

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

Birchtech Corp.

Patent Owner

---

IPR2025-00422  
Patent No. 10,668,430

**PETITION FOR *INTER PARTES* REVIEW**

**TABLE OF CONTENTS**

TABLE OF CONTENTS .....i  
TABLE OF AUTHORITIES .....iv  
TABLE OF EXHIBITS.....vi  
TABLE OF CHALLENGED CLAIMS.....xx  
I. INTRODUCTION ..... 1  
II. MANDATORY NOTICES [37 C.F.R. §42.8(A)(1)] ..... 1  
    A. Real Party-In-Interest [37 C.F.R. §42.8(b)(1)] ..... 1  
    B. Related Matters [37 C.F.R. §42.8(b)(2)].....3  
    C. Lead and Back-Up Counsel [37 C.F.R. §42.8(b)(3)].....7  
    D. Service Information [ 37 C.F.R. §42.8(b)(4)] ..... 10  
III. FEES ..... 10  
IV. REQUIREMENTS FOR *INTER PARTES* REVIEW [37 C.F.R. §42.104(a),  
    (b)(1)-(b)(3)] ..... 10  
    A. Standing..... 10  
    B. Identification of Challenged Claims and Grounds..... 11  
    C. Claim Construction [37 CFR §42.104(b)(3)]..... 11  
V. OVERVIEW OF '430 PATENT ..... 12  
    A. Level of Ordinary Skill ..... 12  
    B. The Alleged Invention of the '430 Patent..... 12  
    C. Prosecution History of the '430 Patent ..... 13  
    D. State of the Art ..... 14  
        1. Mercury and Halogens..... 14  
        2. Coal-Fired Power Plants ..... 14  
        3. EPA Regulations..... 15  
        4. Mercury Removal Using Activated Carbon and Halogens..... 15  
VI. THE ASSERTED REFERENCES ..... 17  
VII. GROUNDS 1-2: OBVIOUSNESS OVER  
    VOSTEEN589/STARNS/MASS-EPA..... 18  
    A. Overview of EX1005 (“Vosteen589”) ..... 18

B.	Overview of EX1008 (“Starns”) and EX1009 (“Mass-EPA”) .....	18
1.	Starns (Grounds 1 and 4) .....	19
2.	Mass-EPA (Grounds 2 and 5).....	22
C.	Analogous Art .....	25
D.	Overview of the Combinations and Reasons to Combine .....	25
1.	Ground 1 (Combination of Vosteen589 with Starns).....	27
2.	Ground 2 (Combination of Vosteen589 with Mass-EPA).....	29
E.	Disclosure and Teachings of the Combinations.....	30
1.	Independent Claim 1 .....	30
2.	Claims Depending from Claim 1 .....	35
3.	Independent Claim 28 .....	56
4.	Independent Claim 29 .....	58
VIII.	GROUND 3: ANTICIPATION BY DOWNS-BOILER.....	61
A.	Overview of EX1006 (“Downs-Boiler”) .....	61
B.	Disclosure of Downs-Boiler.....	62
1.	Independent Claim 1 .....	62
2.	Claims Depending from Claim 1 .....	66
3.	Independent Claim 28 .....	76
IX.	GROUNDS 4-5: OBVIOUSNESS OVER DOWNS- BOILER/STARNs/MASS-EPA.....	77
A.	Analogous Art .....	78
B.	Overview of the Combinations and Reasons to Combine .....	78
1.	Ground 4 (Combination of Downs-Boiler with Starns) .....	79
2.	Ground 5 (Combination of Downs-Boiler with Mass-EPA) ....	79
C.	Disclosure and Teachings of the Combinations.....	80
1.	Independent Claim 1 .....	80
2.	Claims Depending from Claim 1 .....	81
3.	Other Dependent Claims.....	94
4.	Independent Claim 28 .....	95
5.	Independent Claim 29 .....	96

X. THE BOARD SHOULD NOT DISCRETIONARILY DENY  
INSTITUTION.....97

XI. CONCLUSION.....99

CERTIFICATE OF COMPLIANCE .....100

CERTIFICATE OF SERVICE .....101

**TABLE OF AUTHORITIES**

	<b>Page(s)</b>
<b>Cases</b>	
<i>Advanced Bionics, LLC v. Med-El Elektromedizinische Gerate GmbH</i> , IPR2019-01469, Paper 6 (P.T.A.B. Feb. 13, 2020).....	99
<i>Amgen Inc. v. Sanofi</i> , 872 F.3d 1367 (Fed. Cir. 2017) .....	61
<i>In re Applied Materials, Inc.</i> , 692 F.3d 1289 (Fed. Cir. 2012) .....	45, 88
<i>Becton, Dickinson &amp; Co. v. B. Braun Melsungen AG</i> , IPR2017-01586, Paper 8 (Dec. 15, 2017) .....	98, 99
<i>Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.</i> , 800 F.3d 1375 (Fed. Cir. 2015) .....	61
<i>GoPro, Inc. v. Contour IP Holding LLC</i> , 908 F.3d 690 (Fed. Cir. 2018) .....	18
<i>Koninklijke Philips N.V. v. Google LLC</i> , 948 F.3d 1330 (Fed. Cir. 2020) .....	<i>passim</i>
<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00832, Paper 17, 2020 WL 6277239 (P.T.A.B. Oct. 26, 2020) .....	4
<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00834, Paper 18, 2020 WL 6277747 (P.T.A.B. Oct. 26, 2020) .....	4
<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00926, Paper 19, 2020 WL 7061347 (P.T.A.B. Dec. 2, 2020) .....	5
<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00928, Paper 17, 2020 WL 7074473 (P.T.A.B. Dec. 2, 2020) .....	5

*PowerOasis, Inc. v. T-Mobile USA, Inc.*,  
522 F.3d 1299 (Fed. Cir. 2008) .....18

**Statutes**

35 U.S.C. §102 .....19  
35 U.S.C. §314(a) .....97  
35 U.S.C. §325(d) .....98

**Other Authorities**

310 Code of Massachusetts Regulations 7.29 .....22  
Fed. R. Evid. 803(8).....22  
Fed. R. Evid. 902(1)(A) .....22

**TABLE OF EXHIBITS**

<b>Exhibit</b>	<b>Description of Exhibits</b>
1001	U.S. Patent No. 10,668,430 to Olson et al. (filed May 8, 2018) ( <b>“430 Patent” or “Challenged Patent”</b> )
1002	Declaration of Dr. Stephen Niksa in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,668,430 ( <b>“430 Niksa Decl.”</b> )
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) ( <b>“Vosteen589”</b> )
1006	U.S. Patent Pub. No. 2008/0107579 to Downs et al. (published May 8, 2008) ( <b>“Downs-Boiler”</b> )
1007	U.S. Patent Prov. App. No. 60/555,353 (filed Mar. 22, 2004) ( <b>“Downs-Boiler-Provisional”</b> )
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 <sup>TH</sup> ANNUAL CONFERENCE (Baltimore, MD: June 23-27, 2002) ( <b>“Starns”</b> )

Exhibit	Description of Exhibits
1009	<p>Massachusetts Dep. of Environmental Protection, Bureau of Waste Prevention, “Evaluation of the Technological and Economic Feasibility of Controlling and Eliminating Mercury Emissions from the Combustion of Solid Fossil Fuel” (Dec. 2002) (“<b>Mass-EPA</b>”), available at</p> <p><a href="https://web.archive.org/web/20030411074158/http://www.state.ma.us/dep/bwp/daqc/files/mercfeas.pdf">https://web.archive.org/web/20030411074158/http://www.state.ma.us/dep/bwp/daqc/files/mercfeas.pdf</a></p> <p>and at <a href="https://www.mass.gov/doc/evaluation-of-technological-economic-feasibility-of-controlling-eliminating-mercury-emissions/download">https://www.mass.gov/doc/evaluation-of-technological-economic-feasibility-of-controlling-eliminating-mercury-emissions/download</a></p>
1010	<p>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) (“<b>Sjostrom</b>”)</p>
1011	<p>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) (“<b>Eckberg</b>”)</p>
1012	<p>U.S. Patent Pub. No. 2006/0048646 to Olson et al. (published Mar. 9, 2006) (“<b>Olson-646</b>”)</p>
1013	<p>U.S. Patent No. 6,953,494 to Nelson (filed May 6, 2003) (“<b>Nelson</b>”)</p>
1014	<p>U.S. Patent No. 7,514,052 to Lissianski et al. (filed Apr. 7, 2009) (“<b>Lissianski</b>”)</p>

Exhibit	Description of Exhibits
1015	RESERVED
1016	RESERVED
1017	RESERVED
1018	U.S. Patent No. 8,652,235 to Olson et al. (issued February 18, 2014) ( <b>“Olson-235”</b> )
1019	File History of U.S. Patent Application No. 15/974,343, which ultimately issued as U.S. Patent No. 10,668,430 ( <b>“430 Patent File History”</b> ).
1020	File History of U.S. Patent Prov. App. No. 60/605,640 ( <b>“Provisional”</b> )
1021	File History of U.S. Patent Application No. 11/209,163, which ultimately issued as U.S. Patent No. 7,435,286 ( <b>“163 Application File History”</b> )
1022	File History of U.S. Patent Application No. 12/201,595, which ultimately published as 2009/0062119 and was abandoned ( <b>“595 Application File History”</b> )
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 ( <b>“370 Patent File History”</b> ).

