismiss, dismissing Berkshire Hathaway Energy (“BHE”) outright from the litigation and transferring PacifiCorp to the District of Wyoming. *See In re Midwest Energy Emissions Corp. Pat. Litig.*, No. 4:24-md-3132, ECF 19 (S.D. Iowa Jan. 10, 2025). In that same order, the Iowa court transferred Wisconsin Power & Light Co. to the District of Wisconsin.

According to U.S. Patent & Trademark Office Patent Center, the ’370 Patent was filed as App. No. 15/951,970 (“the ’970 Application”) on April 12, 2018, and purports to claim priority as follows:

- Continuation of U.S. Patent Application No. 14/712,558, filed on May 14, 2015 (“the ’558 Application”) and issued on March 17, 2020, as U.S. Patent No. 10,589,225, which is a:

- Continuation of U.S. Patent Application No. 14/318,270, filed on June 27, 2014 (“the ’270 Application”) and issued on September 12, 2017, as U.S. Patent No. 9,757,689, which is a:
- Continuation of U.S. Patent Application No. 13/966,768, filed on August 14, 2013 (“the ’768 Application”) and issued on September 2, 2014, as U.S. Patent No. 8,821,819, which is a:
- Continuation of U.S. Patent Application No. 13/427,665, filed on March 22, 2012 (“the ’665 Application”) and issued on August 20, 2013, as U.S. Patent No. 8,512,655, which is a:
- Continuation of U.S. Patent Application No. 12/419,219, filed on April 6, 2009 (“the ’219 Application”) and issued on May 1, 2012, as U.S. Patent No. 8,168,147, which is a:
- Continuation of U.S. Patent Application No. 12/201,595, filed on Aug. 29, 2008 (“the ’595 Application”) and abandoned on September 30, 2010, which is a:
- Division of U.S. Patent Application No. 11/209,163, filed on Aug. 22, 2005 (“the ’163 Application”) and issued on September 24, 2008, as U.S. Patent No. 7,435,286, which is a non-provisional of:
- U.S. Provisional Patent Application No. 60/605,640, filed on August 30, 2004 (the “Provisional”).

The prior proceedings all involved ME2C. On November 7, 2024, ME2C filed a notice with the USPTO that it had changed its name to Birchtech Corp. *See* Reel 069187, Frame 0413. Yet, ME2C is still proceeding in the district-court litigations as a plaintiff under the ME2C name.

C. LEAD AND BACK-UP COUNSEL [37 C.F.R. §42.8(B)(3)]

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D. SERVICE INFORMATION [37 C.F.R. §42.8(B)(4)]

Petitioners may be served at lead counsel's address provided above and consent to e-mail service, provided it is made to all the following e-mail addresses:

dtobin@mwe.com; boaks@mwe.com; PacifiCorp-PTAB-ME2C@mwe.com;

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III. FEES

Payment for fees is authorized from Deposit Account 50-0417.

IV. REQUIREMENTS FOR *INTER PARTES* REVIEW [37 C.F.R. §42.104(A), (B)(1)-(B)(3)]

A. STANDING

Petitioners certify the '370 Patent is eligible for IPR, and Petitioners are not barred or estopped from requesting IPR challenging the identified claims on the grounds herein.

B. IDENTIFICATION OF CHALLENGED CLAIMS AND GROUNDS

There is a reasonable likelihood that the petitioned claims are unpatentable as follows:

Ground	'370 Claims	Basis for Challenge
1.	1-8, 10-18	§103: Obvious over Vosteen589 (EX1005) and Sarns (EX1008)
2.	1-8, 10-18	§103: Obvious over Vosteen589 and Mass-EPA (EX1009)
3.	1-6, 8, 11	§103: Obvious over Downs-Boiler (EX1006) and Sarns
4.	1-6, 8, 11-12, 14-16	§103: Obvious over Downs-Boiler and Mass-EPA
5.	1, 5-6, 11	§103: Obvious over Lissianski (EX1014) and Sarns
6.	1, 5-6, 11-12, 14-16	§103: Obvious over Lissianski and Mass-EPA

EX1002 ¶13.

C. CLAIM CONSTRUCTION [37 CFR §42.104(B)(3)]

Petitioners do not, at this time, contend that any term requires construction. All terms have been accorded their plain and ordinary meaning. EX1002 ¶¶212-215.

V. OVERVIEW OF '370 PATENT

A. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSITA”) would have at least a bachelor’s degree in chemical engineering, mechanical engineering, or a related field of study with at least two years of experience implementing pollution control in power generation plants for natural gas, coal, and/or industrial waste incineration. EX1002 ¶¶48-51.

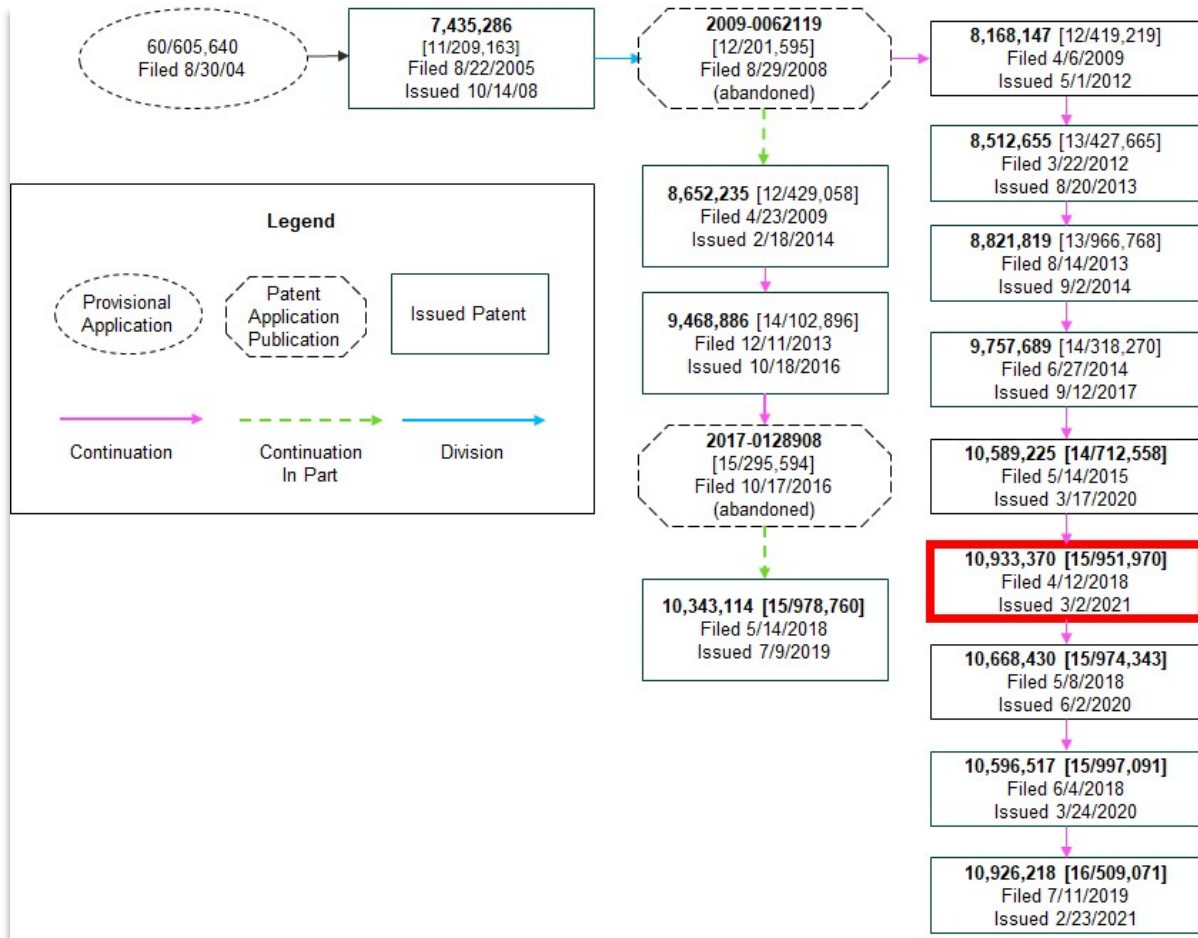
B. THE ALLEGED INVENTION OF THE '370 PATENT

The '370 Patent relates to removing mercury from flue gas. EX1001, 1:41-45. The Patent admits that known “mercury control methods” included injecting activated-carbon sorbent, including “expos[ing] a finely powdered activated carbon to a molecular bromine gas at an elevated temperature or to HBr to produce a sorbent with good mercury removal ability.” EX1001, 2:2-7, 30:27-32. Each independent claim includes: adding an additive chosen from halides, halogens, salts thereof, and combinations thereof to coal; combusting the coal; and contacting mercury in the resulting mercury-containing gas with activated-carbon sorbent, added within a

claimed range of weight ratios compared with the additive. Even this combination of elements was known in the art. EX1002 ¶¶152-156, 208-211.

C. PROSECUTION HISTORY OF THE '370 PATENT

The '370 Patent was filed April 12, 2018, as Application 15/951,970 (“’970 Application”), stemming through seven earlier non-provisional applications to App. No. 60/605,640 (the “Provisional”) filed August 30, 2004. EX1002 ¶¶157-165.



EX1004 (annotated). In the '970 Application (4/12/2018), PO significantly amended the specification. See EX1063-EX1064 (redline comparisons).

During prosecution, the claims were amended in November 2020 to add a ratio to the claims:

Independent claim 1 is presently amended to recite “...wherein a weight ratio of I, I₂, Br, Br₂, Cl, Cl₂, or a combination thereof in the additive fed to the combustion chamber to an amount of the sorbent material added to the mercury-containing gas is from 1:100 to 30:100...”
Independent claim 20 is correspondingly amended. Support can be found in the present published U.S. application at paragraphs [0021], [0025], and [0072].

Applicants distinguished prior art based on this amendment. EX1023, 1592-1609.²

Two months earlier, in September 2020, PO argued to the PTAB for a parent to the ’370 Patent (in order to seek an earlier invention date) that the 1-30 ratio should be given “no patentable weight.”

Here, Petitioners’ expert testified—and ME2C does not dispute—that the 1%-30% range limitation is not entitled to any patentable weight. See Ex. 1003 at ¶ 369 (“Through routine process optimization and routine experimentation, a POSITA would have adjusted the rate of addition of the promoter and/or the rate of addition of the sorbent material to achieve a range from about 1 g to about 30 g of promoter per 100 grams of the sorbent material . . . The range presented nothing more than optimization of result-effective variables that would have been obvious to a POSITA.”).

EX1105 (IPR2020-00926, Paper 13), 34-35. The ’370 Patent examiner was not provided with this information and ultimately allowed the claims based on the 1-

² The claims were ultimately amended by the Examiner to replace the specified ions and molecular halogens with “additive.” EX1023, 1576.

30% ratio. EX1002 ¶¶162-165; EX1023, 1574; *see Belcher Pharms., LLC v. Hospira, Inc.*, 11 F.4th 1345 (Fed. Cir. 2021) (“alleged critical improvement over the prior art was therefore already within the public domain, just not before the examiner”).

D. STATE OF THE ART

The inquiry into whether the “differences between the invention and the prior art would have rendered the invention obvious to a [POSITA] necessarily depends on such artisan’s knowledge,” including “assessment of the background knowledge possessed” by a POSITA. *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337 (Fed. Cir. 2020) (citations omitted). The subjects below would have been “within the general knowledge of a skilled artisan” by 2004. *Id.* at 1338. EX1002 ¶52.

1. Mercury and Halogens

It was known that halogens exist in nature as diatomic molecules (e.g., Cl₂, Br₂), halides/halide compounds (e.g., sodium chloride), and hydrohalides (e.g., hydrogen bromide). EX1040; EX1002 ¶¶53-68 (chemistry fundamentals). It was known that mercury is metallic and generally exists in two forms: elemental (Hg⁰); and oxidized (Hg₂²⁺ (mercurous) or Hg²⁺ (mercuric)). EX1052, 2-1; EX1002 ¶65.

2. Coal-Fired Power Plants

It was known that pulverized-coal firing was performed by feeding particle-sized coal to a combustion chamber, known as a “boiler.” EX1027, 11-13, 12-2, 12-8, 13-1, 18-1. Combustion gases with entrained particles, mercury (Hg), and other pollutants, are referred to as flue gases. EX1027, 19-1; EX1053, 1.1-1 to 1.1-11; EX1002 ¶¶69-77.

Various downstream components were used to control undesirable flue-gas constituents, including electrostatic precipitators (“ESP”) and fabric filters (“FF”) for particulates. EX1027, 33-1 to 33-7; EX1053, 1.1-6 to 1.1-9; EX1037; EX1045; EX1002 ¶¶78-96, 211.

3. EPA Regulations

It was known that mercury posed health concerns. EX1051, ES-27, 7-45; EX1052, 2-6; EX1053, 1.1-1 to 1.1-11. In 2000, the EPA announced plans to further regulate mercury emissions from coal-fired plants. EX1039, 2-8. The timetable to update mercury-emissions standards was set for December 2003, to be finalized December 2004. EX1039, 8; EX1050; EX1054. The EPA passed the Clean Air Mercury Rule in 2005, but gave the industry advanced notice. EX1055-EX1058. State governments were also interested in regulating mercury emissions. EX1009. The power-generation industry mobilized a massive response to evaluate mercury-emissions controls in the early 2000s. EX1039; EX1049; EX1002 ¶¶116-128.

4. Mercury Removal Using Activated Carbon and Halogens

Even before EPA regulations, activated-carbon sorbents were used to remove mercury, and researchers were investigating improving their effectiveness. EX1060, 2-54; EX1038; EX1002 ¶¶97-103.

By 1998, “[a]ctivated carbons ha[d] been the most thoroughly studied sorbent for the capture of mercury.” EX1038, 22; EX1002 ¶98. Two of the named inventors on the Challenged Patent, Dr. Olson and Mr. Holmes, admitted that “activated carbon was the most common [or heavily] studied sorbent for mercury control.” EX1096 (Holmes), 41:5-9; EX1095 (Olson), 114:21-25; *see* EX1097 (Pavlish), 210:4-18; EX1001, 2:5-10, 28:11-19 (known “mercury control methods” included activated carbon); EX1002 ¶¶209-210. It was known to fine-tune mercury removal by controlling sorbent-injection rate. EX1059; EX1009, 33, 73; EX1002 ¶¶104-115.

Dr. Olson admitted his research group “was not the first group to conceive of adding a bromine compound to the furnace or to the flue gas.” EX1095, 145:25-146:4. By 1934, halogens were known to improve activated carbon in removing mercury. *See* EX1029, 1:33-41; *see* EX1002 ¶132. By 1970, it was shown that carbon adsorbed up to a saturation limit (adsorption equilibrium) of around 31-38% of bromine. EX1002 ¶¶109-111; EX1042, 255-262; EX1070, iii-viii, 238, 259, 391. In 1999, researchers demonstrated that flue-gas mercury formed chemical bonds

with halogenated species on activated carbons. EX1043, 119; EX1041, 804, 1212-1213. By 2004, these findings were generalized to interpret capturing elemental and oxidized mercury on injected activated-carbon sorbents. EX1044, 4-5; EX1062 at 2-3 (halides “improve[d] Hg capture both by conversion of the Hg^0 to the more easily removed Hg^{2+} forms and by enhancing the reactivity of Hg^0 with activated carbons”). It was known that halogens, particularly bromine-containing ingredients, improved the effectiveness of activated carbon in removing mercury. EX1002 ¶¶129-151 (discussing EX1005-EX1006; EX1008; EX1012-EX1014; EX1028; EX1036; EX1046-EX1048; EX1106-1107).