<b>Exhibit</b>	<b>Description of Exhibits</b>
1024	File History of U.S. Patent Application No. 15/997,091, which ultimately issued as U.S. Patent No. 10,596,517 (“ <b>517 Patent File History</b> ”).
1025	File History of U.S. Patent Application No. 12/419,219, which ultimately issued as U.S. Patent No. 8,168,147 (“ <b>147 Patent File History</b> ”).
1026	File History of U.S. Patent Application No. 15/978,760 (issued as U.S. Patent No. 10,343,114) (“ <b>114 Patent File History</b> ”)
1027	Babcock & Wilcox, STEAM: ITS GENERATION AND USE, 40th ed. (The Babcock & Wilcox Company: 1992) (“ <b>B&amp;W: Steam</b> ”)
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) (“ <b>Bustard</b> ”)
1029	U.S. Patent No. 1,984,164 to Stock et al. (issued Dec. 11, 1934) (“ <b>Stock</b> ”)
1030	Electric Utilities Environment Conference 2005 Handout (“ <b>EUEC Handout</b> ”)
1031	Scan of jacket/cover of CD mailed to conference attendees from EUEC: 8th Electric Utilities Environmental Conference (Tucson, Arizona: January 23-26, 2005) (“ <b>EUEC CD Scan</b> ”)

Exhibit	Description of Exhibits
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-Boiler-Provisional as the original version ( <b>“Downs-Boiler-Redline”</b> )
1033	U.S. Patent No. 8,512,655
1034	U.S. Patent No. 8,821,819
1035	U.S. Patent No. 9,757,689
1036	CRC Handbook of Chemistry and Physics, 86th Ed.; Lide, D.R., ed. ( <b>“CRC Press: March 2005”</b> )
1037	Paul Chu, “Power Plant Evaluation of the Effect of SCR Technology on Mercury,” Paper No. 106, COMBINED POWER PLANT AIR POLLUTANT CONTROL MEGA SYMPOSIUM (MEGA) (Washington, DC: May 19-22, 2003) ( <b>“Power Plant Evaluation”</b> )
1038	Evan J. Granite et al., “Sorbents for Mercury Removal from Flue Gas,” DOE/FETC/TR-98-01, U.S. Department of Energy (Jan. 1998) ( <b>“Granite”</b> )
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&amp;D Program Review</i> (April 2003) ( <b>“Feeley”</b> )

Exhibit	Description of Exhibits
1040	Oxtoby et al., PRINCIPLES OF MODERN CHEMISTRY, 4 <sup>th</sup> ed (Saunders College Publishing: 1999) (“ <b>Oxtoby</b> ”)
1041	N.N. Greenwood and A. Earnshaw, CHEMISTRY OF THE ELEMENTS, 2nd ed. (Butterworth-Heinemann: 1997) (“ <b>Greenwood</b> ”)
1042	B.R. Puri, <i>Surface Complexes on Carbons</i> , in CHEMISTRY AND PHYSICS OF CARBON 191 (Philip L. Walker, ed.) (Marcel Dekker: 1970) (“ <b>Puri</b> ”)
1043	Frank E. Huggins et al., “XAFS Examination of Mercury Sorption on Three Activated Carbons,” <i>Energy &amp; Fuels</i> 1999(13), p. 114-121 (1999) (“ <b>XAFS</b> ”)
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) (“ <b>Hg Speciation</b> ”)
1045	D.L. Laudal et al., <i>Evaluation of Mercury Speciation at Power Plants Using SCR and SNCR NO<sub>x</sub> Control Technologies</i> , Paper No. A5-01, INT’L CONF. ON AIR QUALITY III (Arlington, VA: Sept. 9-12, 2002) (“ <b>Laudal</b> ”)
1046	U.S. Patent No. 4,196,173 to DeJong (“ <b>DeJong</b> ”)
1047	U.S. Patent No. 5,695,726 to Lerner (“ <b>Lerner</b> ”)
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 &amp; Waste</i>

Exhibit	Description of Exhibits
	<p><i>Management Association</i>, 48(12), 1166–1174.  <a href="https://doi.org/10.1080/10473289.1998.10463753">https://doi.org/10.1080/10473289.1998.10463753</a> (“Carey”)</p>
1049	<p>NETL - Mercury Emissions Control, February, 2003, available at  <a href="https://web.archive.org/web/20030315093905fw_/http://www.netl.doe.gov/coalpower/environment/mercury/control-tech/inactive.html">https://web.archive.org/web/20030315093905fw_/http://www.netl.doe.gov/coalpower/environment/mercury/control-tech/inactive.html</a>  <b>(“U.S. DOE, Completed Mercury Projects, February, 2003”)</b></p>
1050	<p>Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 69 Fed. Reg. 4652-4752 [Volume 69, No. 20] (Jan. 30, 2004) (<b>“EPA-Proposal”</b>)</p>
1051	<p>U.S. EPA, “Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generation Units -- Final Report to Congress,” (Vol. 1 1998), available at  <a href="https://www3.epa.gov/ttn/utox/eurtc1.pdf">https://www3.epa.gov/ttn/utox/eurtc1.pdf</a> (<b>“U.S. EPA – Vol. 1 1998”</b>)</p>
1052	<p>U.S. EPA, “Mercury Study Report to Congress Volume 1: Executive Summary,” EPA-452/R-97-003 (Dec. 1997), available at  <a href="https://www.epa.gov/sites/production/files/2015-09/documents/volume1.pdf">https://www.epa.gov/sites/production/files/2015-09/documents/volume1.pdf</a> (<b>“U.S. EPA – Exec. Summary Vol. 1 Dec. 1997”</b>)</p>
1053	<p>U.S. EPA, AP-42: External Combustion Sources, Chapter 1: Fifth Edition, Volume I (Sep. 1998), available at  <a href="https://www3.epa.gov/ttn/chief/ap42/ch01/index.html">https://www3.epa.gov/ttn/chief/ap42/ch01/index.html</a> (last visited Nov. 20, 2024) (<b>“Chapter 1 of AP-42”</b>)</p>

Exhibit	Description of Exhibits
1054	U.S. DOE, Mercury Emissions Control - Regulatory Drivers (Jan. 24, 2003), available at <a href="https://web.archive.org/web/20030416142937/http://www.netl.doe.gov/coalpower/environment/mercury/regs.html">https://web.archive.org/web/20030416142937/http://www.netl.doe.gov/coalpower/environment/mercury/regs.html</a> (“ <b>Mercury Emissions Control</b> ”)
1055	Clean Air Mercury Rule: Basic Information, available at <a href="https://web.archive.org/web/20050920005951/http://www.epa.gov/mercuryrule/basic.htm">https://web.archive.org/web/20050920005951/http://www.epa.gov/mercuryrule/basic.htm</a> (“ <b>Clean Air Mercury Rule</b> ”)
1056	EPA Newsroom, “EPA Announces First-Ever Rule to Reduce Mercury Emissions from Power Plants” (Mar. 15, 2005), available at <a href="https://archive.epa.gov/epapages/newsroom_archive/newsreleases/91ab7266e65751b985256fc50067d9b0.html">https://archive.epa.gov/epapages/newsroom_archive/newsreleases/91ab7266e65751b985256fc50067d9b0.html</a> (“ <b>3/15/2005 EPA Press Release</b> ”)
1057	EPA Newsroom, “Public Comment Period Begins for Proposed Power Plant Regulations” (Jan. 29, 2004), available at <a href="https://archive.epa.gov/epapages/newsroom_archive/newsreleases/4daf1d46e8dd755c85257036005511f9.html">https://archive.epa.gov/epapages/newsroom_archive/newsreleases/4daf1d46e8dd755c85257036005511f9.html</a> (“ <b>1/29/2004 EPA Press Release</b> ”)
1058	EPA Newsroom, “EPA Supplements Proposal to Reduce Power Plant Mercury Emissions,” (Feb. 24, 2004), available at <a href="https://archive.epa.gov/epapages/newsroom_archive/newsreleases/5810096dabfc9eba85256e440078905f.html">https://archive.epa.gov/epapages/newsroom_archive/newsreleases/5810096dabfc9eba85256e440078905f.html</a> (“ <b>2/24/2004 EPA Press Release</b> ”)
1059	Sharon Sjostrom et al., “Field Studies of Mercury Control Using Injected Sorbents,” AWWA ANNUAL MEETING, Session Ae-1b (2002) (“ <b>Field Studies of Mercury Control</b> ”)

Exhibit	Description of Exhibits
1060	EPA, “Mercury Study Report to Congress Volume VIII: An Evaluation of Mercury Control Technologies and Costs,” EPA Report No. EPA-452/R-97-010 (Dec. 1997), available at <a href="https://www3.epa.gov/airtoxics/112nmerc/volume8.pdf">https://www3.epa.gov/airtoxics/112nmerc/volume8.pdf</a> (“EPA 1997 Mercury Study Report Vol. VIII”)
1061	EUEC 2005 home page, available at <a href="https://web.archive.org/web/20050303090129/http://www.euec.com/">https://web.archive.org/web/20050303090129/http://www.euec.com/</a>
1062	Charlene R. Crocker et al., “Mercury Control with the Advanced Hybrid Particulate Collector Technical Progress Report,” U.S. DOE-NETL (Nov. 2003) (“ <b>Crocker</b> ”)
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	U.S. Patent No. 10,933,370
1067	U.S. Patent No. 10,589,225

<b>Exhibit</b>	<b>Description of Exhibits</b>
1068	File History of U.S. Patent Application No. 14/712,558, which ultimately issued as U.S. Patent No. 10,589,225 (“ <b>225 Patent File History</b> ”)
1069	U.S. Patent Pub. No. 2018/0257030 to Olson et al. (published Sep. 13, 2018) (“ <b>Published ’343 Application</b> ”)
1070	Roop Chand Bansal, et al., ACTIVE CARBON (Marcel Dekker:1988). (“ <b>Bansal</b> ”)
1071	<i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher &amp; Co., et al.</i> , No. 1:19-cv-01334-CJB, Dkt. No. 440 (D. Del. June 24, 2022). (“ <b>Dkt No. 440</b> ”)
1072	<i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher &amp; Co., et al.</i> , No. 1:19-cv-01334-CJB, Dkt. No. 447 (D. Del. July 12, 2022). (“ <b>Dkt No. 447</b> ”)
1073	Welcome Page of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 <sup>th</sup> Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“ <b>AWMA CD Scan</b> ”)
1074	Main Menu of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 <sup>th</sup> Annual Conference & Exhibition (Baltimore, Maryland: June 23-27, 2002) (“ <b>AWMA CD Scan, Main Menu</b> ”)
1075	Author Index of CD mailed to conference attendees of the 2002 Air & Waste Management’s Association’s 95 <sup>th</sup> Annual Conference &

Exhibit	Description of Exhibits
	Exhibition (Baltimore, Maryland: June 23-27, 2002) (“ <b>AWMA CD Scan, Author Index</b> ”)
1076	Papers by Session 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) (“ <b>AWMA CD Scan, Papers by Session</b> ”)
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) (“ <b>AWMA CD Photo</b> ”)
1078	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020613041559/http://www.awma.org/about/overview.htm">https://web.archive.org/web/20020613041559/http://www.awma.org/about/overview.htm</a> (AWMA Overview)
1079	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020527005933/http://www.awma.org/">https://web.archive.org/web/20020527005933/http://www.awma.org/</a> (AWMA Homepage, advertising AWMA 2002 Conference)
1080	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020604012426/http://www.awma.org:80/about/">https://web.archive.org/web/20020604012426/http://www.awma.org:80/about/</a> (AWMA About Page)
1081	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020601173851/http://www.awma.org/ACE2002/tech-program/MondayPM.asp#AE-1c">https://web.archive.org/web/20020601173851/http://www.awma.org/ACE2002/tech-program/MondayPM.asp#AE-1c</a> (AWMA Technical Program Schedule for June 24, 2002 for Session AE-1C)

<b>Exhibit</b>	<b>Description of Exhibits</b>
1082	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020616091740/http://www.awma.org/ACE2002/exhibition/list.asp">https://web.archive.org/web/20020616091740/http://www.awma.org/ACE2002/exhibition/list.asp</a> (AWMA 2002 Conference list of exhibitors)
1083	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020601121532/http://www.awma.org/ACE2002/top10list.asp">https://web.archive.org/web/20020601121532/http://www.awma.org/ACE2002/top10list.asp</a> (AWMA 2002 Conference Top Ten Reasons)
1084	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020610093515/http://www.awma.org/ACE2002/welcome.asp">https://web.archive.org/web/20020610093515/http://www.awma.org/ACE2002/welcome.asp</a> (AWMA 95th Annual Conference and Exhibition Welcome Page)
1085	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020806044928/http://www.awma.org:80/pubs/bookstore/ItemInfo.asp?OrderCode_s=VIP-110-CD">https://web.archive.org/web/20020806044928/http://www.awma.org:80/pubs/bookstore/ItemInfo.asp?OrderCode_s=VIP-110-CD</a> (AWMA Bookstore Page, Order form for 2002 AWMA Conference CD)
1086	AWMA Website (Internet Archive), available at <a href="https://web.archive.org/web/20020806041256/http://www.awma.org:80/pubs/bookstore/">https://web.archive.org/web/20020806041256/http://www.awma.org:80/pubs/bookstore/</a> (AWMA Bookstore Homepage)
1087	State of Massachusetts Mass-EPA (Internet Archive) (dated Jan. 6, 2003), available at <a href="https://web.archive.org/web/20030106044457/http://www.state.ma.us/dep/bwp/about.htm">https://web.archive.org/web/20030106044457/http://www.state.ma.us/dep/bwp/about.htm</a> (describing mission of Mass Department of Environmental Protection, Bureau of Waste Prevention)

Exhibit	Description of Exhibits
1088	State of Massachusetts Mass-EPA (Internet Archive) (dated Dec. 21, 2002), available at <a href="https://web.archive.org/web/20021221040816/http://www.state.ma.us/dep/bwp/bwpprogs.htm">https://web.archive.org/web/20021221040816/http://www.state.ma.us/dep/bwp/bwpprogs.htm</a> (describing the divisions and programs of the Mass Bureau of Waste Prevention)
1089	State of Massachusetts Mass-EPA (Internet Archive) (dated Jan. 6, 2003), available at <a href="https://web.archive.org/web/20030106024342/http://www.state.ma.us/dep/bwp/bwppubs.htm">https://web.archive.org/web/20030106024342/http://www.state.ma.us/dep/bwp/bwppubs.htm</a> (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 <a href="https://web.archive.org/web/20021220143210/http://www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#ecp">https://web.archive.org/web/20021220143210/http://www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#ecp</a> (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 <a href="https://archive.org/legal/affidavit.php">https://archive.org/legal/affidavit.php</a>
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 &amp; 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 &amp; Co., et al.</i> , No. 1:19-cv-01334-CJB.

Exhibit	Description of Exhibits
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 &amp; Co., et al.</i> , No. 1:19-cv-01334-CJB.
1095	Deposition Transcript of Edwin Olson (Aug. 26, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher &amp; 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 &amp; 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 &amp; 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

Other than prosecution histories, EX1019-EX1026, EX1068, all citations to exhibits reference original page numbers found in the underlying document, and all emphases are added.

**TABLE OF CHALLENGED CLAIMS**

<b>Claim Element</b>	<b>Claim Language from '430 Patent</b>
1(Preamble)	1. A method of separating mercury from a mercury-containing gas, the method comprising:
1(a)	combusting coal in a combustion chamber, to provide the mercury-containing gas
1(b)	wherein the coal comprises an additive comprising Br <sub>2</sub> , HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber, or  the combustion chamber comprises an additive comprising Br <sub>2</sub> , HBr, a bromide compound, or a combination thereof or  a combination thereof;
1(c)	injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;  contacting mercury in the mercury-containing gas with the sorbent; and
1(d)	separating the sorbent contacted with the mercury from the mercury-containing gas.
2	2. The method of claim 1, wherein the coal comprises the additive comprising the Br <sub>2</sub> , HBr, the bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber.
3	3. The method of claim 1, wherein the combustion chamber comprises the additive comprising the Br <sub>2</sub> , HBr, the bromide compound, or a combination thereof.
4	4. The method of claim 1, wherein the coal is combusted in the combustion chamber at a coal-combustion facility, wherein the

Claim Element	Claim Language from '430 Patent
	additive comprising the Br <sub>2</sub> , HBr, bromide compound, or combination thereof, is added to the coal before the coal enters the combustion chamber, wherein the addition of the additive comprising the Br <sub>2</sub> , HBr, bromide compound, or combination thereof, to the coal is performed at the coal-combustion facility.
6	6. The method of claim 1, wherein the combustion chamber is an electric utility coal combustion chamber.
7	7. The method of claim 1, wherein the combustion chamber is a coal combustion furnace.
8	8. The method of claim 1, wherein the coal comprises a subbituminous coal.
9	9. The method of claim 1, wherein the coal comprises a lignite coal.
10	10. The method of claim 1, further comprising measuring the mercury content of the mercury-containing gas; and modifying, in response to the measured mercury content of the mercury-containing gas, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br <sub>2</sub> , HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.
11	11. The method of claim 10, wherein the measuring of the mercury content comprises continuous measurement.
12	12. The method of claim 1, further comprising: modifying, in response to a measured mercury content, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br <sub>2</sub> , HBr, the bromide compound,

Claim Element	Claim Language from '430 Patent
	or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.
13	13. The method of claim 1, wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.
14	14. The method of claim 1, wherein the sorbent contacted with the mercury comprises the element bromine and mercury.
15	15. The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas.
16	16. The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas with the sorbent.
17	17. The method of claim 1, wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the added Br <sub>2</sub> , HBr, the bromide compound, or a combination thereof, per 100 g of the sorbent.
18	18. The method of claim 1, wherein the Br <sub>2</sub> , HBr, or the bromide compound is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.
19	19. The method of claim 1, wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.
20	20. The method of claim 1, wherein the sorbent injected into the mercury-containing gas is a sorbent obtained by contacting a sorbent with a halogen or halide promoter prior to the injection of the sorbent into the mercury-containing gas.
21	21. The method of claim 1, wherein the sorbent injected into the mercury-containing gas is free of contact with a halogen or halide

Claim Element	Claim Language from '430 Patent
	promoter prior to injection of the sorbent into the mercury-containing gas.
22	22. The method of claim 1, wherein the combustion chamber comprises a boiler.
23	23. The method of claim 1, wherein the mercury-containing gas is a flue gas.
24	24. The method of claim 1, wherein the injection of the sorbent into the mercury-containing gas occurs upstream of a particulate separator, a scrubber, or a combination thereof.
25	25. The method of claim 24, wherein the particulate separator comprises a baghouse, an electrostatic precipitator, a fabric filter, or a combination thereof.
26	26. The method of claim 1, wherein a halide sorbent enhancement additive comprises the added Br <sub>2</sub> , HBr, bromide compound, or combination thereof.
27	27. The method of claim 26, wherein the sorbent enhancement additive comprises the bromide compound.
28(Preamble)	28. A method of separating mercury from a mercury-containing gas, the method comprising:
28(a)	combusting coal in a combustion chamber, to provide the mercury-containing gas,
28(b)	wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br <sup>-</sup> , or a combination thereof, wherein the coal comprises an additive comprising Br <sub>2</sub> , HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber, or

Claim Element	Claim Language from '430 Patent
	<p>the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, or</p> <p>a combination thereof,</p>
28(c)	<p>injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent; and</p>
28(d)	<p>separating the sorbent contacted with the mercury from the mercury-containing gas.</p>
29(Preamble)	<p>29. A method of separating mercury from a mercury-containing gas, the method comprising:</p>
29(a)	<p>combusting coal in a combustion chamber, to provide the mercury-containing gas,</p>
29(b)	<p>wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof, wherein</p> <p>the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber, or</p> <p>the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, or</p> <p>a combination thereof;</p>
29(c)	<p>injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;</p> <p>contacting mercury in the mercury-containing gas with the promoted sorbent;</p>

<b>Claim Element</b>	<b>Claim Language from '430 Patent</b>
29(d)	separating the promoted sorbent contacted with the mercury from the mercury-containing gas;
29(e)	measuring the mercury content of the mercury-containing gas; and  modifying, in response to the measured mercury content, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br <sub>2</sub> , HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.

**I. INTRODUCTION**

Petitioners request IPR of claims 1-4 and 6-29 of U.S. Patent 10,668,430 (“**430 Patent**” or “**Challenged Patent**”). EX1001. The Petition is supported by the expert declaration of Dr. Stephen Niksa.<sup>1</sup> 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: Berkshire Hathaway Energy Company; Interstate Power & Light Company; MidAmerican Energy Company; PacifiCorp; 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 and Alliant Energy Corporate Services, Inc. These entities were parties to the lawsuit in the Southern District of Iowa where they have been accused of infringing the Challenged Patent.

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

---

<sup>1</sup> 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 PacifiCorp identifies the following additional real-parties-in-interest: MidAmerican Funding, LLC; MHC Inc.; and PPW Holdings LLC.

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 '430 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 parent '370 Patent (EX1066), because the earlier-filed applications to which the '430 and '370 Patents claim 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”) and two petitions against U.S. Patent No. 10,596,517 (“the '517 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).

Though no petitions for IPR have previously been filed against the '430 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 ’430 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. and MES Inc. v. Arthur J. Gallagher & Co., et al.*, No. 1:19-cv-01334-RGA (D. Del.) (filed July 17, 2019).
- *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).