VI. THE ASSERTED REFERENCES

Petitioner asserts five prior-art references in this petition:

Reference	Prior-Art Status (pre-AIA)
Vosteen589 , EX1005 US2004/0013589A1	§102(e) Filed: 7/24/2002
Downs-Boiler , EX1006 US2008/010579A1	§102(e) Filed: 3/21/2005, claiming priority to 3/22/2004
Starns , EX1008	§§102(a)-(b) Presented 6/24/2002 at AWMA, mailed to attendees in Summer 2002, and available for purchase online at least by August 2002

Reference	Prior-Art Status (pre-AIA)
Mass-EPA, EX1009	§§102(a)-(b) Published December 2002 and publicly accessible at least by 1/6/2003
Lissianski, EX1014	§102(e) Filed: 1/6/2004

If PO seeks to swear behind any asserted references, PO bears the burden to produce evidence of entitlement to priority before the actual filing date. *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1304-05 (Fed. Cir. 2008). Petitioner may rebut such arguments at that time, including that the '370 Patent cannot claim priority to any pre-AIA parent application, so cannot swear behind references; or that Vosteen589 and Downs-Boiler are §102(b) (pre-AIA) prior art.

VII. GROUNDS 1-2: OBVIOUSNESS OVER VOSTEEN589/STARNS/MASS-EPA

Ground 1 asserts obviousness of Claims 1-8 and 10-18 over Vosteen589 (EX1005) and Starns (EX1008), and Ground 2 asserts obviousness of these same claims over Vosteen589 and Mass-EPA (EX1009). EX1002 ¶293.

A. OVERVIEW OF EX1005 (“VOSTEEN589”)

Vosteen589 (filed 7/24/2002) describes removing “mercury from the flue gases” in “bituminous coal-fired or lignite-fired power stations.” EX1005 ¶¶[0007]-

[0008]. Vosteen589 adds “bromine and/or a bromine compound and/or a mixture of various bromine compounds” directly to coal. EX1005 ¶¶[0006], [0013]. Vosteen589 explains that bromine-containing and iodine-containing chemicals each help remediate mercury: “Iodine compounds oxidize mercury more effectively compared with bromine compounds. However, from economic aspects, bromine compounds are preferably used in the inventive process.” EX1005 ¶[0016]. “[A]ctivated carbon” (a “dry sorbent”) is used with the “dry or semi-dry adsorption-based emission control stage.” EX1005 ¶¶[0019]-[0020]; EX1002 ¶¶216-217, 219-220.

B. OVERVIEW OF EX1008 (“STARNS”) AND EX1009 (“MASS-EPA”)

A printed publication qualifies as prior art “so long as the relevant public has a means of accessing” it. *GoPro, Inc. v. Contour IP Holding LLC*, 908 F.3d 690, 693 (Fed. Cir. 2018). Each reference meets the *GoPro* standard and qualifies as a printed publication under 35 U.S.C. §§102(a)-102(b) (pre-AIA). EX1002 ¶¶246-259.

1. Starns (Grounds 1, 3, and 5)

Starns was delivered at the June 2002 Air & Waste Management Conference in Baltimore, Maryland (“AWMA”).

**Technical Program
Monday, June 24, 2002**

AE-1c Panel

Results from Full-Scale Mercury Control Testing: Overview and Panel Discussion

Sponsoring Committee: AE-1

Chair: Sharon Sjostrom, Apogee

Co-Chair: C. Jean Bustard, ADA-ES

Panel will begin at 1:30 p.m.

1:30 p.m. Travis Starns, ADA-ES: Full Scale Tests of Mercury Control with Sorbent Injection and an ESP at Wisconsin Electric's Pleasant Prairie Power Plant

EX1081; EX1098, 20; *see* EX1073. Dr. Niksa attended the conference and confirms that hundreds of other POSITAs attended, including engineers, technical staff from R&D organization, and government officials (e.g., EPA and DOE). EX1002 ¶¶246-249, 253; EX1078-EX1084; EX1098.

AWMA published a CD with the 2002 conference papers, including Starns, and Dr. Niksa received his copy in Summer 2002. EX1002 ¶¶247, 250. A photograph of Dr. Niksa's copy (containing EX1008) is shown below:



EX1077. Further corroborating public accessibility, the AWMA online “bookstore” allowed the public to purchase the CD at least by August 6, 2002 (corresponding to Internet Archive date stamp of “20020806”). EX1085-EX1086; EX1098, 4, 6.³ Publications on the CD were indexed by session (topic) and author, as shown below:

³ EX1091 (explaining date stamps of Internet Archive).



Author Index The Air & Waste Management Association's 95th Annual Conference & Exhibition

AUTHOR	PAPER TITLE	PAPER NUMBER
Spencer, Mary <i>Environmental Management Directorate</i>	■ Pollution Prevention in Weapon System Test and Evaluation	43433
Srivastava, Ravi K. <i>U.S. EPA</i>	■ Controlling Multiple Emissions from Coal-fired Power Plants	45376
Stallings, John H. <i>US Air Force</i>	■ Department of Defense Integrates P2 into Wapons Systems Development: Toward a Green Life Cycle	41784
Starns, Travis <i>ADA-ES, LLC</i>	■ Full-Scale Test of Mercury Control with Sorbent Injection and an ESP at Wisconsin Electric's Pleasant Prairie Power Plant	43249

Session AE-1c Results from Full-Scale Mercury Control Testing: Overview and Panel Discussion		
PAPER NUMBER	PAPER TITLE <i>AUTHOR(S)</i>	Return To AE-1c in the Session Listing
43249	Full-Scale Test of Mercury Control with Sorbent Injection and an ESP at Wisconsin Electric's Pleasant Prairie Power Plant <i>Travis Starns, Jean Bustard, Michael Durham, Charles Lindsey, Cameron Martin,, Richard Schlager, Brian Donnelly, Sharon Sjostrom, Paul Harrington, Sheila Haythornthwaite, Richard Johnson, Ed Morris, Ramsay Chang, and Scott Renninger</i>	

EX1073-EX1076. Starns (EX1008) is paper number 43249. EX1076, 19; EX1002 ¶¶251-252.

2. Mass-EPA (Grounds 2, 4, and 6)

Mass-EPA was authored by Bureau of Waste Prevention (“BWP”), a division of the Massachusetts Department of Environmental Protection. Its cover reflects its status as a government document:⁴

⁴ Mass-EPA was published December 2002 by regulatory agencies in the State of Massachusetts pursuant to 310 Code of Massachusetts Regulations 7.29. EX1009, 1; EX1099, 21. Mass-EPA qualifies as admissible under FRE 803(8) and 902(1)(A).



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**EVALUATION OF THE TECHNOLOGICAL AND ECONOMIC
FEASIBILITY OF CONTROLLING AND ELIMINATING
MERCURY EMISSIONS FROM THE COMBUSTION OF SOLID
FOSSIL FUEL**

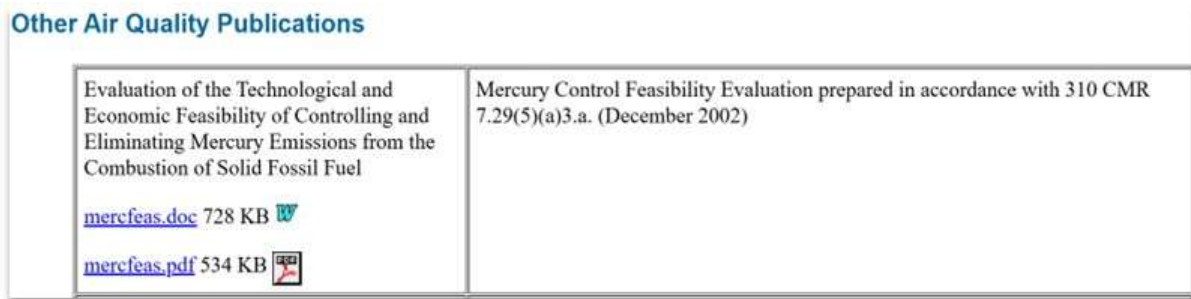
Pursuant to 310 CMR 7.29 – Emissions Standards for Power Plants

December 2002

EX1009, 1. BWP provided for the “health, safety, [and] welfare of its citizens” by “[d]irect[ing] the use of the most advanced treatment technology of wastes/emissions.” EX1087; EX1099, 6. Within BWP was the Planning and Evaluation Division, handling “long range ... pollution planning and evaluation,” including an “Air Program Planning Unit.” EX1088; EX1099, 8. A POSITA would have looked to publications from the Air Program Planning Unit, since it provided

“shared and integrated environmental, engineering and program data, which will be accessible to all.” EX1088-EX1089; EX1099, 8-10; EX1002 ¶255.

The “Air Program Planning Unit Publications” page was organized by subject—with descriptive, text-searchable, titles—and made available for download Mass-EPA (EX1009) as the “mercfeas.pdf” file shown below:



EX1090; EX1099, 12. As reflected in the date stamp from Internet Archive (“20021220143210”), the “mercfeas.pdf” file was available for download by December 20, 2002.⁵ EX1091; EX1002 ¶¶256-257.

A POSITA would have been motivated to look for Mass-EPA, because it was commissioned pursuant to a State of Massachusetts regulation. EX1009, 1. A POSITA would have studied the document to operate power plants in Massachusetts

⁵ Mass-EPA is currently available for download at the State of Massachusetts website: <https://www.mass.gov/doc/evaluation-of-technological-economic-feasibility-of-controlling-eliminating-mercury-emissions/download>.

and as a harbinger of future federal regulations concerning mercury removal nationwide. EX1002 ¶258.

C. ANALOGOUS ART

The field of endeavor of the Challenged Patent is “removal of pollutants from flue gas or product gas from a gasification system,” specifically removing “mercury ... from gas streams generated during the burning or gasification of fossil fuels.” EX1001, 1:41-43. The specific problem faced by the ’370 inventors was needing a “more economical and effective mercury removal technology.” EX1001, 2:38-39; EX1002 ¶¶218, 254, 259.

Vosteen589, Starns, and Mass-EPA are analogous art to the ’370 Patent, as they are in the same field of endeavor and reasonably pertinent to the problems the inventors faced. Vosteen589 improves previous mercury-removal techniques at power stations that were “not sufficiently effective” and were “relatively expensive.” EX1005 ¶¶[0001], [0004]; EX1002 ¶218. Starns and Mass-EPA remove mercury at coal-fired power plants using activated-carbon sorbent. EX1008, 2; EX1009, Abstract, 4, 32; EX1002 ¶¶254, 259.

D. OVERVIEW OF THE COMBINATIONS AND REASONS TO COMBINE

A POSITA would have been motivated to combine Vosteen589 with Starns (Ground 1) and with Mass-EPA (Ground 2), with reasonable expectation of success,

because all three references are directed towards the same goal (removing mercury from flue gases) and are interoperable. EX1002 ¶294.

Vosteen589 uses a “dry emission control system” for the “flue gas,” which works “based on the adsorption of ionic mercury compounds.” EX1005 ¶¶[0018], [0019] (“mercury sorption stage”), [0007] (mercury “is readily adsorbable to a range of adsorbents”). “Adsorption” is a process where adsorbate (e.g., atoms, ions, molecules) in a fluid (typically gas) bind to a sorbent’s surface. Vosteen589 discloses “finely pulverulent slaked lime/activated carbon” sorbent. EX1005 ¶[0019]. For the coal-fired power plant, a “dry electrostatic precipitator (ESP) is used.” EX1005 ¶[0034]; EX1002 ¶295.

Though Vosteen589 discloses activated-carbon sorbent and particulate-control devices (e.g., ESPs), Vosteen589 does not fully disclose certain implementational details, such as how sorbent is introduced. Starns and Mass-EPA supply those details, including hardware and control processes. A POSITA would have been motivated to use activated-carbon injection (as in Starns and Mass-EPA) with Vosteen589, with reasonable expectation of success, because activated-carbon injection was well-known, as admitted by the ’370 Patent. EX1001, 2:8-15, 7:41-48, 28:11-24; *see* EX1096 (Holmes), 41:5-9; EX1095 (Olson), 114:21-25; EX1097

(Pavlish), 210:4-18.⁶ Each combination represents combining prior art elements (activated-carbon sorbent) according to known methods (injection into flue gas) to yield predictable results (mercury removal). EX1002 ¶296.

Starns and Mass-EPA provide the details of activated-carbon injection (“ACI”), including how sorbent-injection rate affects mercury removal, where to inject the sorbent, and how to remove sorbent with an ESP. A POSITA would have looked to Starns (Ground 1) and Mass-EPA (Ground 2) for practical applications of Vosteen589’s processes for adding halogens to improve mercury removal on activated-carbon sorbents. A POSITA would have used “injection” (described by Starns and Mass-EPA) to introduce activated-carbon sorbent into the mercury-containing flue gas of Vosteen589, particularly embodiments using an ESP in the dry-emission system (disclosed in Vosteen589, Starns, and Mass-EPA). As described below, both Starns and Mass-EPA tout ACI as a mature technology. Using halogens (Vosteen589) with activated-carbon sorbent (Vosteen589, Starns, and Mass-EPA) would yield predictable results of improved mercury removal (as compared to bare activated carbon) with lowered sorbent costs. EX1002 ¶296.

⁶ Dr. Olson, Mr. Holmes, and Mr. Pavlish are the three named inventors on the Challenged Patent.

1. **Ground 1 (Combining Vosteen589 with Starns)**

A POSITA would have been motivated to use the ACI of Starns in the dry-emission system of Vosteen589. Starns identifies the “most mature, retrofit technology available today is the injection of sorbents such as powdered activated carbon (“PAC”) into the flue gas upstream of the particle control equipment. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2. Starns provides details for supplying PAC using “injection equipment” with a “bulk-storage silo and twin blower/feeder trains,” shown below. EX1002 ¶¶297-298.



EX1008, 7-8. “A PLC [(programmable logic controller)] is used to control system operation and adjust injection rates.” EX1008, 7. Among the “[p]rimary variables”

to control mercury removal is “injection concentration” of the sorbent. EX1008, 10. As ACI was a “mature” technology, the combination of Vosteen589 and Starns represents combining prior art elements according to known methods to yield predictable results of removing mercury. EX1002 ¶¶298-301.

2. Ground 2 (Combining Vosteen589 with Mass-EPA)

A POSITA would have been motivated to use the ACI of Mass-EPA with the dry-emission system of Vosteen589. Like Vosteen589, Mass-EPA pertains to systems for removing mercury from flue gas of coal-combustion plants:

Mercury can be captured and removed from gas by injection of a sorbent into the exhaust system and subsequent collection of the particulates in a PM control device. Availability of low-cost and efficient sorbents and effective particulate collection are key in implementation of this type of mercury control.

EX1009, 32 (section entitled “Sorbent Injection”). Mass-EPA focuses on the same, already mature, sorbent as Vosteen589:

Activated carbon (AC) has been the most extensively studied sorbent for mercury adsorption. Currently, AC seems to be the most likely candidate to reach commercialization for mercury removal in the near future.

EX1009, 32. A POSITA would be additionally motivated to use ACI, because the “estimated costs for powdered activated carbon injection-based technology, which most likely will reach commercialization for mercury control before other technologies, is within the current control costs for NOx” (another type of pollutant). EX1009, 58. As ACI was ready for commercialization by 2002, years before the

'370 Patent's earliest possible priority date, the combination of Vosteen589 and Mass-EPA represents combining prior-art elements according to known methods to yield predictable results of removing mercury. EX1002 ¶¶302-306.

Mass-EPA provides an express motivation to combine: “improving mercury adsorption efficiency of activated carbons has been ongoing with the goal of improving carbon to mercury injection rates and reducing control costs.” EX1009, 39. Using halogens (Vosteen589) with ACI (Mass-EPA) would yield predictable results of improved mercury-adsorption efficiency, achieving the Mass-EPA's stated goal of “reducing control costs.” EX1002 ¶307.

E. DISCLOSURE AND TEACHINGS OF THE COMBINATIONS

Grounds 1 and 2 largely rely on the common disclosure of Vosteen589, with certain claim limitations disclosed by Starns (Ground 1) and by Mass-EPA (Ground 2). EX1002 ¶¶293, 308.

1. Independent Claim 1

a. Element 1(Pre): “A method of separating mercury from a mercury-containing gas, the method comprising”

Vosteen589 discloses “removing mercury from flue gases.” EX1005, Title, cl. 1; *see* ¶¶[0007]-[0008], Abstract. Flue gas is a mercury-containing gas, and “removing mercury” refers to separating the mercury from mercury-containing gas to reduce emissions. EX1002 ¶¶309-311.

- a. Element 1(a): “combusting a mixture of coal and an additive in a combustion chamber, to form the mercury-containing gas, wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof;”**

Vosteen589 discloses “a coal-fired power station,” including a “combustion chamber.” EX1005 ¶[0005]; *see* ¶¶[0034], [0046]-[0048], Figs. 7-9. The combustion chamber (i.e., boiler/furnace) combusts coal to form the mercury-containing flue gas. EX1002 ¶¶312-314.

Vosteen589 applies additives comprising bromine (Br₂, an exemplary halogen), hydrogen bromide (HBr, an exemplary halide), and/or bromide compounds (e.g., sodium bromide, NaBr, which is an exemplary halogen salt) by mixing the additives with the coal in the combustion chamber and/or upstream of combustion chamber:

[0006] ... removing mercury from flue gases of ... power stations ..., in which bromine and/or a bromine compound and/or a mixture of various bromine compounds is fed to the if appropriate multistage furnace....

[0009] [A]n aqueous solution of hydrogen bromide [HBr] or an alkali metal bromide, in particular sodium bromide [NaBr], or an aqueous solution of the alkali metal bromide is used.

[0013] The bromine compound, for example, sodium bromide, can be added in solid form, for example as salt, or liquid form, for example as aqueous solution, to the ... coal or the like to be burnt, upstream of the furnace. ... The addition can also be made to a plant section upstream of the furnace, for example, ... to a coal mill.

[0014] ... feed the bromine compound, for example an aqueous solution of hydrogen bromide or sodium bromide, at a fine dispersion to the combustion air and/or if appropriate to a recirculated substream, in particular recirculated flue gas, recirculated ash and recirculated fly ash.

EX1005 ¶¶[0006], [0009], [0013], [0014]. Vosteen589 further discloses this claim element in Vosteen589's claims:

1. Process for removing mercury from flue gases of high-temperature plants, in particular from power stations ... characterized in that bromine and/or a bromine compound and/or a mixture of various bromine compounds is fed to the if appropriate multistage furnace and/or to the flue gas in a plant section downstream of the furnace, ... and then the flue gas being subjected to an if appropriate multistage cleanup for removing mercury from the flue gas, which cleanup comprises a wet scrubber and/or a dry cleanup.

2. Process according to claim 1, characterized in that the bromine compound is an aqueous solution of hydrogen bromide and/or an alkali metal bromide, in particular sodium bromide, and/or an aqueous solution of alkali metal bromide.

EX1005, cls. 1-2; EX1002 ¶¶315-316.

b. Element 1(b): “adding a particulate sorbent material comprising activated carbon into the mercury-containing gas,”

This element is disclosed by Vosteen589 with Starns (Ground 1) and Mass-EPA (Ground 2).

i. Grounds 1-2

Vosteen589 discloses a “dry emission control system” for the “flue gas,” which works “based on the adsorption of ionic mercury compounds.” EX1005 ¶¶[0017]-[0019]; *see* ¶¶[0005]-[0007] (“removal of mercury from the flue gases in

a flue gas emission control system downstream of the combustion”); ¶[0019] (“mercury sorption stage”). One exemplary sorbent is “finely pulverulent slaked lime/activated carbon.” EX1005 ¶[0019]; *see* ¶¶[0003], [0007], [0019]. EX1002 ¶¶317-320.

Starns and Mass-EPA disclose further details for how and where to add the activated-carbon sorbent into the flue gas. Each disclose “powdered” activated carbon, which is a particulate sorbent material. EX1002 ¶¶321.

ii. Ground 1

Starns describes hardware and control processes for “injecting activated carbon ahead of particle control devices (PCD) to remove mercury.” EX1008, 2. The “injection equipment” includes a “bulk-storage silo and twin blower/feeder trains,” shown below:



EX1008, 7-8. Through “injection of sorbents such as powdered activated carbon (PAC) into the flue gas upstream of the particle control equipment,” the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2. “Four sorbents were” evaluated, and “[a]ll four sorbents were PACs.” EX1008, 9. EX1002 ¶¶322-323.

Starns discloses “using activated carbon injection upstream of an ESP.” EX1008, 20. The mercury-sorbent composition is removed because, “upstream of the particle control equipment” (ESP), the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2; EX1002 ¶323.

iii. Ground 2

Mass-EPA describes activated carbon as “the most extensively studied sorbent for mercury adsorption” (EX1009, 32) and discloses “activated carbon injection,” including “powdered” activated carbon (PAC) injection, in numerous places. *See* EX1009, 31-56. The “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21; *see* 6-7, 22-23. After mercury adsorbs onto activated-carbon sorbent, the “particulate-bound form of mercury can be readily captured in the particulate matter (PM) control devices, i.e., electrostatic precipitators (ESPs) and fabric filters (FFs).” EX1009, 20. “An ESP or a FF is always installed downstream of a ... dry injection point to remove the sorbent from the flue gas.” EX1009, 27; EX1002 ¶¶324-325.

c. Element 1(c): “wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;”

Claim Element 1(c) is obvious over Vosteen589 and Starns (Ground 1) and Vosteen589 and Mass-EPA (Ground 2). Vosteen589 describes the Br-concentration in mercury-containing flue gas, and Starns and Mass-EPA describe the sorbent concentration. EX1002 ¶¶326-340.

Vosteen589 discloses two values for the “total bromine content (Br_{tot}) in the boiler flue gas”: 43 and 75 mg/M³ S.T.P.db. EX1005 ¶¶[0031], [0046], [0048], Fig. 8. This refers to milligrams Br per cubic meter of mercury-containing flue gas, on a dry basis, at standard temperature and pressure. EX1002 ¶327.

Vosteen589 discloses that activated-carbon is used (EX1005 ¶[0019]), but does not disclose the gas-phase concentration. As Dr. Niksa explains with source citations, it was routine in the industry to use injection rates of around 10 pounds sorbent per MMacf flue gas to capture mercury. EX1002 ¶328; *see* ¶¶114-115. This is the value used by Starns (Ground 1) and Mass-EPA (Ground 2). EX1008, 20; EX1009, 12, 73; EX1002 ¶¶329-330.

Dr. Niksa explains how a POSITA would have been readily capable of converting between units of Br concentration in the flue gas (Vosteen589) and sorbent concentration in the flue gas (Starns and Mass-EPA), and then dividing the two to determine a weight ratio. The quantity of Br in the flue gas equals the bromine-containing additive applied to the combustion chamber and/or coal (e.g., as opposed to native halogens in the coal), as the Br concentration is near zero prior to the additive being applied. EX1005 Fig. 8. The above calculations involve fundamental calculations taught in undergraduate chemistry, such as unit conversions (e.g., between L and ft³ and pounds to grams) and the ideal gas law (PV=nRT). Dividing the two numbers—the Br concentration of Vosteen589 (43

mg/m³ S.T.P. db) and the activated-carbon concentration of Starns and Mass-EPA (10 lb/MMacf each)—provides a mercury-containing gas that comprises about 17.3 grams of the element bromine per 100 grams of activated-carbon sorbent. EX1002 ¶¶331-337.

The exemplary bromine-containing additives in Vosteen589 include aqueous NaBr, aqueous HBr, and Br₂. Converting from the weight of Br in the additive, to the weight of additive itself, is likewise well within the ability of a POSITA, involving multiplying by the ratios of molecular masses (e.g., 79.9 grams Br for every: 79.9 grams Br₂, 102.89 grams of NaBr, 80.91 grams HBr). For every 100 grams sorbent, there are: 22.27 grams NaBr additive, 17.51 grams HBr additive, and 17.3 grams of Br₂. These are within the claimed range of 1:100-30:100. EX1002 ¶337.

Even if a POSITA were to use the highest sorbent injection rate tested in Chart 2 of Mass-EPA (Ground 2), which is 30 lb/MMacf, there would still be a ratio of between 1-30 grams additive for every 100 grams of sorbent. EX1002 ¶338.

Even using the higher Br concentration disclosed in Vosteen589 (75 mg/M³ S.T.P. db) with 10 lbs/MMacf sorbent, that would still provide ratios of: 29.97 grams HBr per 100 grams sorbent; and 29.6 grams Br₂ per 100 grams sorbent. These are within the claimed range of 1:100-30:100. EX1002 ¶339.

It would have been obvious to try other ratios, such as by increasing halogen concentration (while reducing activated-carbon injection rates), or decreasing halogen concentration (while increasing active-carbon injection) as part of routine process optimization to achieve the desired mercury removal. EX1002 ¶340.

Claim Element 1(c) is merely an attempt to claim a workable range for combining a conventional halogen (e.g., bromine) being used in a conventional way (to oxidize mercury and promote activated carbon) with a conventional sorbent (activated carbon). Nothing in the '370 Patent specification attributes significance to the claimed range or establishes that the claimed range “achieves unexpected results.” The range presents nothing more than optimization of “result-effective” variables that would have been obvious to a POSITA. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1297-98 (Fed. Cir. 2012); *see Pfizer Inc. v. Sanofi Pasteur Inc.*, 94 F.4th 1341, 1347 (Fed. Cir. 2024) (“decades-old legal principle that “where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation”); EX1002

¶340.⁷ Patent Owner has previously admitted this is correct concerning U.S. Patent No. 8,168,147 (parent to Challenged Patent):

[T]he inventors reduced all aspects of the '147 patent claims to practice except for the claimed ratio of 1-30 grams of promoter per 100 grams of sorbent (i.e., a 1%-30% ratio). ... [T]his range limitation is entitled to no patentable weight.

EX1105 (IPR2020-00926, Paper 13), 34.

Petitioners' expert testified—and ME2C does not dispute—that the 1%-30% range limitation is not entitled to any patentable weight. See Ex. 1003 at ¶ 369 (“Through routine process optimization and routine experimentation, a POSITA would have adjusted the rate of addition of the promoter and/or the rate of addition of the sorbent material to achieve a range from about 1 g to about 30 g of promoter per 100 grams of the sorbent material . . . The range presented nothing more than optimization of result-effective variables that would have been obvious to a POSITA.”).

EX1105, 35.

⁷ As PO's expert in the Delaware Litigation stated, “power plants employing bromine additives and activated carbon would necessarily produce a sorbent that is 1 g to 30 g bromine per 100 g of activated carbon.” EX1092, 153 (cl. 4). He further cited to this analysis for a claim that requires “the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent. EX1092, 154 (cl. 29).

d. Element 1(d): “contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and”

This element is disclosed by Vosteen589 with Starns (Ground 1) and with Mass-EPA (Ground 2). EX1002 ¶341.

i. Grounds 1-2

Vosteen589 discloses a “dry emission control system” for the “flue gas,” which works “based on the adsorption of ionic mercury compounds.” EX1005 ¶¶[0017]-[0019]; *see* ¶¶[0005]-[0007] (“removal of mercury from the flue gases in a flue gas emission control system downstream of the combustion”); ¶[0019] (“mercury sorption stage”). The flue-gas mercury is adsorbed, and thus contacted, with activated-carbon sorbent to form a mercury-sorbent composition. As described below, Starns and Mass-EPA disclose how and where to inject the activated-carbon sorbent into the flue gas. EX1002 ¶¶341-344.

ii. Ground 1

Starns describes that “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2; EX1002 ¶343.

iii. Ground 2

Mass-EPA describes that the “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21; *see* 33; EX1002 ¶344.

e. Element 1(e): “separating the mercury-sorbent from the mercury-containing gas.”

i. Grounds 1-2

Vosteen589 discloses “removing mercury ... from flue gases.” EX1005 ¶[0005]. Vosteen589 “clean[s] gas downstream of the ... dry flue gas emission control system,” meaning the mercury-sorbent composition has been separated from the mercury-containing gas. EX1005 ¶[0022]; *see* ¶[0006], cl.1. The mercury-sorbent composition is separated downstream from the combustion chamber by a particle-control device, such as ESP or fabric filter. EX1005 ¶¶[0019], [0033]-[0034], [0039], [0042], [0047]-[0049], cl. 8. EX1002 ¶345.

ii. Ground 1

Starns recommends “using activated carbon injection upstream of an ESP.” EX1008, 20. “[U]pstream of the particle control equipment” (ESP), the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface,” and the mercury-sorbent composition is then removed by the ESP. EX1008, 2; EX1002 ¶346.

iii. Ground 2

In Mass-EPA, “[t]he particulate-bound form of mercury can be readily captured in the particulate matter (PM) control devices, i.e., electrostatic precipitators (ESPs) and fabric filters (FFs).” EX1009, 20. A “particulate-bound” mercury refers to the mercury-sorbent composition. “An ESP or a FF is always

installed downstream of a ... dry injection point to remove the sorbent from the flue gas.” EX1009, 27; EX1002 ¶347.

2. Claims Depending from Claim 1

a. Claim 2-4:

2: “adding the additive to the coal before combusting the coal.”

3: “the additive mixed with the coal is in a liquid.”