NRG, Vistra, Talen, and AEP were defendants in the Delaware case. 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 Petitioner 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 ’430 Patent was filed as App. No. 15/974,343 (“the ’343 Application”) on May 8, 2018, and purports to claim priority as follows:

- Continuation of U.S. Patent Application No. 15/951,970, filed on April 12, 2018 (“the ’970 Application”) and issued on March 2, 2021, as U.S. Patent No. 10,933,370, which is a:
- 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)]**

<b>LEAD COUNSEL</b>	<b>BACK-UP COUNSEL</b>
Brian W. Oaks (Reg. No. 44,981) McDermott Will & Emery LLP	David J. Tobin (Reg. No. 60,776) McDermott Will & Emery LLP

<b>LEAD COUNSEL</b>	<b>BACK-UP COUNSEL</b>
<p>300 Colorado Street, Suite 2200 Austin, TX 78701 Tel: 512-726-2574 Email: boaks@mwe.com</p>	<p>2501 North Harwood Street, Suite 1900 Dallas, TX 75201 Tel: (214) 210-2793 Email: dtobin@mwe.com</p> <p>Syed K. Fareed (Reg. No. 67,088) McDermott Will &amp; Emery LLP 300 Colorado Street, Suite 2200 Austin, TX 78701 Tel: (512) 726-2579 Email: sfareed@mwe.com</p> <p>Christian T. Tatum (Reg. No. 81,270) McDermott Will &amp; Emery LLP 300 Colorado Street, Suite 2200 Austin, TX 78701 Tel: (512) 298-4614 Email: ctatum@mwe.com</p>
	<p>Benjamin Hershkowitz (Reg. No. 41,833) Gibson, Dunn &amp; Crutcher LLP 200 Park Avenue New York, NY 10166 Tel: (212) 351-2410 Fax: (212) 351-6210 Email: BHershkowitz@gibsondunn.com</p> <p>David L. Glandorf (Reg. No. 62,222) Gibson, Dunn &amp; Crutcher LLP 1801 California St. STE 4200 Denver, CO 80202 Tel: (303) 298-5726 Fax: (303) 313-2837 Email: DGlandorf@gibsondunn.com</p>

<b>LEAD COUNSEL</b>	<b>BACK-UP COUNSEL</b>
	<p>NoahLani Litwinsella (Reg. No. 78,477) Gibson, Dunn &amp; Crutcher LLP 1801 California St. STE 4200 Denver, CO 80202 Tel: (303) 298-5715 Fax: (303) 313-2885 Email: NLitwinsella@gibsondunn.com</p>
	<p>R. Scott Johnson (Reg. No. 45,792) Fredrikson &amp; Byron, P.A. 111 E Grand Ave, Suite 301 Des Moines, IA 50309 Tel: 515-242-8900 Email: rsjohnson@fredlaw.com</p> <p>Thomas M. Patton (Reg. No. 76,193) Fredrikson &amp; Byron, P.A. 11 E. Grand Ave., Suite 301 Des Moines, IA 50309 Tel: 515-242-8900 Email: tpatton@fredlaw.com</p>
	<p>Michelle M. Kemp (Reg. No. 48,438) Perkins Coie LLP 33 East Main Street, Suite 201 Madison, WI 53703 Tel: (608) 663-7460 Email: MKemp@perkinscoie.com</p>
	<p>Michael T. Piery (Reg. No. 71915) QUARLES &amp; BRADY LLP 411 E Wisconsin Avenue, Suite 2400 Milwaukee, WI 53202 Tel.: (414) 277-5000 E-mail: michael.piery@quarles.com</p>

<b>LEAD COUNSEL</b>	<b>BACK-UP COUNSEL</b>
	Lauren C. Bolcar (Reg. No. 68994) QUARLES & BRADY LLP 2020 K Street NW, Suite 400 Washington, DC 20006 Tel.: (202) 372-9600 E-mail: lauren.bolcar@quarles.com

**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; BHershkowitz@gibsondunn.com; DGlandorf@gibsondunn.com; NLitwinsella@gibsondunn.com; mkemp@perkinscoie.com; rsjohnson@fredlaw.com; tpatton@fredlaw.com; MidAmerican@fredlaw.com; Michael.piery@quarles.com; lauren.bolcar@quarles.com.

**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 ’430 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:

<b>Ground</b>	<b>'430 Claims</b>	<b>Basis for Challenge</b>
1.	1-4, 6-29	§103: Obvious over Vosteen589 (EX1005) and Starns (EX1008)
2.	1-4, 6-29	§103: Obvious over Vosteen589 and Mass-EPA (EX1009)
3.	1-4, 6-9, 14-16, 18-19, 22-28	§102: Anticipated by Downs-Boiler (EX1006)
4.	1-4, 6-29	§103: Obvious over Downs-Boiler and Starns
5.	1-4, 6-29	§103: Obvious over Downs-Boiler and Mass-EPA

EX1002 ¶13. Ground 3 in this petition corresponds to the anticipation reference in IPR2020-00834 for the related '114 Patent, which the Board instituted. EX1026, 84-85, 96.

**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 ¶¶227-229.

**V. OVERVIEW OF '430 PATENT**

**A. LEVEL OF ORDINARY SKILL**

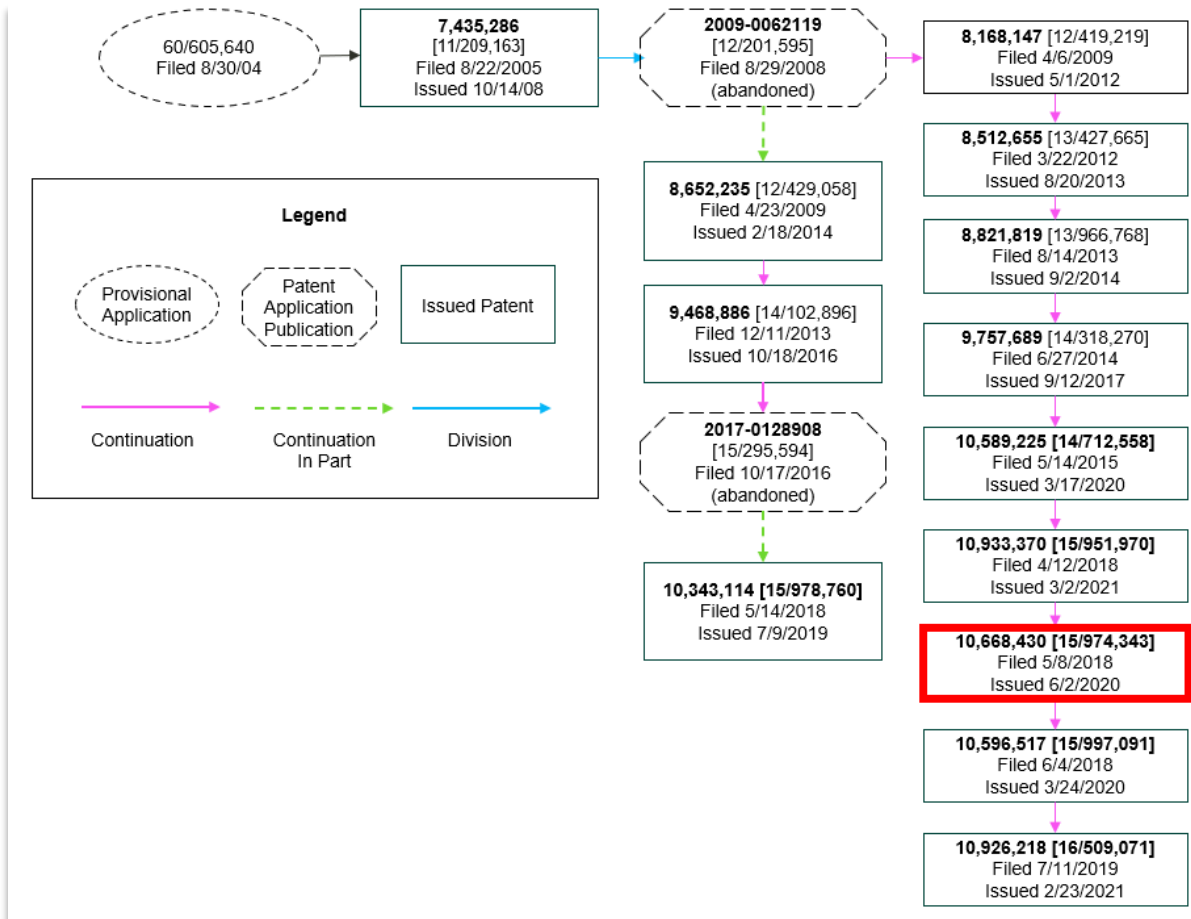
A person of ordinary skill in the art (“POSITA”) would have at least a bachelor’s degree in chemical engineering, mechanical engineering, or a related field of study with at least two years of experience implementing pollution control in power generation plants for natural gas, coal, and/or industrial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

**B. THE ALLEGED INVENTION OF THE '430 PATENT**

The '430 Patent relates to removing mercury from flue gas. EX1001, 1:40-46. 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, 30:24-27. The Patent combines these known solutions to improve sorbent efficacy. Each independent claim includes: adding bromine-containing ingredients to the combustion chamber and/or coal before it enters the combustion chamber; and collecting mercury in the mercury-containing gas with activated-carbon sorbent. Even this combination of elements was known in the art. EX1002 ¶¶152-156, 223-226.

**C. PROSECUTION HISTORY OF THE '430 PATENT**

The '430 Patent was filed May 8, 2018, as Application 15/974,343 (“’343 Application”) (EX1019), stemming through eight earlier non-provisional applications to App. No. 60/605,640 (the “Provisional”) (EX1020) filed August 30, 2004. EX1002 ¶¶157-176.



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

**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., Cl<sub>2</sub>, Br<sub>2</sub>), 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 (Hg<sup>0</sup>); and oxidized (Hg<sub>2</sub><sup>2+</sup> (mercurous) or Hg<sup>2+</sup> (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 ¶¶72-77.

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, 226.

### **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, requiring 70% mercury removal, 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 ¶¶98-108. Two named inventors, 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, 2:8-12 (known “mercury control methods” included activated carbon); EX1002 ¶¶224-225. It was known to fine-tune mercury removal by controlling sorbent-injection rate. EX1059; EX1009, 33, 73; EX1002 ¶¶112-115.

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<sup>0</sup> to the more easily removed Hg<sup>2+</sup> forms and by enhancing the reactivity of Hg<sup>0</sup> with activated

carbons”). It was known that halogens, particularly bromine-containing ingredients, improved the effectiveness of activated carbon in removing mercury. EX1002 ¶¶132-151 (discussing EX1005-EX1006; EX1008; EX1012-EX1014; EX1028; EX1036; EX1046-EX1048).