4: “the liquid is a hydrocarbon, supercritical carbon dioxide, water, salt solution, or a combination thereof.”

As discussed for Element 1(a), the halogen-containing ingredients are added to the coal upstream of the combustion chamber. These halogen-containing ingredients (e.g., HBr, NaBr) are added to the coal as an “aqueous solution” (i.e., the halogen-containing ingredients are dissolved in water). EX1005 ¶¶[0009], [0013]-[0014], claim 2. Aqueous NaBr is a salt solution. As confirmed by Claim 4, which depends from Claim 3, a “liquid” can include “water” and a “salt solution,” each of which are present in the aqueous additives of Vosteen589. EX1002 ¶¶348-350.

b. Claim 5: “carbocations in the activated carbon of the mercury-sorbent accept electrons from mercury atoms of the mercury-sorbent.”

According to Patent Owner’s expert in the Delaware litigation, this chemical reaction takes place between the activated carbon and mercury. EX1092, 160 (’147 Patent Claim 1c); EX1002 ¶351.

c. Claim 6: “the additive is substantially in vapor form in the mercury-containing gas.”

Vosteen589 applies aqueous hydrogen bromide (HBr), halide compounds in solid or aqueous form (e.g., NaBr), and molecular bromine (Br₂). At least a portion of the bromine-containing ingredients added to the coal and/or combustion chamber would have vaporized and reacted to form HBr vapor in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. EX1095 (Olson), 98:23-100:3, 231:3-9; EX1092 (O’Keefe Report), 154 (recognizing that Br “exits the combustion chamber and contacts the sorbent in a gaseous state”). Vosteen589 confirms that bromine-containing ingredients are present in the mercury-containing flue gas, as it describes “the mass ratio of bromine to mercury in the flue gas.” EX1005, cl. 5; EX1002 ¶352.

The halogens (e.g., HBr and/or Br₂) remain in vapor form at flue-gas temperatures when contacting the sorbent. For example, the flue gas is typically at 143°C (Starns, Ground 1) and 140-160°C (Mass-EPA, Ground 2). EX1008, 10;

EX1009, 26; EX1002 ¶¶352-353 (discussing boiling points of HBr and Br₂);
EX1036, 4-53, 4-65.

d. Claims 7, 10:

7: “the additive is chosen from Cl₂, HCl, sodium chloride, calcium chloride, and a combination thereof.”

10: “the additive is chosen from I₂, HI, sodium iodide, calcium iodide, potassium iodide, and combinations thereof.”

Vosteen589 discloses that a “chlorine compound and/or iodine compound can be fed ... as a supplement to, or partial replacement of, the added bromine compound,” and that the “process proceeds, in addition to the bromine compounds, in the presence of chlorine and/or iodine.” EX1005 ¶[0016]. Vosteen589 further discloses that molecular chlorine (Cl₂) and molecular iodine (I₂) would be used as the partial supplement for the additive, and used in combination with the bromine-containing additive:

1. Process for removing mercury from flue gases of high-temperature plants, in particular from power stations ... characterized in that bromine and/or a bromine compound and/or a mixture of various bromine compounds is fed to the if appropriate multistage furnace

6. Process according to one of claims 1 to 5, characterized in that the combustion is carried out *additionally in the presence of chlorine and/or a chlorine compound and/or a mixture of various chlorine compounds and/or iodine and/or an iodine compound and/or a mixture of various iodine compounds.*

EX1005 claims 1, 6. A POSITA would recognize that a “chlorine compound” and “iodine compound” refers to “Cl” and “I” bonded with another element, respectively, and that the terms by themselves (“chlorine” and “iodine”) refer to Cl_2 and I_2 , respectively. EX1002 ¶¶354, 357.

In addition to the Cl_2 and I_2 in Vosteen589, which satisfy Claim 7 and 10, a POSITA would have been motivated to apply widely-available and inexpensive halide compounds, such as sodium chloride (NaCl , table salt) or sodium iodide (NaI) for the “chlorine compound” and “iodine compound” taught by Vosteen589, as Vosteen589 is already using an analogous compound (NaBr , sodium bromide). Indeed, as Dr. Niksa explains in the technical background, it was known that chlorides, bromides, and iodides are all helpful to remediating mercury in that they oxidize mercury. EX1002 ¶¶355, 359, 53-55, 61-64, 109-113, 132-151; *see* EX1062 at 2-3, 10 (“screening tests of several oxidation additives including chloride compounds (e.g., sodium chloride, hydrogen chloride, calcium chloride) and potassium iodide”).

Vosteen589 provides additional motivation to use iodine-containing chemicals as a partial replacement for bromine-containing chemicals when using coals with higher native-mercury content (or lower native-halogen content), for which additional mitigation may be needed to further reduce mercury emissions. Though Vosteen589 teaches that iodine compounds can be more expensive than

corresponding bromine compounds (less “economical”), it also discloses that “[i]odine compounds oxidize mercury more effectively compared with bromine compounds.” EX1005 ¶[0016]. Thus for high-mercury applications, where additional mitigation is required, a POSITA would be motivated to include iodine compounds in the additive. EX1002 ¶358.

It would have been obvious that the weight ratio of Element 1(c) (of additive to sorbent) would still be within “about 1:100 to about 30:100” when chlorine or iodine is used in combination with a bromine-containing additive because, according to Vosteen589, the chlorine-containing chemicals and iodine-containing chemicals act as a “partial replacement” of the bromine-containing chemicals, such as on a mass basis. Further, the range presents nothing more than optimization of “result-effective” variables that would have been obvious to a POSITA. *Applied Materials*, 692 F.3d at 1297-98; *see Pfizer*, 94 F.4th at 1347; EX1105, 34-35; EX1002 ¶¶355, 357.

e. Claim 8: “the additive is chosen from Br₂, HBr, sodium bromide, calcium bromide, and a combination thereof.”

Vosteen589 discloses this limitation. As discussed for Element 1(a), the halogen-containing ingredients include Br₂, HBr, and sodium bromide (NaBr). EX1005 ¶¶[0009], [0013]-[0014], cl. 1-2; EX1002 ¶356.

f. Claim 11: “the activated carbon is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof.”

i. Ground 1

Starns states, “The most mature, retrofit technology available today is the injection of sorbents such as powdered activated carbon (PAC) into the flue gas upstream of the particle control equipment.” EX1008, 2; EX1002 ¶361.

ii. Ground 2

Mass-EPA discusses powdered activated carbon as “the most extensively studied sorbent” and “most actively researched and tested sorbent[s].” EX1009, 22, 32; EX1002 ¶362.

g. Claim 12: “adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth elements, alkali salts, alkaline earth salts, and combinations thereof.”

Claim 12 would have been obvious over Vosteen589 and Starns (Ground 1) and Vosteen589 and Mass-EPA (Ground 2). EX1002 ¶363.

i. Grounds 1-2

Vosteen589 discloses mixing “lime” and “slaked lime” with activated carbon and adding to flue gas. EX1005 ¶[0019]. Lime contains calcium oxide, CaO, and slaked lime contains calcium hydroxide, Ca(OH)₂. Lime and slaked lime are both

alkaline components and are alkaline earth salts. EX1002 ¶¶58, 131. A POSITA would have been motivated to mix the lime and slaked lime with activated-carbon sorbent, as they adsorb other flue-gas constituents that would otherwise compete with mercury for binding sites on the activated-carbon sorbent. EX1002 ¶364.

ii. Ground 1

Claim 12 is further obvious over Starns. Starns refers to “injection of sorbents such as powdered activated carbon (PAC) into the flue gas.” EX1008, 2. When activated-carbon sorbent is mixed with lime or slaked lime (as in Vosteen589), that lime or slaked lime would also be injected into the mercury-containing flue gas. EX1002 ¶365.

iii. Ground 2

Claim 12 is further obvious over Mass-EPA. “Increased removal of mercury from gas has been demonstrated by co-injection of activated carbon and calcium-based sorbents.” EX1009, 32. Other alkaline sorbents include: “activated carbon was co-injected with either sodium carbonate or lime for SO₂ control. With either of these sorbents, an improvement in the adsorption of gaseous Hg by the activated carbon was reported.” EX1009, 37. Lime is an alkaline-earth salt, and sodium carbonate (Na₂CO₃) is an alkali salt. EX1002 ¶366.

h. Claim 13: “contacting the sorbent material with a mercury-stabilizing reagent chosen from S, Se, H₂S, SO₂, H₂Se, SeO₂, CS₂, P₂S₅, and combinations thereof.”

i. Grounds 1-2

Vosteen589 discloses this claim. Vosteen589 “ensured that a sufficient supply of sulphur dioxide [i.e., SO₂] for the inventive process was available.” EX1005 ¶[0036]. Vosteen589 seeks for the combustion of coal to “take place in the presence of a sulphur compound, in particular sulphur dioxide” that then makes its way into the flue gas. EX1005 ¶[0006]. The sulphur dioxide facilitates the bromine reacting with mercury. EX1005 ¶¶[0010], [0012]. A POSITA would have known that the sulfur compound, such as SO₂, forms very early when present in the combustion process within the combustion chamber. The bulk of the SO₂ formed in a combustion chamber is present along an entire cleaning system and would be available to contact the downstream activated-carbon sorbent, injected by both Starns (Ground 1) and Mass-EPA (Ground 2). EX1002 ¶367.

i. Claims 14-15:

14: “contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.”

15: “the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.”

i. Grounds 1-2

Vosteen589 discloses these claims. In addition to the halogens added to coal and/or to the combustion chamber, they are also injected directly into the mercury-containing gas downstream of the combustion chamber: “bromine and/or a bromine compound ... is fed to the if [sic] appropriate multistage furnace and/or to the flue gas in a plant section downstream of the furnace.” EX1005, cl. 1, ¶[0006]; *see* ¶[0014] (adding HBr to “recirculated flue gas”); ¶[0016] and claim 6 (adding iodine). Hydrogen bromide (HBr) is a hydrogen halide. Additional halogens (such as those containing Br, Cl, and I) are examples of a secondary component. EX1002 ¶¶368-369, 372.

Vosteen589 discloses that, in addition to the bromine-containing ingredients added to coal or combustion chamber, “the combustion is carried out additionally in the presence of chlorine and/or a chlorine compound and/or a mixture of various chlorine compounds and/or iodine and/or an iodine compound and/or a mixture of

various iodine compounds.” EX1005, cl. 6. The “iodine” and “chlorine” are each halogens. A POSITA would have known that these additional materials would contact the activated-carbon sorbent, which is also injected downstream of the combustion chamber. Contact among added halogens and activated carbon sorbents downstream of the combustion chamber is inevitable because once halogens appear in flue gas, they remain in the gas phase. Adsorption is the only available means to extract halogen vapors from flue gas, and activated carbon is a much stronger sorbent for halogens (e.g., as compared to fly ash). EX1095, 98:23-100:3, 231:3-9 (discussing in-flight promotion); EX1002 ¶370.

ii. Ground 2

The claim is further obvious over Mass-EPA, which co-injects activated carbon “doped with” chlorine and iodine. EX1009, 33. Each of these are examples of halogens. EX1002 ¶371.

j. Claim 16: “the secondary component is chosen from I₂, HI, and combinations thereof.”

i. Grounds 1-2

As discussed for Claim 14, Vosteen589 discloses the addition of “iodine and/or an iodine compound.” EX1005 ¶[0016], cl. 6. A POSITA would recognize that an “iodine compound” refers to “I” bonded with another element, and “iodine” by itself refers to I₂. EX1002 ¶373.

k. Claim 18: “the additive comprises a and b, b and c, a and c, or a, b, and c: a) I⁻ and/or I₂, b) Br⁻ and/or Br₂, c) Cl⁻ and/or Cl₂.”

Vosteen589 discloses that “chlorine compound and/or iodine compound can be fed ... as a partial replacement of the added bromine compound,” and that the “process proceeds, in addition to the bromine compounds, in the presence of chlorine and/or iodine.” EX1005 ¶[0016]. As discussed for Element 1(a) and Claims 7 and 10, because the chlorine compound and iodine compound are a “partial replacement” for the bromine compound, it would have been obvious that the weight ratio of additive to sorbent would remain within the claimed range. *See also* EX1105, 34-35. Vosteen589 further teaches that “[p]referably, an aqueous solution of the compound is sprayed into one of the combustion chambers.” EX1005 ¶[0013]. A POSITA would have understood that bromine, chlorine, and iodine compounds in an aqueous solution (i.e., salt solutions) would dissociate such that the solution contains Br⁻, Cl⁻, and I⁻ ions, respectively. EX1002 ¶374.

3. Independent Claim 17

Claim 17 is nearly identical to Claims 1 and 18, with minor changes, as shown below:

~~17.~~ A method for separating mercury from a mercury-containing gas, the method comprising:

combusting ~~a mixture of~~ coal ~~and~~ comprising an additive in a combustion chamber, ~~to form the mercury-containing gas,~~ wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof; ~~18.~~ to form the mercury-containing gas, wherein the additive comprises a and b, b and c, a and c, or a, b, and c:

a) I^- and/or I_2 ,

b) Br^- and/or Br_2 ,

c) Cl^- and/or Cl_2 ;

~~adding a particulate~~ injecting a sorbent material comprising activated carbon into the mercury-containing gas, wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;

contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and

separating the mercury-sorbent from the mercury-containing gas.

Claim 17 is obvious for the reasons described for Claims 1 and 18. EX1002 ¶¶375-381. As discussed above for Element 1(a), the additive is applied to the coal before the coal enters the combustion chamber and/or to the coal in the combustion chamber. As discussed above for Element 1(b), the sorbent material is added by injecting it into the mercury-containing gas. As discussed for Claims 1 and 18, Vosteen589 expressly discloses the use of molecular bromine (Br_2), and salt solutions that contain Br^- (e.g., aqueous NaBr and aqueous HBr). As discussed for Claims 7 and 10, these bromine-containing additives are used in combination with “chlorine” (Cl_2) and/or iodine (I_2). EX1005 ¶[0016] and claims 1, 2, 6.

**VIII. GROUNDS 3-4: OBVIOUSNESS OVER DOWNS-
BOILER/STARN/MASS-EPA**

Ground 3 asserts obviousness of Claims 1-6, 8, and 11 over Downs-Boiler (EX1007) and Starns (EX1008). Ground 4 asserts obviousness of Claims 1-6, 8, 11-12, and 14-16 over Downs-Boiler and Mass-EPA (EX1009). EX1002 ¶382.

A. OVERVIEW OF EX1006 (“DOWNS-BOILER”)

Downs-Boiler (EX1006) qualifies as prior art, with a priority date of March 22, 2004, when 60/555,353 (“**Downs-Boiler-Provisional**”) was filed. EX1007. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015); *Amgen Inc. v. Sanofi*, 872 F.3d 1367, 1380 (Fed. Cir. 2017) (*Dynamic* applies to published patent applications). The disclosure of Downs-Boiler is supported by Downs-Boiler-Provisional, as illustrated by a redline comparison (EX1032) and confirmed by Dr. Niksa. EX1002 ¶¶221-224, 228-239. The Board previously found that Downs-Boiler qualifies as prior art as of March 22, 2004. EX1026, 84-85, 96.

At least claim 1 of Downs-Boiler has written-description support in Downs-Boiler-Provisional. EX1002 ¶229. Regarding Element 1(a) of Downs-Boiler, Downs-Boiler-Provisional discloses a “method of removing elemental mercury from coal combustion flue gases.” EX1007, ¶[0021]. Regarding Elements 1(b)-1(d), Downs-Boiler-Provisional provides a “bromine-containing reagent” to mercury-containing (flue) gas in the combustion chamber in order to “promote the oxidation of elemental mercury” and create an oxidized form. EX1007, Fig. 2, ¶[0027]; *see*

also ¶¶[0002]-[0006], [0018]-[0019], [0021], [0027]; EX1002 ¶¶230-237. Regarding Element 1(e), Downs-Boiler-Provisional “removes both oxidized and elemental mercury species” from the flue gas. EX1007, cl. 1, ¶¶[0004]-[0005], [0018]-[0019]; EX1002 ¶¶238-239.

Like Downs-Boiler-Provisional, Downs-Boiler seeks to enhance the effectiveness of mercury removal by powdered activated carbon (PAC), by adding a bromine-containing promoter to crushed coal (point A), pulverized coal (point B), or a combustion chamber (point C). EX1006, Fig. 2, ¶[0007]; *see also* Abstract, ¶¶[0003], [0015], [0018], [0021]-[0022], [0025]; EX1002 ¶¶226-227.

B. ANALOGOUS ART

Starns and Mass-EPA are analogous art. *Supra* §VII.C. Downs-Boiler is analogous art to the '370 Patent as it is in the same field of endeavor and reasonably pertinent to the problems the inventors faced. Downs-Boiler adds halogens to improve the effectiveness of activated carbon in mitigating mercury at power stations. EX1006 ¶¶[0003], [0015], [0018]-[0022], [0025], Abstract, Title; EX1002 ¶225.

C. OVERVIEW OF THE COMBINATIONS AND REASONS TO COMBINE

A POSITA would have been motivated to combine Downs-Boiler with Starns (Ground 3) and Downs-Boiler with Mass-EPA (Ground 4), with reasonable expectation of success, because all three references are directed towards the same

goal—i.e., removing mercury from coal-combustion flue gases—and are interoperable. EX1002 ¶383.

As described above and further below, Downs-Boiler enhances the effectiveness of mercury removal with PAC injection by adding bromine-containing ingredients to the coal or combustion chamber. EX1006, Abstract, Figs. 4-6. Downs-Boiler, however, does not fully disclose all details about implementing that PAC injection system, such as injection rates. Starns and Mass-EPA supply those details, such as hardware and control processes. A POSITA would have been motivated to combine, with reasonable expectation of success, because ACI was well-known in the art, as admitted by the '370 Patent. EX1001, 2:8-15, 7:41-48, 28:11-24; *see* EX1096 (Holmes), 41:5-9; EX1095 (Olson), 114:21-25; EX1097 (Pavlish), 210:4-18. Each combination represents combining prior art elements (activated-carbon sorbent in Downs-Boiler and Starns/Mass-EPA) according to known methods (injection into flue gas in Downs-Boiler and Starns/Mass-EPA) to yield predictable results (mercury removal). EX1002 ¶¶384-385, 97-115.

1. Ground 3 (Combining Downs-Boiler with Starns)

Additional reasons to use the ACI of Starns are described above regarding Ground 1. *Supra* §VII.D.1. For example, Starns refers to ACI as the “most mature, retrofit technology available today” (EX1008, 2) and discloses the hardware and

control processes to supply PAC to the flue gas of Downs-Boiler. EX1002 ¶¶386-390.

2. Ground 4 (Combining Downs-Boiler with Mass-EPA)

Additional reasons to use the ACI of Mass-EPA are described above regarding Ground 2. *Supra* §VII.D.2. For example, Mass-EPA refers to ACI as “the most extensively studied sorbent for mercury adsorption.” EX1009, 32. Mass-EPA discloses the hardware and control processes to supply PAC and other sorbent additives to the flue gas. EX1002 ¶¶391-396.

D. DISCLOSURE AND TEACHINGS OF THE COMBINATIONS

Grounds 3 and 4 largely rely on the common disclosure of Downs-Boiler, with certain claim limitations disclosed by Starns (Ground 3) and by Mass-EPA (Ground 4). EX1002 ¶¶382, 397.

1. Independent Claim 1

a. Element 1(Pre): “A method for separating mercury from a mercury-containing gas, the method comprising”

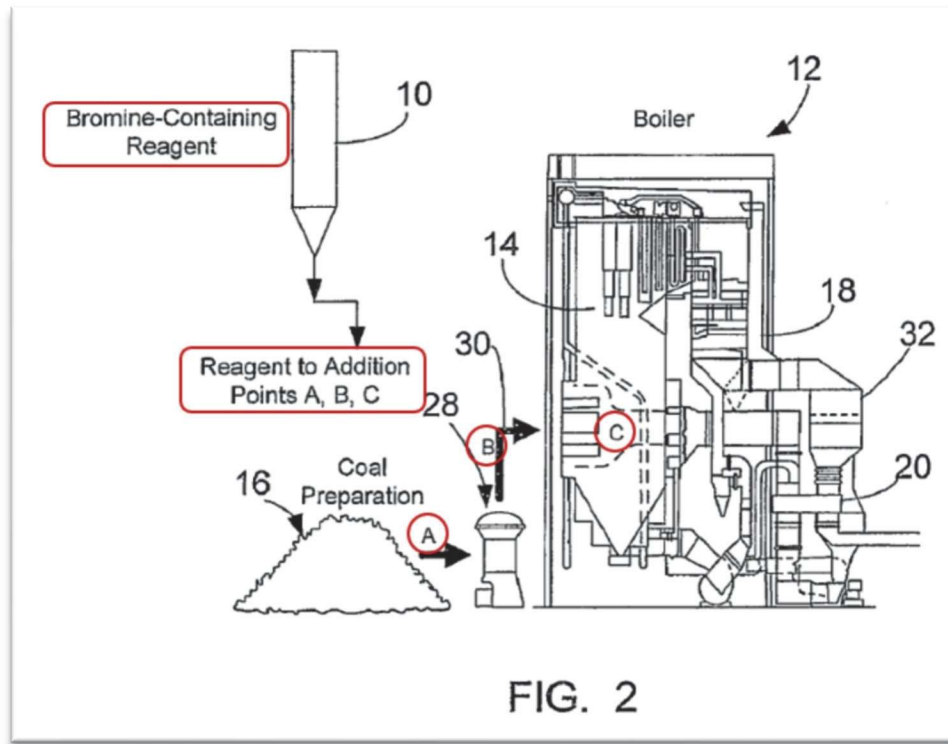
Downs-Boiler is entitled, “Bromine Addition for the Improved Removal of Mercury from Flue Gas.” EX1006, Title; EX1007, Title. “Removal of mercury” refers to separating mercury from mercury-containing gas. EX1006 ¶¶[0004], [0007], [0018]; EX1007 ¶¶[0005], [0013], [0021]; EX1002 ¶¶398-399.

b. Element 1(a): “combusting a mixture of coal and an additive in a combustion chamber, to form the mercury-containing gas, wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof;”

Downs-Boiler states, “Mercury appears in coal combustion flue gases in both solid and gas phases.” EX1006 ¶[0001]. Downs-Boiler discusses combusting coal throughout. *See* EX1006 ¶¶[0002], [0010]-[0015], [0020], Figs. 2, 4-6; EX1007 ¶¶[0002]-[0003], [0009], [0012]-[0016], [0018], [0023], Figs. 2-6; EX1002 ¶¶400-402.

Downs-Boiler applies an additive comprising bromine-containing reagents, including “alkali metal and alkaline earth metal bromides, hydrogen bromide (HBr) or bromine (Br₂),” and “an aqueous solution of calcium bromide (CaBr₂).” EX1006 ¶¶[0018]-[0019], [0021]; EX1007 ¶¶[0021]-[0022], [0024]. These are examples of halides (HBr), halogens (Br₂), and salts thereof (CaBr₂). EX1002 ¶403.

The bromine-containing reagents are mixed with coal upstream of the combustion chamber (Points A and B) and/or in the combustion chamber (Point C).



EX1006, Fig. 2, ¶¶[0007] (“bromine-containing compounds, added to the coal, or to the boiler combustion furnace”), [0015]; EX1007, Fig. 2, ¶¶[0009], [0018]. Calcium bromide (CaBr_2) and other bromine-containing reagents are “sprayed onto the crushed coal 16 before the coal 16 is pulverized for combustion” (location A) and added to pulverized coal (location B) before the coal enters the combustion chamber. EX1006, Fig. 2, ¶[0019]; EX1007, Fig. 2, ¶[0022]. Downs-Boiler also adds bromine-containing reagents directly into the combustion chamber (location C): “fed to the boiler combustion zone 14 in gaseous, liquid, or solid form.” EX1006 ¶[0022]; EX1007 ¶[0025]; EX1002 ¶¶404-407.

c. Element 1(b): “adding a particulate sorbent material comprising activated carbon into the mercury-containing gas,”

i. Grounds 3-4

Downs-Boiler discloses “injection of a carbonaceous sorbent (e.g., powdered activated carbon, or PAC) into the flue gas upstream of the dust collector to adsorb vapor-phase mercury.” EX1006 ¶[0004]; EX1007 ¶[0005]. The activated carbon is in particulate (powdered) form, and the “PAC injection systems” are a component of “downstream pollution control systems,” as they are downstream of the combustion chamber. EX1006 ¶[0015]; *see* ¶¶[0012-0014]; EX1007 ¶[0018]; *see* ¶¶[0014]-[0016]; EX1002 ¶¶408-409. As further evidence that the activated-carbon sorbent is added into the mercury-containing gas, Downs-Boiler refers to “sorbent, and its burden of adsorbed mercury,” and the creation of “particulate-bound mercury” due to the increased “reactivity of oxidized mercury with PAC.” EX1006 ¶¶[0003]-[0004], [0015]-[0016]; EX1007 ¶¶[0005], [0018]-[0019]; EX1002 ¶¶410-411.

ii. Ground 3

Starns further confirms that by “injection of sorbents such as powdered activated carbon (PAC) into the flue gas,” the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2. A “powdered” sorbent is in particulate form. EX1002 ¶412.

iii. Ground 4

Mass-EPA confirms that “sorbent particles ... contact the Hg in the flue gas.”
EX1009, 21 n.25; *see* 33 (“mercury to contact the AC [(activated carbon)] particle”).
EX1002 ¶413.

d. Element 1(c): “wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;”

Claim Element 1(c) is obvious over the combinations of Downs-Boiler with Starns (Ground 3) and Downs-Boiler with Mass-EPA (Ground 4). Downs-Boiler identifies Br- concentration in mercury-containing flue gas, and Starns and Mass-EPA describe the sorbent concentration. The ratio of the two is within the claimed range. EX1002 ¶¶414-425.

Downs-Boiler adds bromine-containing reagent to the coal to provide 375-1000 ppm equivalent Br increase in coal.

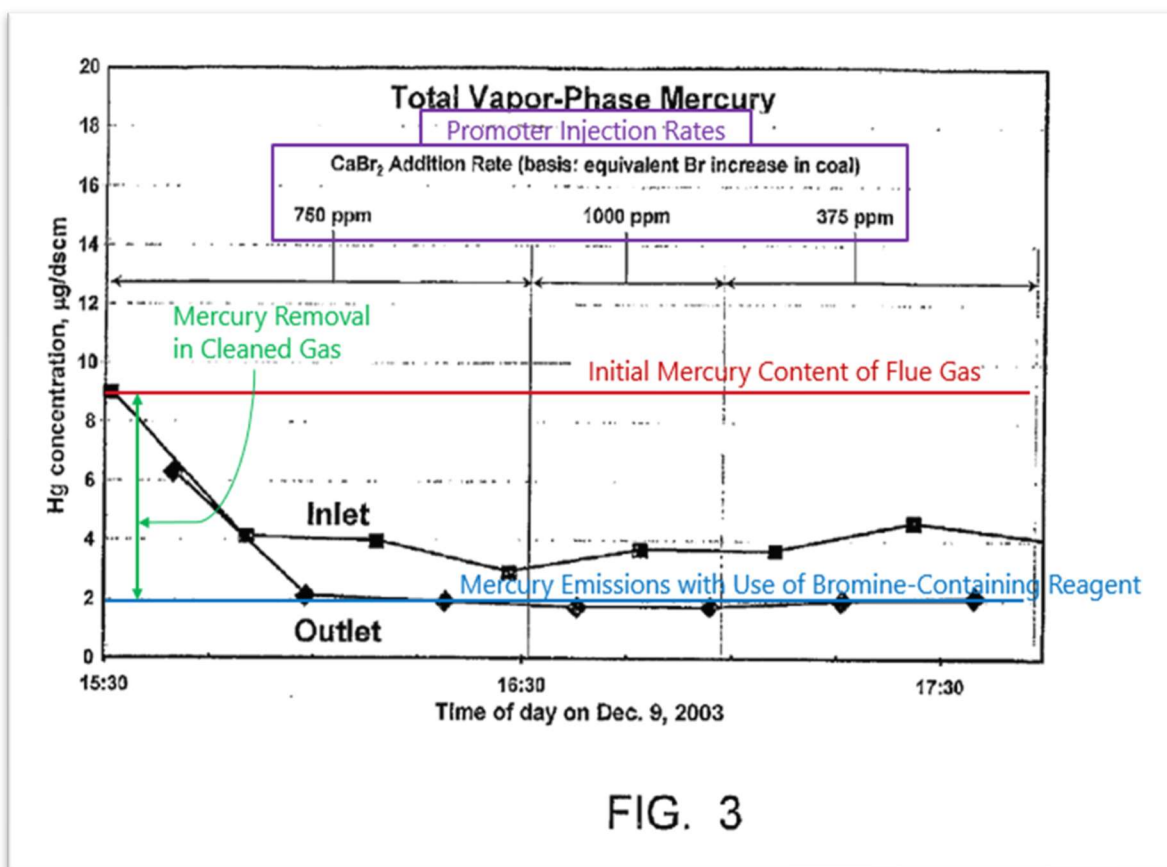


FIG. 3

EX1006, Fig. 3 (annotated), ¶[0018]; EX1007, Fig. 3, ¶[0021]. Dr. Niksa explains how a POSITA would have been able to calculate gas-phase concentration of Br based on the data presented by Downs-Boiler of 375 ppm Br added to “western U.S. subbituminous coal.” EX1006 ¶[0017]; EX1007 (Downs-Boiler-Provisional), ¶[0020]. A POSITA would have understood that, as compared to the halogen concentration of native coal, nearly all the gas-phase concentration of Br comes from the bromine-containing reagent. EX1002 ¶[414, 417-423].