**VI. THE ASSERTED REFERENCES**

Petitioner asserts four prior-art references in this petition:

Reference	Prior-Art Status (pre-AIA)
<b>Vosteen589</b> , EX1005 US2004/0013589A1	§102(e)  Filed: 7/24/2002
<b>Downs-Boiler</b> , EX1006 US2008/010579A1	§102(e)  Filed: 3/21/2005, claiming priority to 3/22/2004
<b>Starns</b> , 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
<b>Mass-EPA</b> , EX1009	§§102(a)-(b)  Published December 2002 and publicly accessible at least by 1/6/2003

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 '430 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 1-4 and 6-29 over Vosteen589 (EX1005) and Starns (EX1008). Ground 2 asserts obviousness of Claims 1-4 and 6-29 over Vosteen589 and Mass-EPA (EX1009). EX1002 ¶301.

**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” directly to coal. EX1005 ¶¶[0006], [0013]. “[A]ctivated carbon” (a “dry sorbent”) is used with the “dry or semi-dry adsorption-based emission control stage.” EX1005 ¶¶[0019]-[0020]; EX1002 ¶¶230-234.

**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 ¶¶254-267.

1. **Starns (Grounds 1 and 4)**

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 ¶¶254-257, 261; EX1078-EX1084; EX1098.

AWMA published a CD with the 2002 conference papers, including Starns, and Dr. Niksa received his copy in Summer 2002. EX1002 ¶¶255, 258-260. 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.<sup>2</sup> Publications on the CD were indexed by session (topic) and author, as shown below:

---

<sup>2</sup> EX1091 (explaining date stamps of Internet Archive).



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

<b>AUTHOR</b>	<b>PAPER TITLE</b>	<b>PAPER NUMBER</b>
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 Weapons 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>	<a href="#">Return To AE-1c in the Session Listing</a>
43249	<b>Full-Scale Test of Mercury Control with Sorbent Injection and an ESP at Wisconsin Electric's Pleasant Prairie Power Plant</b> <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 ¶¶258-260.

## 2. Mass-EPA (Grounds 2 and 5)

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:<sup>3</sup>

---

<sup>3</sup> 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).



JANE M. SWIFT  
Governor

COMMONWEALTH OF MASSACHUSETTS  
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

BOB DURAND  
Secretary  
LAUREN A LISS  
Commissioner

**Bureau of Waste Prevention  
Division of Planning and Evaluation**

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

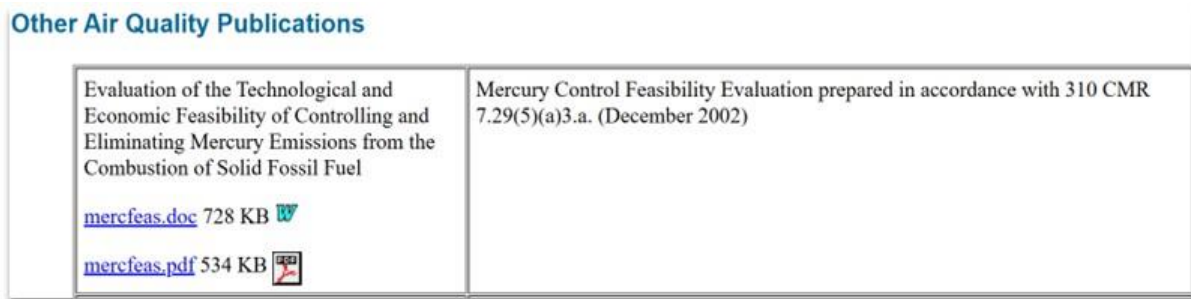
Pursuant to 310 CMR 7.29 – Emissions Standards for Power Plants

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 ¶263.

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.<sup>4</sup> EX1091; EX1002 ¶¶263-265.

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

---

<sup>4</sup> 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 ¶266.

**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, 1:40-44. The specific problem faced by the ’430 inventors was a “more economical and effective mercury removal technology.” EX1001, 2:35-36; EX1002 ¶¶232, 262, 267.

Vosteen589, Starns, and Mass-EPA are analogous art to the ’430 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 ¶232. Starns and Mass-EPA remove mercury at coal-fired power plants using activated-carbon sorbent. EX1008, 2; EX1009, Abstract, 4, 32; EX1002 ¶¶262, 267.

**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 ¶302.

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 ¶303.

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 ’430 Patent. EX1001, 2:5-12, 7:41-48, 28:9-22; *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) according to known methods (injection into flue gas) to yield predictable results (mercury removal). EX1002 ¶304.

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 ¶304.

**1. Ground 1 (Combination of 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  
¶¶305-306.



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 ¶¶306-309.

**2. Ground 2 (Combination of Vosteen589 with Mass-EPA)**

A POSITA would have been motivated to use the ACI of Mass-EPA in 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 ’430 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 ¶¶310-314.

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 ¶¶315.

**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 ¶¶301, 316.

**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 to reduce emissions. EX1002 ¶¶317-319.

**b. Element 1(a): “combusting coal in a combustion chamber, to provide the mercury-containing gas”**

Vosteen589 discloses “a coal-fired power station,” which includes a “combustion chamber.” EX1005 ¶[0005]; *see* ¶¶[0034], [0046]-[0048], Figs. 7-9.

The combustion chamber (i.e., boiler/furnace) combusts coal and provides the mercury-containing flue gas. EX1002 ¶¶320-322.

- c. Element 1(b): “wherein the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber, or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof or a combination thereof;”**

Vosteen589 applies an additive comprising bromine (Br<sub>2</sub>), hydrogen bromide (HBr), and bromide compounds (e.g., sodium bromide, NaBr) to the combustion chamber and to the coal upstream of combustion chamber:

[0006] The invention relates to a process for 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.

EX1005 ¶¶[0006], [0009], [0013]; see ¶[0014], cls. 1-2; EX1002 ¶¶323-324.

**d. Element 1(c): “injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent; and”**

This element is disclosed by Vosteen589 with Starns (Ground 1) and with Mass-EPA (Ground 2). EX1002 ¶325.

**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]. The flue-gas mercury is adsorbed, and thus contacted, with activated-carbon sorbent. As described below, Starns and Mass-EPA each disclose how and where to inject the activated-carbon sorbent into the flue gas. EX1002 ¶¶325-328, 331-332.

**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 ¶¶329, 333.

### iii. Ground 2

Mass-EPA describes activated carbon as “the most extensively studied sorbent for mercury adsorption” (EX1009, 32) and discloses “activated carbon injection” in numerous places. *See generally* EX1009, 31-56. The “sorbent particles ... contact the Hg in the flue gas.” EX1009, 21; *see* 6-7, 21-23, 33; EX1002 ¶¶330, 334.

**e. Element 1(d): “separating the sorbent contacted with the mercury 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 sorbent contacted with mercury has been separated. EX1005 ¶¶[0022]; *see* ¶¶[0006], cl.1. The sorbent contacted with mercury 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 ¶335.

ESPs were well-known components in coal-fired power plants to remove particulate matter, such as the sorbent contacted with the mercury. EX1002 ¶¶86-88. To be effective, the sorbent must be injected after the combustion zone (where mercury-containing flue gas is generated) and before the separation system (where sorbent is removed). EX1002 ¶¶336-337.

**ii. Ground 1**

Starns recommends “using activated carbon injection upstream of an ESP.” EX1008, 20. The sorbent contacted with mercury 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 ¶336.

**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 sorbent contacted with mercury. “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 ¶337.

**2. Claims Depending from Claim 1**

- a. Claims 2-3: “wherein the [cl. 2-coal; cl. 3-combustion chamber] comprises the additive comprising the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, [cl. 2-wherein the additive is added to the coal before the coal enters the combustion chamber].”**

These claims are obvious for the reasons discussed for Element 1(b). Regarding Claim 2, Vosteen589 applies bromine (Br<sub>2</sub>), hydrogen bromide (HBr), and other bromide compounds (sodium bromide, NaBr) to the coal upstream of the combustion chamber. EX1005 ¶¶[0006], [0009], [0013]-[0014], [0044], cl.2. Regarding Claim 3, the bromine-containing ingredients are present in the combustion chamber after the treated coal is fed into the chamber. Vosteen589 also applies the above-mentioned bromine-containing ingredients directly to the

combustion chamber. EX1005 ¶¶[0006], [0009], [0013]-[0014], cls. 1-2; EX1002 ¶¶338-339.

**b. Claims 4, 6:**

**4: “wherein the coal is combusted in the combustion chamber at a coal-combustion facility, wherein the additive comprising the Br<sub>2</sub>, HBr, bromide compound, or combination thereof, is added to the coal before the coal enters the combustion chamber, wherein the addition of the additive comprising the Br<sub>2</sub>, HBr, bromide compound, or combination thereof, to the coal is performed at the coal-combustion facility.”**

**6: “wherein the combustion chamber is an electric utility coal combustion chamber.”**

**i. Grounds 1-2**

Vosteen589 discloses these limitations. As discussed for Elements 1(a)-1(b), the coal is combusted in a combustion chamber, and the bromine-containing ingredients are added to the coal upstream of the combustion chamber. The addition is performed at a coal-combustion facility, such as the “coal-fired power station of Bayer AG.” EX1005 ¶¶[0034], [0045], Fig. 9. Regarding Claim 6, the bromine-containing ingredient is applied at a “power station,” which is an electric utility. EX1005, Abstract, ¶¶[0001]-[0003], [0005], [0008], [0032], [0034], [0045]-[0047], cl. 1; EX1002 ¶¶340-341.

**ii. Ground 1**

Claim 6 is further obvious over Starns. Starns discloses sorbent injection at “Wisconsin Electric’s Pleasant Prairie Power Plant,” which is an electric utility power plant. EX1008, Title, 4; EX1002 ¶342.

**iii. Ground 2**

Claim 6 is further obvious over Mass-EPA, whose disclosure was intended for “coal-fired electric utility power plants operating in the United States.” EX1009, 53; *see* 8; EX1002 ¶343.

**c. Claim 7: “wherein the combustion chamber is a coal combustion furnace.”**

This claim is obvious for the reasons discussed for Elements 1(a)-1(b). Vosteen589 describes the combustion chamber as a “multistage furnace,” into which the coal and bromine compounds are fed. EX1005 Abstract, ¶[0013], cl. 1; EX1002 ¶344.

**d. Claim 8: “wherein the coal comprises a subbituminous coal.”**

**i. Grounds 1-2**

Vosteen589 describes combustion of coal in “power stations, for example bituminous coal-fired or lignite-fired power stations.” EX1005 ¶[0008]. A POSITA would have understood that the four broad classifications of coal, organized from highest to lowest rank are: anthracite; bituminous; subbituminous; and lignite. In

general, bituminous and anthracite coals have the highest native-halogen levels (which help remove mercury), whereas lignite (and subbituminous) coals tend to have much lower levels. EX1002 ¶69. A POSITA would recognize that mercury-control technology directed at both bituminous coals and lignite (the extreme ends of halogen content) would also work for the intermediate-rank subbituminous coals. EX1002 ¶345.