Downs-Boiler discloses using activated carbon, but not the quantity. As Dr. Niksa explains with source citations, it was routine to use injection rates of around

10 pounds/MMacf of flue gas to capture mercury. EX1002 ¶¶414; *see* ¶¶114-115. This is the value used by Starns (Ground 3) and by Mass-EPA (Ground 4). EX1008, 20; EX1009, 12, 73; EX1002 ¶¶415-416.

Dr. Niksa explains how a POSITA would have been readily capable of converting between units of Br concentration (Downs-Boiler) and sorbent concentration (Starns and Mass-EPA), and then dividing the two to determine a ratio. This involves fundamental calculations taught in undergraduate chemistry, such as unit conversions (e.g., between Liters and ft^3 and pounds to grams) and the ideal gas law ($PV=nRT$). Dr. Niksa performs the unit conversions, including at the actual temperatures disclosed by Starns (EX1008, 10) and Mass-EPA (EX1009, 26). The 375 ppm of Br added to coal (Downs-Boiler) and the well-known injection rate of 10 pounds sorbent per MMacf (as disclosed in Starns and Mass-EPA), provides a mercury-containing gas with 20.4 grams of the element bromine per 100 grams of sorbent. EX1002 ¶¶417-422.

Converting from grams of the element bromine in the gas to grams of the additive added to the coal and/or combustion chamber is likewise well within the ability of a POSITA, involving multiplying by the ratios of molecular masses (e.g., 79.9 grams Br for every: 199.89 grams of CaBr_2 , 80.91 grams HBr , 159.80 grams

Br₂).⁸ These additives yield ratios of 25.5 grams CaBr₂ per 100 grams sorbent, 20.6:100 when using HBr; and 20.4:100 when using Br₂. These are within the claimed range of 1:100-30:100. EX1002 ¶423.

Even if a POSITA were to use the highest sorbent injection rate tested in Chart 2 of Mass-EPA (Ground 4), which is 30 lb/MMacf, there would still be a ratio of between 1-30 grams additive for every 100 grams of sorbent. EX1002 ¶424.

It would have been obvious to try other ratios, such as by increasing halogen concentration (while reducing activated-carbon injection rates), or decreasing halogen concentration (while increasing activated-carbon injection) as part of routine process optimization to achieve the desired mercury removal. EX1002 ¶425.

Claim Element 1(c) is merely an attempt to claim a workable range for combining a conventional halogen (bromine) being used in a conventional way (to oxidize mercury and promote activated carbon) with a conventional sorbent (activated carbon). Nothing in the '370 Patent attributes significance to the claimed range or establishes that the claimed range “achieves unexpected results.” The range presents nothing more than optimization of “result-effective” variables that would

⁸ Br₂ and CaBr₂ each contribute two “Br” atoms per molecule, so the number is further divided by two. EX1002 ¶423.

have been obvious to a POSITA. *Applied Materials*, 692 F.3d at 1297-98;⁹ EX1002

¶425. Patent Owner has previously admitted this is correct concerning U.S. Patent No. 8,168,147 (parent to Challenged Patent):

[Regarding] the claimed ratio of 1-30 grams of promoter per 100 grams of sorbent (i.e., a 1%-30% ratio). ... this range limitation is entitled to no patentable weight.

EX1105 (IPR2020-00926, Paper 13), 34.

Petitioners' expert testified—and ME2C does not dispute—that the 1%-30% range limitation is not entitled to any patentable weight. See Ex. 1003 at ¶ 369 (“Through routine process optimization and routine experimentation, a POSITA would have adjusted the rate of addition of the promoter and/or the rate of addition of the sorbent material to achieve a range from about 1 g to about 30 g of promoter per 100 grams of the sorbent material . . . The range presented nothing more than optimization of result-effective variables that would have been obvious to a POSITA.”).

EX1105, 35.

⁹ As PO's expert in the Delaware Litigation stated, “power plants employing bromine additives and activated carbon would necessarily produce a sorbent that is 1 g to 30 g bromine per 100 g of activated carbon.” EX1092, 153 (cl. 4). He further cited to this analysis for a claim that requires “the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent. EX1092, 154 (cl. 29).

e. Element 1(d): “contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and”

i. Grounds 3-4

Downs-Boiler discloses that mercury in the mercury-containing gas contacts the sorbent material to form a mercury-sorbent composition, as evidenced by Downs-Boiler’s reference to “sorbent, and its burden of adsorbed mercury,” and the creation of “particulate-bound mercury” due to the increased “reactivity of oxidized mercury with PAC.” EX1006 ¶¶[0003]-[0004], [0015]-[0016]; EX1007 ¶¶[0005], [0018]-[0019]; EX1002 ¶¶426-427.

ii. Ground 3

Starns further confirms that by “injection of sorbents such as powdered activated carbon (PAC) into the flue gas,” the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2. A “powdered” sorbent is in particulate form. EX1002 ¶428.

iii. Ground 4

Mass-EPA confirms that “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21 n.25; *see* 33 (“mercury to contact the AC [(activated carbon)] particle”). EX1002 ¶429.

f. Element 1(e): “separating the mercury-sorbent from the mercury-containing gas.”

Downs-Boiler discloses that activated-carbon “sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector,” which separates the mercury-sorbent composition by removing it from the mercury-containing (flue) gas. EX1006 ¶[0004]; EX1007 ¶[0005]; EX1002 ¶430. An ESP and FF, disclosed by Downs-Boiler, were well-known particulate control devices to separate particles (e.g., mercury-sorbent composition) from mercury-containing gas. EX1006 ¶¶[0003], [0023], Figs. 4-6; EX1007 ¶¶[0004], [0026], Figs. 4-6; EX1002 ¶¶430, 86-88.

2. Claims Depending from Claim 1

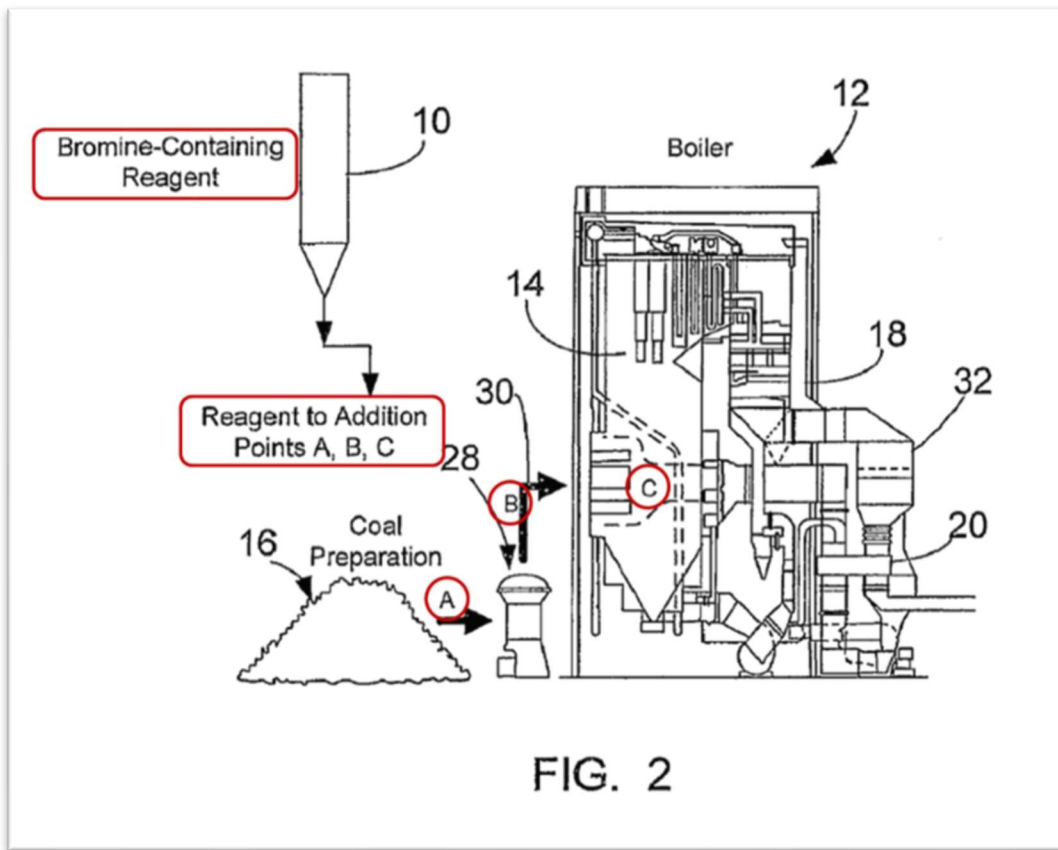
a. Claim 2-4:

2: “adding the additive to the coal before combusting the coal.”

3: “the additive mixed with the coal is in a liquid.”

4: “the liquid is a hydrocarbon, supercritical carbon dioxide, water, salt solution, or a combination thereof.”

As discussed for Element 1(a), the bromine-containing additive is added to the coal upstream of the combustion chamber, such as points A and B.



EX1002 ¶¶431-433.

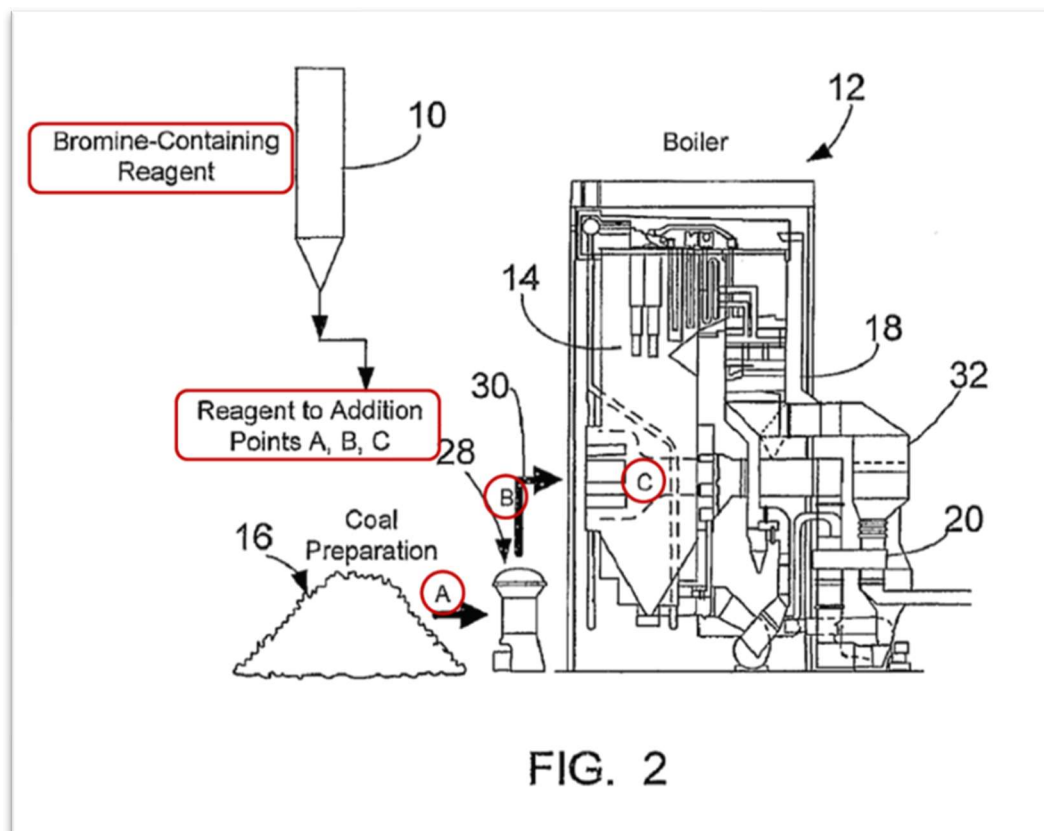
As described for Element 1(a), Downs-Boiler discloses mixing Br_2 and “an aqueous solution of calcium bromide (CaBr_2)” with the coal. EX1006 ¶¶[0018]-[0019], [0021]; EX1007 ¶¶[0021]-[0022], [0024]. A POSITA would have known that Br_2 is a liquid at room temperature, and that the aqueous solution of calcium bromide is CaBr_2 dissolved in water (i.e., a liquid). CaBr_2 is a salt, and aqueous CaBr_2 is a salt solution. As confirmed by Claim 4, which depends from Claim 3, a “liquid” can include “water” and a “salt solution.” EX1002 ¶¶431-433.

b. Claim 5: “carbocations in the activated carbon of the mercury-sorbent accept electrons from mercury atoms of the mercury-sorbent.”

According to Patent Owner’s expert in the Delaware litigation, this chemical reaction takes place between the activated carbon and mercury. EX1092, 160 (’147 Patent Claim 1c); EX1002 ¶434.

c. Claim 6: “the additive is substantially in vapor form in the mercury-containing gas.”

As discussed for Element 1(a), Downs-Boiler discloses adding Br_2 , HBr , or an “aqueous solution of calcium bromide” (CaBr_2) to the coal (Points A-B) and/or combustion chamber (Point C).



EX1006, Fig. 2, ¶¶[0018]-[0019], [0021]-[0022]; EX1007 Fig. 2, ¶¶[0021]-[0022], [0025]; EX1002 ¶435.

At the temperatures of the combustion chamber and flue gas, at least a portion of the Br added to coal and/or combustion chamber would have vaporized and reacted to form HBr in the combustion chamber, emerging in vapor form to contact the sorbent in the mercury-containing flue gas. *See* EX1095 (Inventor Olson), 98:23-100:3, 231:3-9; EX1092 (O’Keefe Report), 154 (Br contacts sorbent in gaseous state), 170 (same analysis for ’517 cl. 7), 176 (same analysis for ’430). Downs-Boiler confirms that bromine-containing species are present in the mercury-containing flue gas, as it “enhances the removal of mercury across a PAC injection process.” EX1006 ¶¶[0015]-[0016]; EX1007 ¶¶[0018]-[0019]; EX1002 ¶¶436-437 (further discussing EX1036).

The halogens (e.g., HBr and/or Br₂) remain in vapor form at flue-gas temperatures when contacting the sorbent. For example, the flue gas is typically at 143°C (Starns, Ground 3) and 140-160°C (Mass-EPA, Ground 4). EX1008, 10; EX1009, 26; EX1002 ¶¶436-438 (discussing boiling points of HBr and Br₂); EX1036, 4-53, 4-65.

d. Claim 8: “the additive is chosen from Br₂, HBr, sodium bromide, calcium bromide, and a combination thereof.”

As discussed for Element 1(a), Downs-Boiler discloses that the additive can be chosen from Br₂, HBr, and/or an “aqueous solution of calcium bromide” (CaBr₂). EX1002 ¶439.

e. Claim 11: “the activated carbon is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof.”

Downs-Boiler discloses “powdered activated carbon (PAC).” EX1006 ¶[0025]; EX1007 ¶[0028]; EX1002 ¶440. This claim is further obvious over Starns and Mass-EPA.

i. Ground 3

Starns states, “The most mature, retrofit technology available today is the injection of sorbents such as powdered activated carbon (PAC) into the flue gas upstream of the particle control equipment.” EX1008, 2; EX1002 ¶441.

ii. Ground 4

Mass-EPA discusses powdered activated carbon as “the most extensively studied sorbent” and “most actively researched and tested sorbent[s].” EX1009, 22, 32; EX1002 ¶442.

f. Claim 12: “adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth elements, alkali salts, alkaline earth salts, and combinations thereof.”