**ii. Ground 1**

Claim 8 is further obvious over Starns, which removed mercury for units that “fire a variety of Powder River Basin (PRB) low sulfur, sub-bituminous coals.” EX1008, 4; EX1002 ¶346.

**iii. Ground 2**

Claim 8 is further obvious over Mass-EPA. “Powder River Basin (PRB) subbituminous coal” was burned at a facility that achieved “73% mercury removal upon injection of sorbent, an increase from the 5.3% removal seen without sorbent injection.” EX1009, 24, 29, 77; EX1002 ¶347.

**e. Claim 9: “wherein the coal comprises a lignite coal.”**

**i. Grounds 1-2**

Vosteen589 describes combustion of coal in “power stations, for example bituminous coal-fired or lignite-fired power stations.” EX1005 ¶[0008]; EX1002 ¶348.

**i. Ground 2**

Claim 9 is further obvious over Mass-EPA, which removes mercury from “lignite” coal. EX1009, 9, 19, 24-25, 39; EX1002 ¶349.

**f. Claims 10-11:**

**10: “measuring the mercury content of the mercury-containing gas; and modifying, in response to the measured mercury content of the mercury-containing gas, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof”**

**11: “the measuring of the mercury content comprises continuous measurement.”**

These claims are disclosed by Vosteen589 alone (Grounds 1-2), and in combination with Starns (Ground 1) and Mass-EPA (Ground 2). All three references disclose continuously measuring mercury content. Based on the mercury measurements, Vosteen589 achieves mercury-removal targets by modifying halogen-injection rates, and Starns and Mass-EPA modify sorbent-injection rates. Each control scheme satisfies Claims 10-11. EX1002 ¶¶350-359.

**i. Grounds 1-2**

Vosteen589 discloses that “mercury content of the flue gas, in particular the content of metallic mercury [i.e., elemental mercury], is measured continuously

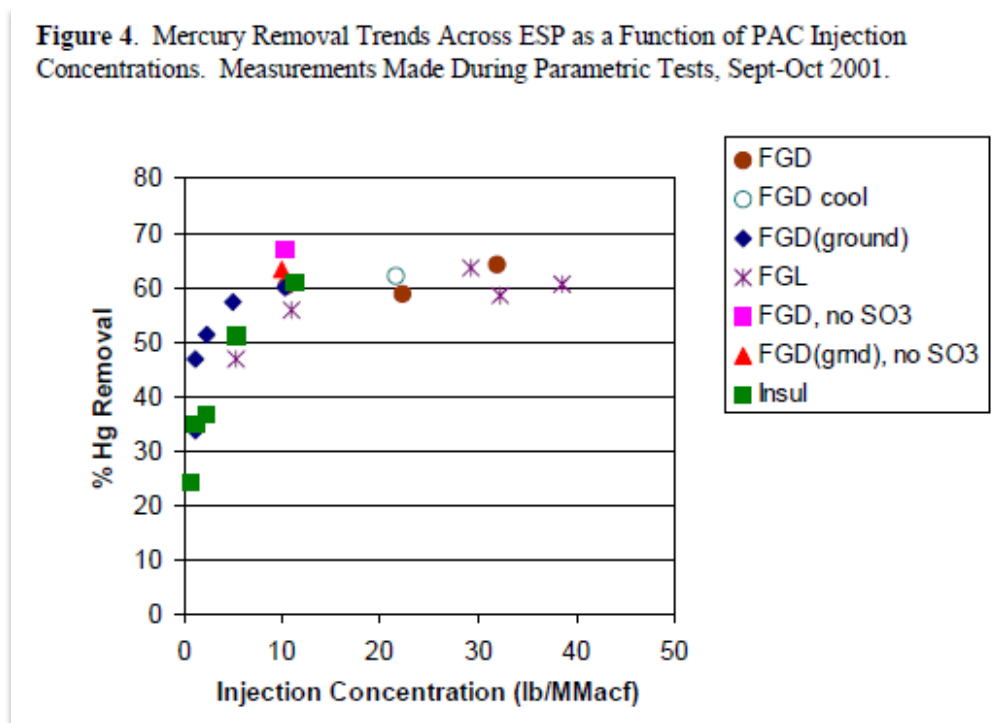
downstream of the flue gas emission control system and on the basis of the measured mercury content the amount of bromine fed and/or bromine compounds and/or the mixture of bromine compounds ... is controlled.” EX1005 ¶¶0022]; *see id.* (measuring and controlling based on “total mercury in the clean gas”); cl. 10 (similar quote); Figs. 2-8 (showing mercury measurements). Controlling the “amount of bromine fed” refers to modifying the addition rate of Br<sub>2</sub>, HBr, and sodium bromide (discussed above for Element 1(b)) to the coal. A POSITA would have modified the addition rate to keep mercury below the “strict limiting values [that] exist for the legally permissible emission of mercury” to avoid regulatory penalties. EX1005 ¶¶0002]; EX1002 ¶350; *see* ¶¶116-121.

Claims 10-11 are further obvious over Starns (Ground 1) and Mass-EPA (Ground 2). Each modifies sorbent-injection rate into the flue gas based on mercury-content measurements. A POSITA would have used such a control scheme either in place of the control scheme of Vosteen589 (modifying halogen rate), or in addition to that control scheme (e.g., modifying both sorbent rate and halogen rate) for additional process flexibility. EX1002 ¶¶351, 354. It would have been obvious that modifying sorbent-injection rate would be performed as part of routine process control and optimization to account for variances in the coal. EX1002 ¶¶69-71, 114-115. Upon reviewing the measured-mercury data presented in Starns (Ground 1) and Mass-EPA (Ground 2), a POSITA would have understood that adding excessive

sorbent would be wasteful, and adding insufficient sorbent may not achieve mercury-removal targets, and would have modified sorbent-injection rate accordingly. EX1002 ¶¶352-353, 357-358.

**ii. Ground 1**

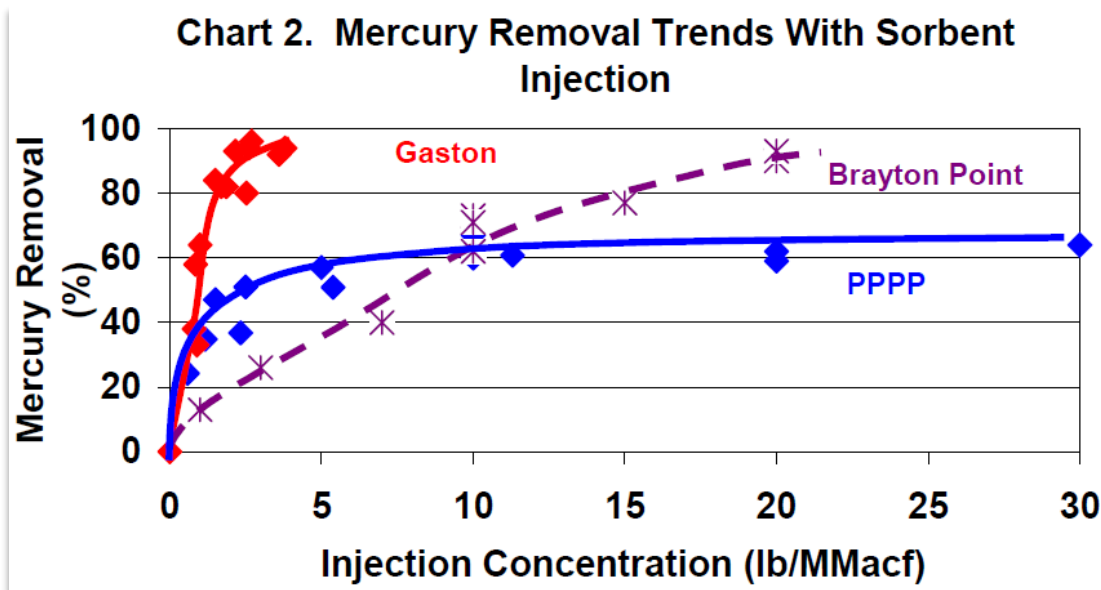
Starns discloses a mercury monitor that was “operate[d] continuously,” and “[m]ercury removal was monitored as a function of the sorbent injection concentration.” EX1008, 8, 11. Starns controls mercury content (Y-axis) based on modifying sorbent-injection rate (X-axis), such as 1-10 lb/MMacf (pounds sorbent per million actual ft<sup>3</sup> of flue gas). EX1008, 7, 11, 13, 20, Figs. 3-6.



EX1008, Figs. 4-5; EX1002 ¶352.

iii. Ground 2

Mass-EPA discloses using “continuous emissions monitoring systems (CEMS) to monitor stack-level Hg emissions.” EX1009, 60. Mass-EPA measures mercury content to select sorbent-injection rates. EX1009, 11-12, 33, 50, 60, 73 (“mercury removal as a function of [sorbent] injection rate”). This is further seen in Chart 2:



EX1009, 12. Mass-EPA summarized its testing as determining “mercury removal as a function of [sorbent] injection rate.” EX1009, 73; *see* EX1009, 13. A POSITA would have been motivated to modify sorbent-injection rate to keep mercury content of the mercury-containing gas below a desired level, targeting “an overall reduction of 75%.” EX1009, 5; EX1002 ¶¶355-357.

**g. Claim 12: “modifying, in response to a measured mercury content, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.”**

Claim 12 is obvious for the reasons discussed for Claims 10-11. EX1002 ¶360.

**h. Claim 13: “wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.”**

This claim is obvious over Vosteen589 and Starns (Ground 1) and Mass-EPA (Ground 2). Vosteen589 describes the Br-concentration in flue gas, and Starns and Mass-EPA each describe the sorbent concentration. The ratio of the two is within the claimed range. EX1002 ¶¶361-372.

Vosteen589 discloses two values for the “total bromine content (Br<sub>tot</sub>) in the boiler flue gas”: 43 and 75 mg/M<sup>3</sup> 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 ¶362.

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 ¶¶114-115, 363. This is

the sorbent-injection rate in Starns (Ground 1) and Mass-EPA (Ground 2). EX1008, 20; EX1009, 12, 73; EX1002 ¶¶364-365.