Claim 12 is obvious over Mass-EPA (Ground 4). “Increased removal of mercury from gas has been demonstrated by co-injection of activated carbon and calcium-based sorbents.” EX1009, 32. Other alkaline sorbents include: “activated carbon was co-injected with either sodium carbonate or lime for SO₂ control. With either of these sorbents, an improvement in the adsorption of gaseous Hg by the activated carbon was reported.” EX1009, 37. Lime is an alkaline-earth salt, and sodium carbonate (Na₂CO₃) is an alkali salt. EX1002 ¶443.

g. Claims 14-16:

14: “contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.”

15: “the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.”

16: “the secondary component is chosen from I₂, HI, and combinations thereof.”

These claims would have been obvious over Downs-Boiler and Mass-EPA (Ground 4). Mass-EPA injects activated carbon doped with chlorine and iodine, which are exemplary halogens. EX1009, 33; EX1002 ¶¶444-446.

IX. GROUND 5-6: OBVIOUSNESS OVER LISSIANSKI/STARN/MASS-EPA

Ground 5 asserts obviousness of Claims 1, 5-6, and 11 over Lissianski (EX1014) and Starns (EX1008). Ground 6 asserts obviousness of Claims 1, 5-6, 11-12, and 14-16 over Lissianski (EX1014) and Mass-EPA (EX1009). EX1002 ¶447.

A. OVERVIEW OF EX1014 (“LISSIANSKI”)

Lissianski (filed 1/6/2004 and issued 4/7/2009) is entitled, “Method for Removal of Mercury Emissions from Coal Combustion.” Lissianski describes injecting aqueous salt solutions of ammonium halides (referred to as “halogen agent”)—including NH_4Cl , NH_4Br , or NH_4I —into a combustion chamber to help oxidize mercury. EX1014, Abstract, 4:14-29, Figs. 1-2. The halogen agent “allows for improved efficiency of mercury removal by activated carbon (AC) injection.” EX1014, 3:45-49; *see* 3:20-22, claim 8. EX1002 ¶¶240-241, 243-245.

B. ANALOGOUS ART

Starns and Mass-EPA are analogous art. *Supra* §VII.C. Lissianski is analogous art to the '370 Patent as it is in the same field of endeavor and reasonably pertinent to the problems the inventors faced. Lissianski adds halogens to improve the effectiveness of activated carbon in mitigating mercury at power stations. EX1014, 3:45-49, claim 8; EX1002 ¶242.

C. OVERVIEW OF THE COMBINATIONS AND REASONS TO COMBINE

A POSITA would have been motivated to combine Lissianski with Starns (Ground 5) and Lissianski with Mass-EPA (Ground 6), with reasonable expectation of success, because all three references are directed towards the same goal—i.e., removing mercury from coal-combustion flue gases—and are interoperable. EX1002 ¶448.

As described above and further below, Lissianski enhances the effectiveness of mercury removal with PAC injection by adding halogen agents (NH₄Cl, NH₄Br, and NH₄I) to the coal or combustion chamber. EX1014, Abstract, 4:14-29, Figs. 1-2. Lissianski, however, does not fully disclose all details about implementing that PAC injection system, such as injection rates or which activated-carbon to use. Starns and Mass-EPA supply those details, such as hardware and control processes. A POSITA would have been motivated to combine, with reasonable expectation of success, because ACI was well-known in the art, as admitted by the '370 Patent. EX1001, 2:8-15, 7:41-48, 28:11-24; *see* EX1096 (Holmes), 41:5-9; EX1095 (Olson), 114:21-25; EX1097 (Pavlish), 210:4-18. Each combination represents combining prior art elements (activated-carbon sorbent in Lissianski and Starns/Mass-EPA) according to known methods (injection into flue gas in Lissianski and Starns/Mass-EPA) to yield predictable results (mercury removal). EX1002 ¶¶448-453.

1. Ground 5 (Combination of Lissianski with Starns)

Additional reasons to use the ACI of Starns are described above regarding Ground 1. *See supra* §VII.D.1. For example, Starns refers to ACI as the “most mature, retrofit technology available today” (EX1008, 2) and discloses the hardware and control processes to supply PAC to the flue gas of Lissianski. EX1002 ¶¶454-457.

2. Ground 6 (Combination of Lissianski with Mass-EPA)

Additional reasons to use the ACI of Mass-EPA are described above regarding Ground 2. *See supra* §VII.D.2. For example, Mass-EPA refers to ACI as “the most extensively studied sorbent for mercury adsorption.” EX1009, 32. Mass-EPA discloses the hardware and control processes to supply PAC and other sorbent additives to the flue gas. EX1002 ¶¶458-463.

D. DISCLOSURE AND TEACHINGS OF THE COMBINATIONS

Grounds 5 and 6 largely rely on the common disclosure of Lissianski, with certain claim limitations disclosed by Starns (Ground 5) and by Mass-EPA (Ground 6). EX1002 ¶¶447, 464.

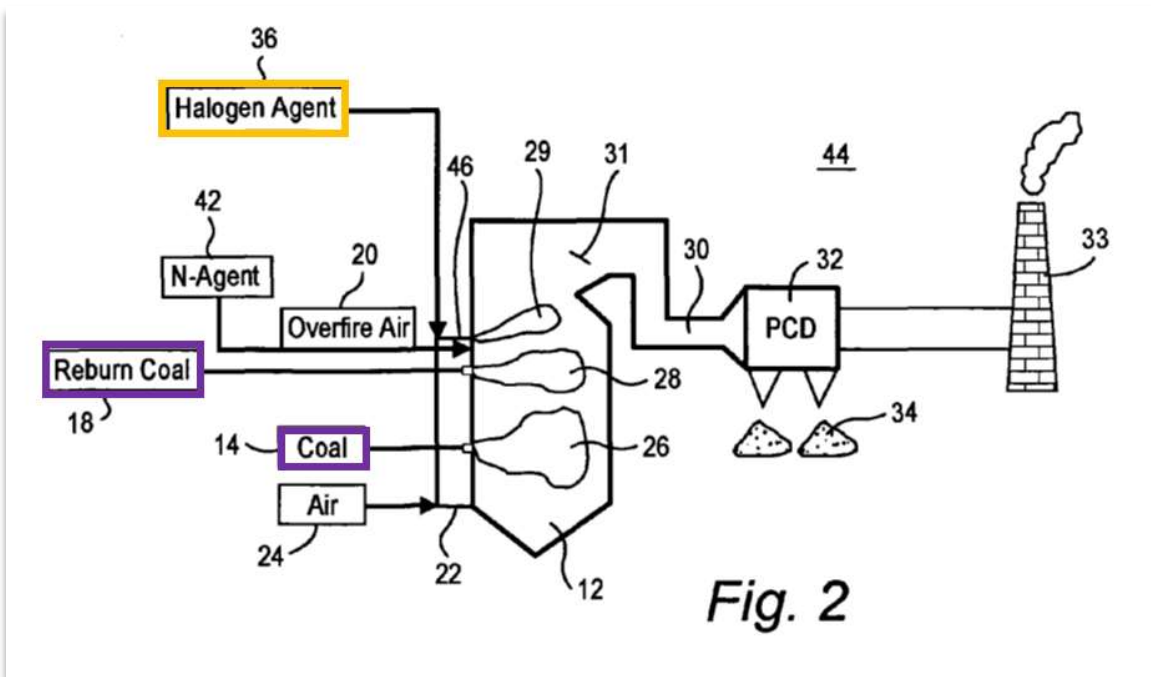
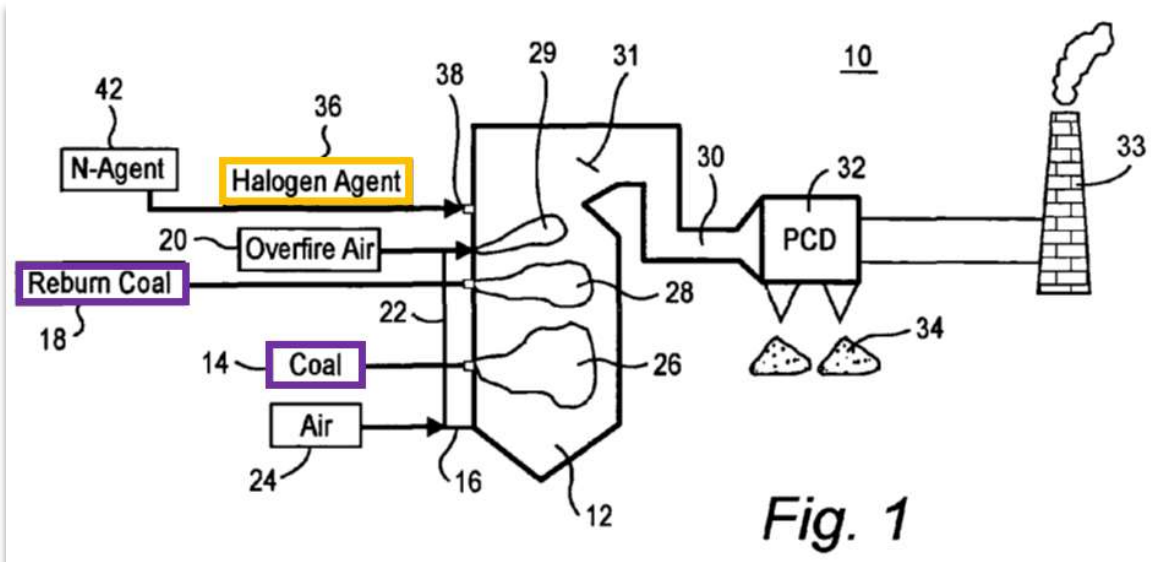
1. **Independent Claim 1**

- a. Element 1(Pre): “A method for separating mercury from a mercury-containing gas, the method comprising”**

Lissianski is entitled, “Method for Removal of Mercury Emissions from Coal Combustion.” EX1014, Title. “Removal of Mercury” refers to separating mercury from mercury-containing gas. The mercury is removed “with an adsorbent in the flue gas.” EX1014, Abstract. The adsorbed mercury is “collect[ed],” which is a form of separating it from the flue gas. EX1014, claim 1; EX1002 ¶465.

- b. Element 1(a): “combusting a mixture of coal and an additive in a combustion chamber, to form the mercury-containing gas, wherein the additive is chosen from halides, halogens, salts thereof, and combinations thereof;”**

Lissianski discusses combusting coal to form the mercury-containing gas. For example, the title is, “Method for Removal of Mercury Emissions from Coal Combustion.” *See also* EX1014, Abstract (“A method to reduce emissions in flue gas due to combustion of coal in the combustion unit”). The term “flue gas” refers to mercury-containing gas. Lissianski refers to the combustion chamber as “furnace 12” or, alternatively, as “boiler 12.” EX1014, 1:1-6. Combustion chamber 12 is shown below in Figures 1-2.



EX1014, Figs. 1-2 (annotated); EX1002 ¶466.

Lissianski describes ammonium halides (referred to as “halogen agent” and annotated gold)—including NH_4Cl , NH_4Br , or NH_4I —into a combustion chamber to help oxidize mercury. EX1014, Abstract, 4:14-29, Figs. 1-2. Each of these are a

halide salt that include a cation (NH_4) and anion (halides Cl, Br, and I). In the combustion chamber, the “hot flue gas causes the additive to thermally decompose to form HCl, HBr, or HI which results in more significant mercury oxidation.” EX1014, 3:42-47; EX1002 ¶467.

A POSITA would have recognized from Lissianski, or at least found it obvious, that the halide agent is mixed with coal for combustion. In Figures 1 and 2 of Lissianski, a mixture of halide agent (item 36, annotated gold) and coal (items 14 and 18, annotated purple) is combusted in combustion chamber 12. As shown in Figures 1 and 2, coal (annotated purple) is added to the combustion chamber in two places:

Most of the coal is burned in a primary combustion zone 26 of the boiler 12. The remaining coal (or fuel) is injected downstream into the reburn zone 28 through the reburn injectors 18 to provide fuel-rich combustion in the reburn zone 28.

EX1014, 4:5-9; *see* 4:43-69 (discussing reburn system).¹⁰ The halogen agent mixes with both the primary coal and reburn coal, because as Lissianski explains, the injectors are designed to ensure thorough mixing between coal and additive:

¹⁰ As Dr. Niksa explains, reburn coal is a technique in which a portion of pulverized coal that is normally burnt as primary fuel is first partially burned and then injected into a second combustion zone, in the upper part of the boiler. This allows the reburn

The halogen additive can be co-injected with air, recycled flue gas, nitrogen or another carrier gas to increase the penetration of the additive...

In either case, the halogen agent (additive) is in a mixture with coal that is combusted. EX1002 ¶¶468-469.

c. Element 1(b): “adding a particulate sorbent material comprising activated carbon into the mercury-containing gas,”

i. Grounds 5-6

Lissianski discloses “mercury removal by activated carbon injection,” a type of particulate sorbent material. EX1014, 3:21-22; *see* EX1014, 3:45-49, cl. 7. A POSITA would have understood that the active carbon injection occurs into the mercury-containing gas, downstream of the combustion chamber. For instance, a POSITA would have understood that the activated carbon is used to adsorb mercury in the flue gas. EX1014, 3:42-49; EX1002 ¶¶470-471.

ii. Ground 5

Starns further confirms that by “injection of sorbents such as powdered activated carbon (PAC) into the flue gas,” the “gas-phase mercury in the flue gas

coal to react with unburned materials from the primary burn and associated NO_x, and helps reduce overall NO_x emissions from the power plant. EX1002 ¶468.

contacts the sorbent and attaches to its surface.” EX1008, 2; *see* 7-9. A “powdered” sorbent is in particulate form. EX1002 ¶472.

iii. Ground 6

Mass-EPA confirms that “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21 n.25; *see* 33 (“mercury to contact the AC [(activated carbon)] particle”). EX1002 ¶473.

d. Element 1(c): “wherein a weight ratio of the additive added to the coal, added to the combustion chamber, or a combination thereof, to an amount of the sorbent material added to the mercury-containing gas is from about 1:100 to about 30:100;”

Claim Element 1(c) is obvious over the combinations of Lissianski with Starns (Ground 5) and Lissianski with Mass-EPA (Ground 6). Lissianski identifies halogen concentration in the mercury-containing flue gas, and Starns and Mass-EPA describe the sorbent concentration. EX1002 ¶¶474-485.

Lissianski discloses modeling of mercury oxidation, based on supplying halogen-containing additives to the mercury-containing gas at 0.3 ppm and/or 3 ppm.

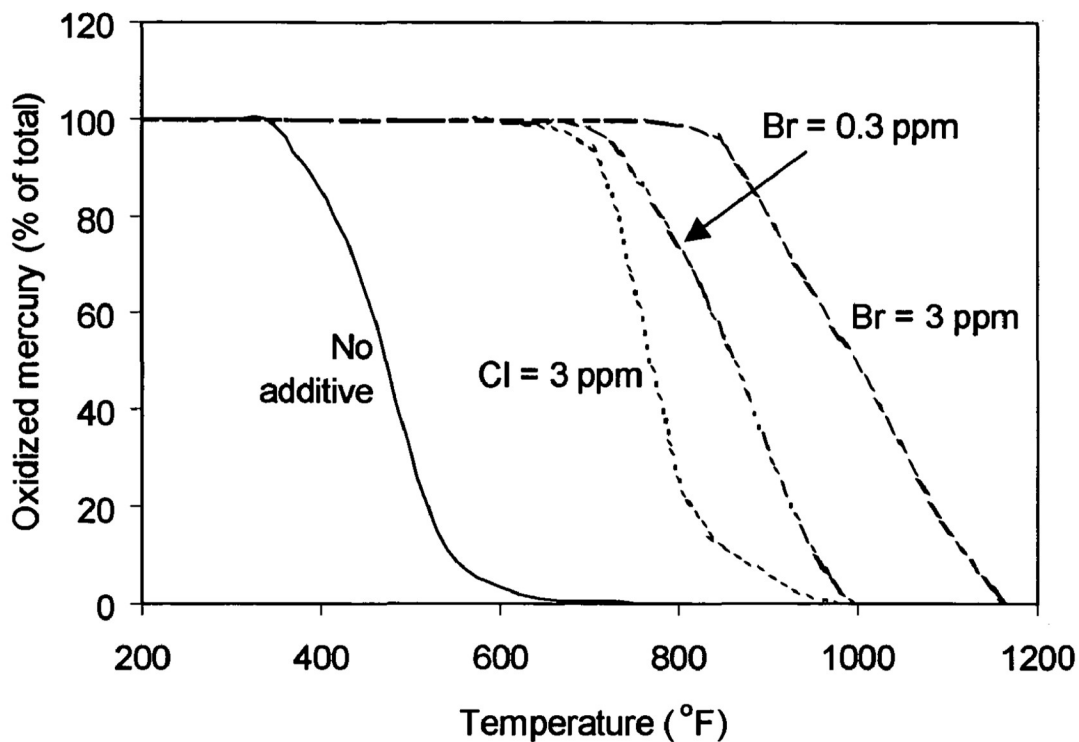


Fig. 9

EX1014, Fig. 9; *see* 6:63-7:6 (describing the modeling). As Dr. Niksa explains, and as taught by Lissianski, mercury oxidation tends to proceed more effectively at lower temperatures (i.e., as the temperature increases, the fraction of oxidized mercury is lower compared to elemental mercury) and higher halogen concentrations. Given the emphasis in Lissianski of increasing the fraction of oxidized mercury, a POSITA would have been motivated to select the 3 ppm value for halogen-agent concentration injected into the combustion chamber. *See, e.g.*, EX1014, Abstract, 1:14-51, 2:2-13, 3:12-50, 6:53-7:6, claim 1; EX1002 ¶¶474-476. Dr. Niksa explains

how a POSITA would have been able to calculate gas-phase concentration of halogen agent based on the data presented by Lissianski. A POSITA would have understood that, as compared to the halogen concentration of native coal, nearly all the gas-phase concentration of Cl, Br, and I comes from the halogen agent. EX1014, 1:53-67; EX1002 ¶¶476, 479-484.

Lissianski discloses injecting activated carbon, but not its gas-phase concentration. As Dr. Niksa explains with source citations, it was routine to use injection rates of around 10 pounds/MMacf of flue gas to capture mercury. EX1002 ¶477; *see* ¶¶114-115. This is the value used by Starns (Ground 5) and by Mass-EPA (Ground 6). EX1008, 20; EX1009, 12, 73.

Dr. Niksa explains how a POSITA would have been readily capable of converting between units of ppm Br, I, and Cl (Lissianski) and sorbent concentration (Starns and Mass-EPA), and then dividing the two to determine a ratio. This involves fundamental calculations taught in undergraduate chemistry, such as unit conversions (e.g., between Liters and ft³ and pounds to grams) and the ideal gas law ($PV=nRT$). Dr. Niksa performs the unit conversions, including at the actual flue-gas temperatures disclosed by Starns (EX1008, 10) and Mass-EPA (EX1009, 26). The 3.0 ppm of halogen agent (e.g., NH₄Br, NH₄I, and/or NH₄Cl) added to the combustion chamber in Lissianski, and the well-known injection rate of 10 pounds sorbent per MMacf (as disclosed in Starns and Mass-EPA), provides a mercury-

containing gas as follows: 7.9 grams ammonium iodide per 100 grams of sorbent; 5.4 grams ammonium bromide per 100 grams of sorbent; and 2.9 grams ammonium chloride per 100 grams of sorbent. Each of these is within the claimed range of 1:100-30:100. It would have been obvious to try other ratios, such as by increasing halogen concentration (while reducing activated-carbon injection rates), or decreasing halogen concentration (while increasing activated-carbon injection) as part of routine process optimization to achieve the desired mercury removal. EX1002 ¶¶479-485.

Claim Element 1(c) is merely an attempt to claim a workable range for combining a conventional halogen (bromine, iodine, chlorine) being used in a conventional way (to oxidize mercury and promote activated carbon) with a conventional sorbent (activated carbon). Nothing in the '370 Patent specification attributes significance to the claimed range or establishes that the claimed range “achieves unexpected results.” The range presents nothing more than optimization of “result-effective” variables that would have been obvious to a POSITA. *Applied Materials*, 692 F.3d at 1297-98; *Pfizer*, 94 F.4th at 1347 (“decades-old legal principle that “where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine

experimentation”); EX1002 ¶485.¹¹ Patent Owner has previously admitted this the “claimed ratio of 1-30 grams promoter per 100 grams of sorbent ... is entitled to no patentable weight.” EX1105, 34. “The range presented nothing more than optimization of result-effective variables that would have been obvious to a POSITA.” EX1105, 35.

e. Element 1(d): “contacting mercury in the mercury-containing gas with the sorbent material, to form a mercury-sorbent; and”

i. Grounds 5-6

Lissianski discloses this claim element. Lissianski discloses “adsorbing the oxidized mercury generated by the combustion of the coal with an adsorbent in the flue gas.” EX1014, 2:10-12. Lissianski further describes that “[o]xidized mercury ... is water soluble and is easily adsorbed on high carbon fly ash or activated carbon.” EX1014, 1:35-36. The “adsorbing” process that Lissianski describes refers

¹¹ As PO’s expert in the Delaware Litigation stated, “power plants employing bromine additives and activated carbon would necessarily produce a sorbent that is 1 g to 30 g bromine per 100 g of activated carbon.” EX1092, 153 (cl. 4). He further cited to this analysis for a claim that requires “the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent. EX1092, 154 (cl. 29).

to a process by which adsorbate (e.g., atoms, ions, or molecules) in a fluid (typically a gas) are bound to the surface of a sorbent, and thus by definition the sorbent is “contacting mercury in the mercury-containing gas” and forming a mercury-sorbent composition. EX1002 ¶486.

ii. Ground 5

Starns further confirms that by “injection of sorbents such as powdered activated carbon (PAC) into the flue gas,” the “gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface.” EX1008, 2. A “powdered” sorbent is in particulate form. EX1002 ¶487.

iii. Ground 6

Mass-EPA confirms that “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21 n.25; *see* 33 (“mercury to contact the AC [(activated carbon)] particle”). EX1002 ¶488.

f. Element 1(e): “separating the mercury-sorbent from the mercury-containing gas.”

Lissianski discloses this claim element. Lissianski discloses “collecting the adsorbent with the oxidized mercury in a combustion waste treatment system.” EX1014, 2:13-14. Indeed, as described by Lissianski, it was well known that “volatized mercury can be captured by coal fly ash and removed via a particulate collection system.” EX1014, 1:15-17; *see* EX1014, 1:37-38. Lissianski discloses such a particulate collection system as PCD **32** in, for example, Figures 1-2 shown

above. EX1002 ¶489. This claim limitation would be further obvious over Starns (Ground 5) and Mass-EPA (Ground 6), each of which disclose separating the mercury-sorbent composition with an ESP. EX1002 ¶¶490-491.

2. Claims Depending from Claim 1

a. Claim 5: “carbocations in the activated carbon of the mercury-sorbent accept electrons from mercury atoms of the mercury-sorbent.”

According to Patent Owner’s expert in the Delaware litigation, this chemical reaction takes place between the activated carbon and mercury. EX1092, 160 (’147 Patent Claim 1c); EX1002 ¶492.

b. Claim 6: “the additive is substantially in vapor form in the mercury-containing gas.”

As discussed for Element 1(a), Lissianski discloses adding aqueous salt solutions of ammonium halides. Lissianski discloses that the “halogen containing additive is injected where the flue gas is in a temperature range of 1600 °F to 2300 °F.” EX1014, cl. 7; *see* 4:17-19. At this high of a temperature, the additive is in vapor form. EX1014, 3:42-47 (the ammonium halides “thermally decompose” in the “hot flue gas”); 4:23 (“mixing of the additive aqueous solution and flue gas”). EX1002 ¶493.

a. Claim 11: “the activated carbon is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof.”

As described for Claim 1, Lissianski discloses “activated carbon.” A POSITA would have understood that this is a shorter form of stating “powdered activated carbon.” EX1002 ¶494. This claim would be further obvious in view of Starns and Mass-EPA.

i. Ground 5

Starns states, “The most mature, retrofit technology available today is the injection of sorbents such as powdered activated carbon (PAC) into the flue gas upstream of the particle control equipment.” EX1008, 2; EX1002 ¶495.

ii. Ground 6

Mass-EPA discusses powdered activated carbon as “the most extensively studied sorbent” and “most actively researched and tested sorbent[s].” EX1009, 22, 32; EX1002 ¶495.

b. Claim 12: “adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth elements, alkali salts, alkaline earth salts, and combinations thereof.”

Claim 12 would have been obvious over Lissianski and Mass-EPA (Ground 6). Mass-EPA states, “Increased removal of mercury from gas has been

demonstrated by co-injection of activated carbon and calcium-based sorbents”

EX1009, 32. Other alkaline sorbents include “activated carbon was co-injected with either sodium carbonate or lime for SO₂ control. With either of these sorbents, an improvement in the adsorption of gaseous Hg by the activated carbon was reported.”

EX1009, 37. Lime is an alkaline-earth salt, and sodium carbonate (Na₂CO₃) is an alkali salt. EX1002 ¶496.

c. Claims 14-16:

14: “contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.”

15: “the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.”

16: “the secondary component is chosen from I₂, HI, and combinations thereof.”

These claims would have been obvious over Lissianski and Mass-EPA (Ground 6). Mass-EPA injects activated carbon doped with chlorine (Cl₂) and iodine (I₂), which are exemplary halogens. EX1009, 33; EX1002 ¶¶497-499.

X. THE BOARD SHOULD NOT DISCRETIONARILY DENY INSTITUTION

The Board should not deny institution under 35 U.S.C. §314(a), because the district-court proceeding has barely begun, and Petitioner WEC is not a party to the

district-court proceedings. The MDL Panel consolidated the Arizona¹²/Missouri/Iowa actions into multidistrict litigation in the Southern District of Iowa for pretrial proceedings (Dec. 17, 2024). On January 10, 2025, the Iowa court dismissed BHE outright. The Court transferred PacifiCorp to the District of Wyoming and transferred Wisconsin Power & Light to the District of Wisconsin. Those actions were subsequently transferred back to the MDL in the Southern District of Iowa. On March 7, 2025, the MDL issued a Case Management Order, including a “Trial Ready Date” of October 12, 2026. This date is a no-earlier-than date and, in any event, “applies solely to cases originally filed in the United States District Court for the Southern District of Iowa.” EX1104 (MDL Dkt. 60). A Final Written Decision in the present IPR proceeding is expected before the trial ready date in Iowa. Further, for Petitioners PacifiCorp and WPL, trial will be at indeterminate future date, after October 12, 2026.

The Board should not deny institution under 35 U.S.C. §325(d). Starns or Mass-EPA is used in every obviousness combination, and neither was cited on the cover of the patent or considered by the examiner. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17-18 (Dec. 15, 2017) (factors (a)-(b) and (d) indicate the same art was not presented previously to the Office).

¹² The Arizona action since settled.

While the '370 Patent cites Downs-Boiler (EX1006) and Lissianski (EX1014) on the cover—among **18 columns** (9 pages) of cited references—the examiner did not use any of those references in a substantive rejection. *Id.*, 17-18 (factors (a)-(d)). Furthermore, the Examiner erred by not citing Lissianski or Downs-Boiler during prosecution. *Id.*, 17-18 (factor (e)). “[O]verlooking specific teachings of the relevant prior art” is an example of a “material error.” *Advanced Bionics*, IPR2019-01469, Paper 6, at 8-9, n.9.

Among all the asserted references in this Petition, the Examiner discussed a counterpart to Vosteen589 during prosecution. However, the Examiner only cited to that counterpart as a secondary reference, finding that it “discloses the additive is chosen from Br₂, HBr, sodium bromide, calcium bromide, and a combination thereof (paragraph [0010]) and “discloses the additive is mixed with the coal and is a liquid and wherein the liquid is a hydrocarbon, chlorinated hydrocarbon, supercritical carbon dioxide, water, salt solution, or a combination thereof (paragraph [0014]).” EX1023, 1625-1626 (5/27/2020 Office Action). Applicants did not dispute these findings. Rather Applicants distinguished the counterpart to Vosteen589 and other prior art based on the claimed 1-30% ratio. EX1023, 1592-1609. Yet, in another proceeding before the Board, PO argued that this claim limitation should be given “no patentable weight,” and that the “range presented nothing more than optimization of results-effective variables that would have been obvious to a

POSITA.” EX1105, 34-35. The Examiner erred by overlooking key teachings, and by allowing the claims because of the 1-30 ratio. EX1023, 1574.

XI. CONCLUSION

Petitioners respectfully request that IPR of the '370 Patent be instituted and that the Challenged Claims be cancelled as unpatentable.

Respectfully submitted,

March 24, 2025

Date

/s/Brian W. Oaks

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ATTORNEYS FOR PETITIONERS

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition, exclusive of the exempted portions as provided in 37 C.F.R. § 42.24(a), contains 13,823 words which is no more than 14,000 words and therefore complies with the type-volume limitations of 37 C.F.R. § 42.24(a). 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.

Dated: March 24, 2025

/s/Brian W. Oaks

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LEAD ATTORNEY FOR PETITIONERS

CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. §§ 42.6(e) and 42.105, the undersigned certifies that on the 24th day of March 2025, a complete and entire copy of the PETITION FOR *INTER PARTES* REVIEW (“petition”), Power of Attorney and related Exhibits were served on Patent Owner at the correspondence address of record for the subject patent:

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
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via Express Mail or by means at least as fast and reliable as Express Mail. Additionally, a courtesy copy was served via electronic mail on the Patent Owner’s counsel at the following email address:

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