Dr. Niksa explains how a POSITA would have been readily capable of converting between units of Br concentration (Vosteen589) and sorbent concentration (Starns and Mass-EPA), then dividing the two to determine a ratio. This involves fundamental calculations taught in undergraduate chemistry, such as unit conversions (e.g., between L and ft<sup>3</sup> and pounds to grams) and the ideal gas law (PV=nRT). Dividing the Br concentration of Vosteen589 (43 mg/m<sup>3</sup> S.T.P. db) by the sorbent concentration of Starns and Mass-EPA (10 lb/MMacf) yields a mercury-containing gas with 17.3 grams of the element bromine per 100 grams of activated-carbon sorbent—which is within the claimed range of 1-30. Using the higher Br concentration in Vosteen589 (75 mg/M<sup>3</sup> S.T.P. db) with 10 lbs/MMacf sorbent would provide a mercury-containing gas with 29.6 grams of the element bromine per 100 grams of activated-carbon sorbent, still within the claimed 1-30 range. It would have been obvious to try other ratios, such as increasing halogen concentration (while reducing ACI rates) or decreasing halogen concentration (while increasing ACI), as part of routine process optimization to achieve desired mercury removal. EX1002 ¶¶366-372.

Claim 13 is merely an attempt to claim a workable range for combining a conventional halogen (bromine), used in a conventional way (to oxidize mercury

and promote activated carbon), with a conventional sorbent (activated carbon). Nothing in the '430 Patent attributes significance to the claimed range or establishes that the claimed range “achieves unexpected results.” The range presents mere 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); EX1002 ¶372. PO’s expert in the Delaware Litigation stated that the ratio in this claim limitation would “necessarily” be present. EX1092 (O’Keefe), 153 ('114 Patent cl. 4, ratio is “necessarily present”), 158 ('114 Patent cl. 29, cross-citing the “necessarily present” language of claim 4), 170 ('517 cl. 19, same language), 175-176 ('430 cl. 13, 17).

**i. Claims 14: “wherein the sorbent contacted with the mercury comprises the element bromine and mercury.”**

As described for Element 1(c), mercury adsorbs onto sorbent to form a mercury-sorbent composition. The composition also includes Br, because as Vosteen589 discloses, mercury in the flue gas is oxidized by the bromine-containing species to form  $\text{HgBr}_2$ , and “[m]ercury bromide  $\text{HgBr}_2$  adsorbs more strongly to dry

sorbents.” EX1005 ¶¶[0017]-[0019]. Once adsorbed, the sorbent comprises mercury and the element bromine.<sup>5</sup> EX1002 ¶¶373-376.

**j. Claims 15-16: “comprising removing greater than 70 wt % of the mercury in the mercury-containing gas [cl. 16-with the sorbent].”**

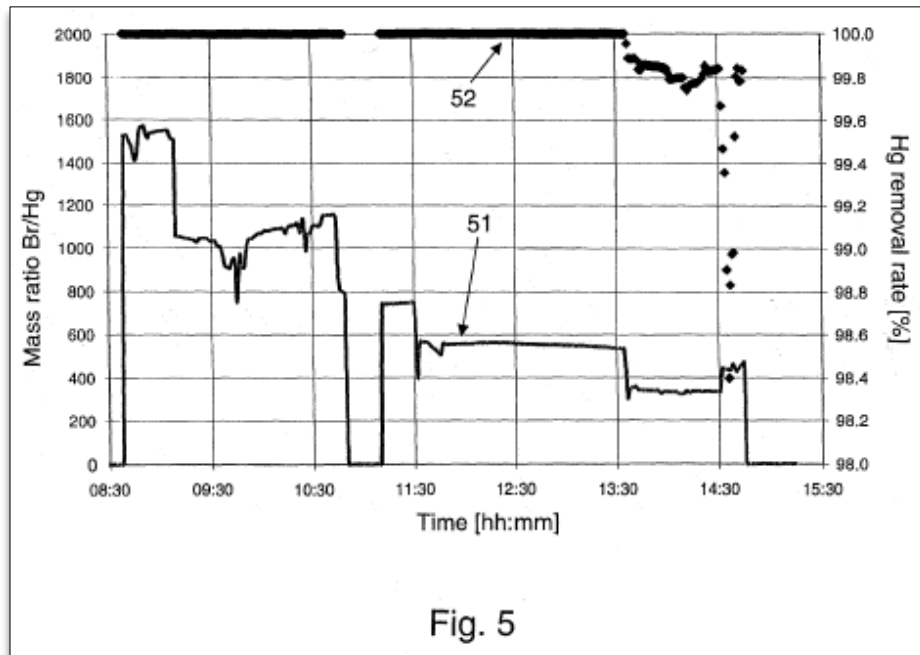
Claims 15-16 would have been obvious over Vosteen589 and Starns (Ground 1) and Vosteen589 and Mass-EPA (Ground 2). Each reference achieves greater than 70 wt% mercury removal.

**i. Grounds 1-2**

Vosteen589 discloses “substantially complete removal of mercury (Hg), from flue gases.” EX1005 ¶[0005]; *see* ¶[0037]. More than 98.0% “Hg removal” is shown below (right axis):

---

<sup>5</sup> To the extent PO narrowly construes the claim to require that the sorbent first contact bromine before contacting mercury, such a read would be unsupported. Nevertheless, the claim would still have been obvious for the reasons discussed *infra* Claim 20.



EX1005, Fig. 5; see ¶¶[0028], [0042]; EX1002 ¶¶[377-378].

Regarding Claim 16, Vosteen589 converts approximately 90% of elemental mercury to oxidized mercury. EX1005 ¶¶[0048]-[0049]. At that high conversion-rate, nearly 90% of the total mercury content (oxidized + elemental) would be removed on the sorbent. EX1005 ¶[0007] (oxidized (“ionic”) mercury is “readily adsorbable”). Vosteen589 discloses plants that “do not have a wet flue gas emission control system [(scrubber)], but solely have a dry emission control system having a mercury sorption stage.” EX1005 ¶[0019]. Such plants would be dependent on the sorbent, particularly when burning lignite coal (i.e., low levels of unburnt carbon). EX1005 ¶[0008] (“lignite-fired power station”). EX1002 ¶¶[378, 382].

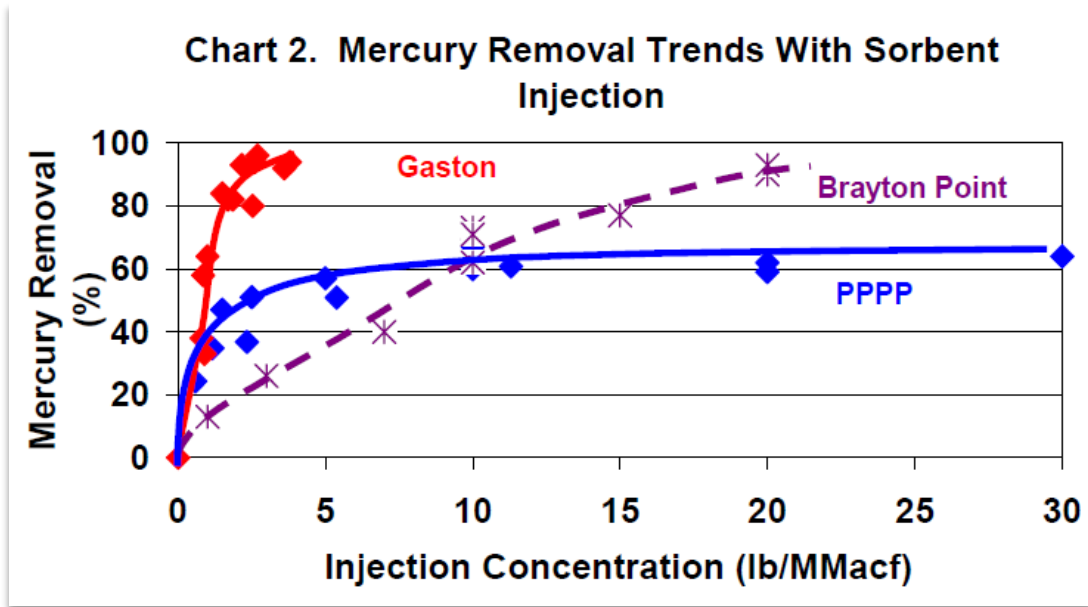
Vosteen589 further renders Claims 15-16 obvious, because Vosteen589 discloses removing sufficient mercury to comply with regulatory requirements. EX1005 ¶¶[0002], [0015]. A POSITA would have been motivated, with reasonable expectation of success through routine process optimization, to adjust the bromine addition rate and/or ACI rate to meet and surpass (e.g., for safety margin) well-known regulatory proposals calling for at least 70% mercury removal. *See supra* §V.D.3; *Koninklijke*, 948 F.3d at 1337; EX1002 ¶¶381, 385.

**ii. Ground 1**

Claims 15-16 would be further obvious over Starns, which discloses removing 70% mercury when using 10 lb/MMacf of activated carbon with solely dry-emission controls. EX1008, 2, 20. When combined with the halogen improvements of Vosteen589, the removal would be even greater. EX1002 ¶¶379, 383.

**iii. Ground 2**

Claims 15-16 would be further obvious over Mass-EPA, which discloses removing more than 70% mercury with dry-emission systems.



EX1009, 11-12 (Chart 2); *see* EX1009, 70, 74. When combined with the halogenation of Vosteen589, the removal would be even greater. EX1002 ¶¶380, 384.

**k. Claim 17: “wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the added Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, per 100 g of the sorbent.”**

This claim is obvious for the reasons discussed for Claim 13. PO’s expert treats Claim 17 the same as Claim 13, including arguing that the claimed ratios are “necessarily” present. EX1092 (O’Keefe), 153 (’114 Patent cl. 4, ratio is “necessarily present”), 158 (’114 Patent cl. 29, cross-citing the “necessarily present” language of claim 4), 170 (’517 cl. 19, same language), 175-176 (’430 cl. 13, 17); EX1002 ¶¶386-389.

**I. Claim 18: “wherein the Br<sub>2</sub>, HBr, or the bromide compound is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.”**

Vosteen589 discloses this claim for the reasons discussed above for Element 1(b). Vosteen589 applies aqueous hydrogen bromide (HBr), bromide compounds in solid or aqueous form (e.g., NaBr), and molecular bromine (Br<sub>2</sub>). At least a portion of the Br added to the coal, when fed to the combustion chamber, would have vaporized and reacted to form HBr in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. EX1095 (Olson), 98:23-100:3, 231:3-9; EX1092, 154 (recognizing that Br “exits the combustion chamber and contacts the sorbent in a gaseous state”), 170 (same analysis for ’517 cl. 7), 176 (same analysis for ’430). 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 ¶390.

The halogens (e.g., HBr and/or Br<sub>2</sub>) remain in gaseous form at flue-gas temperatures when contacting the sorbent. For example, the flue gas in Starns (Ground 1) is typically at 143°C, and the flue gas in Mass-EPA (Ground 2) ranges from 140-160°C. EX1008, 10; EX1009, 26; EX1002 ¶¶391-392 (discussing EX1036, 4-53, 4-65).

**m. Claim 19: “wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.”**

**i. Grounds 1-2**

Vosteen589 discloses “granulated activated carbon,” another term for “granular” activated carbon. EX1005 ¶[0019]; EX1002 ¶393.

**ii. 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 ¶394.

**iii. 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 ¶395.

**n. Claim 20: “wherein the sorbent injected into the mercury-containing gas is a sorbent obtained by contacting a sorbent with a halogen or halide promoter prior to the injection of the sorbent into the mercury-containing gas.”**

**i. Grounds 1-2**

Claim 20 is obvious over Vosteen589 and Starns (Ground 1) and Mass-EPA (Ground 2). A POSITA would have known that for coals with higher native-mercury content (or lower native-halogen content), additional mitigation may be needed to

further reduce mercury emissions. EX1002 ¶¶69-71, 396. A POSITA would have been motivated to try, with reasonable expectation of success, pre-halogenating the sorbent before injection into the mercury-containing flue gas. For example, it was known since the 1930s to remove mercury vapors by injecting halogen-impregnated activated-carbon sorbents into a mercury-containing flue gas. *Supra* §V.D.4. Though more expensive, such pre-halogenation would have been beneficial, particularly for coals with higher native-mercury content (or lower native-halogen content) to reduce mercury emissions. EX1002 ¶398; *Koninklijke*, 948 F.3d at 1337.

**ii. Ground 2**

Claim 20 is further obvious over Mass-EPA, which discloses two alternative sorbents to inject into a flue gas: “activated carbon (or the impregnated activated carbon).” EX1009, 32. Exemplary forms of the impregnated (pre-halogenated) sorbent include “chlorine-impregnated activated carbon” and “[m]odified activated carbons ... doped with ... chlorine and iodine,” and which “can provide higher mercury adsorption capacity.” EX1009, 33-34 & n.44. Chlorine and iodine are halogen or halide promoters. EX1002 ¶109-11, 397.

- o. Claim 21: “wherein the sorbent injected into the mercury-containing gas is free of contact with a halogen or halide promoter prior to injection of the sorbent into the mercury-containing gas.”**

Claim 21 is obvious over Vosteen589 and Starns (Ground 1) and Vosteen589 and Mass-EPA (Ground 2).

As discussed above for Claim Element 1(c), each combination injects activated-carbon sorbent into the mercury-containing flue gas. Vosteen589 does not characterize the sorbent as having been pre-halogenated prior to injection. A POSITA would have selected halogen-free sorbent due to its lower cost (compared to pre-brominated PAC), particularly for applications (e.g., types of coal) that do not require the enhanced removal properties of PAC. EX1002 ¶399.

Regarding Ground 1, Starns discloses Norit “Darco FGD”: a “standard powdered activated carbon (FGD) ... supplied by Norit Americas ... is tested in all cases as the benchmark sorbent.” EX1008, 3. Regarding Ground 2, Mass-EPA discloses the same activated-carbon sorbent: “Norit America’s ‘Darco FGD.’” EX1009, 73-74; EX1002 ¶¶400-401.

Regarding Grounds 1-2, a POSITA would have recognized that Norit Darco FGD is substantially free of halogen and halide promotion. Articles dating back to at least 1998 confirm that the chemical composition of “Norit Darco FGD” does not

have halogens. EX1002 ¶401 (discussing EX1048, chemical analysis of Norit FGD).

**p. Claim 22: “wherein the combustion chamber comprises a boiler.”**

As discussed for Elements 1(a)-1(b), Vosteen589 discloses “a coal-fired power station” that has a “boiler.” EX1005 ¶¶[0005], [0034], [0046]-[0047], Fig. 9; EX1002 ¶402.

**q. Claim 23: “wherein the mercury-containing gas is a flue gas.”**

Vosteen589 discloses this claim. Its title is, “Process for Removing Mercury from Flue Gases.” EX1005, Title, Abstract, cl. 1; EX1002 ¶403.

**r. Claims 24-25:**

**24: “the injection of the sorbent into the mercury-containing gas occurs upstream of a particulate separator, a scrubber, or a combination thereof”**

**25: “the particulate separator comprises a baghouse, an electrostatic precipitator, a fabric filter, or a combination thereof.”**

**i. Grounds 1-2**

These claims are obvious over Vosteen589 and Starns (Ground 1) and Mass-EPA (Ground 2).

Vosteen589 discloses an electrostatic precipitator (ESP), a type of particulate separator to remove the mercury/sorbent composition. EX1005 ¶¶[0019], [0033]-[0039], [0042], [0047]-[0049], cl. 8, Fig. 9 (item 96). A POSITA would have known that the sorbent must be injected upstream of the ESP (as discussed for Element 1(c)) so that the ESP can function to collect the sorbent. *Supra* §V.D.2; EX1005, ¶¶[0003], [0006]; EX1002 ¶¶404-405, 409.

**ii. Ground 1**

Starns recommends “using activated carbon injection upstream of an ESP.” EX1008, 20; EX1002 ¶406.

**iii. Ground 2**

These claims are also obvious over Vosteen589 and Mass-EPA. The approaches “demonstrated or under investigation to control mercury” included an “ElectroStatic Precipitator (ESP).” EX1009, 7. Mass-EPA teaches injecting activated carbon “upstream of an ESP.” EX1009, 32, 53-54; EX1002 ¶¶407-408.

s. **Claims 26-27:**

**26: “wherein a halide sorbent enhancement additive comprises the added Br<sub>2</sub>, HBr, bromide compound, or combination thereof.”**

**27: “wherein the sorbent enhancement additive comprises the bromide compound.”**

As discussed for Element 1(b), Vosteen589 applies bromine (Br<sub>2</sub>), hydrogen bromide (HBr), and other bromide compounds (sodium bromide) to the coal upstream of the combustion chamber and/or directly to the combustion chamber. EX1005 ¶¶[0006], [0009], [0013]-[0014], cls.1-2; EX1002 ¶¶410-411.

**3. Independent Claim 28**

Claim 28 is nearly identical to Claim 1, with minor changes, as shown in the redline below:

~~1~~28. A method of separating mercury from a mercury-containing ~~gas~~, the method comprising:  
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof, wherein  
the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber,  
or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, or a combination thereof;  
injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;  
contacting mercury in the mercury-containing gas with the sorbent; and separating the sorbent contacted with the mercury from the mercury-containing gas.

Claim 28 is obvious for the reasons described for Claim 1. EX1002 ¶¶412-421. The differences are discussed below.

**a. Element 28(b): “the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof...;”**

As discussed for Claim Element 1(b), Vosteen589 discloses adding to the combustion chamber and/or coal aqueous hydrogen bromide (HBr), bromide compounds in solid or aqueous form (e.g., sodium bromide, NaBr), and molecular bromine (Br<sub>2</sub>). At combustion temperatures (much greater than the boiling point of water), the HBr vaporizes such that the mercury-containing gas also includes HBr. At least a portion of the Br added to the coal and/or combustion chamber would have vaporized and reacted to form HBr in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. Vosteen589 also discloses adding bromine-containing ingredients directly to the mercury-containing gas, such as adding them to a “recirculated flue gas” stream. EX1005 ¶[0014]; *see* cl. 3 (“Br added to the “furnace and/or to the flue gas”). EX1002 ¶¶416-419.

When bromine-containing species (e.g., HBr) and carbon contact one another in the flue gas, the bromide acts as a promoter. EX1002 ¶¶129-130, 416. Lead inventor Dr. Olson admitted that, “if calcium bromide is added to coal and put into the furnace and activated carbon is injected downstream of the furnace,” then there would be “in-flight promotion.” EX1095 at 231:3-9; *see id.* at 98:23-100:3.

Vosteen589 confirms that the halogen/halide promoter is present in the mercury-containing flue gas, as he describes “the mass ratio of bromine to mercury in the flue gas.” EX1005, cl. 5; *see* ¶¶[0025], [0028], [0031]; EX1002 ¶418.

At the temperatures of the combustion chamber and flue gas, the bromine-containing ingredients are vaporized and thus present in the mercury-containing flue gas. EX1002 ¶417; EX1036, 4-53, 4-65. For example, the flue gas in Starns (Ground 1) is typically at 143°C, and the flue gas in Mass-EPA (Ground 2) ranges from 140-160°C. EX1008, 10; EX1009, 26. The halogens (e.g., HBr and Br<sub>2</sub>) would remain in the gas phase at these temperatures. EX1002 ¶417.

#### **4. Independent Claim 29**

Claim 29 is nearly identical to Claims 1 and 10, with minor changes, as shown in the redline below:

~~129~~. A method of separating mercury from a mercury-containing gas, the method comprising:  
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof, wherein  
the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber,  
or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof;  
injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;  
contacting mercury in the mercury-containing gas with the promoted sorbent; ~~and~~ separating the promoted sorbent contacted with the mercury from the mercury-containing gas;  
~~10. The method of claim 1, further comprising~~  
measuring the mercury content of the mercury-containing gas; and  
modifying, in response to the measured mercury content ~~of the mercury-containing gas~~, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.]

For the same reasons as Claims 1 and 10, Claim 29 is also obvious. EX1002 ¶¶422-429. The differences are discussed below.

- a. **Element 29(b): “the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof...;”**

This limitation is disclosed for the same reasons as stated above for Element 28(b). EX1002 ¶425.

**b. Element 29(c): “such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;”**

As described above for Claim 14, when bromine and carbon contact one another (e.g., upon Vosteen589’s adsorption), the bromine and activated carbon react to form a promoted sorbent. It was well-known in the art that halogens (including bromine) “promoted” activated-carbon sorbents because they improved mercury removal by increasing the ability of the activated carbon to bind with the mercury. *See supra* §V.D.4; EX1002 ¶¶426-427, 129-130. Lead inventor Dr. Olson admitted that, “if calcium bromide is added to coal and put into the furnace and activated carbon is injected downstream of the furnace,” then there would be “in-flight promotion.” EX1095 (Olson), 231:3-9; *see* 98:23-100:3. The “promotion” of activated carbon by halogens is a form of reaction. EX1095, 45:16-25, 174:7-14; *see also* EX1092, 156 (labeled as limitation 24e, O’Keefe explaining how adding bromine-containing ingredients to coal would contact and react with sorbent), 179 (same analysis for ’430 Claim 29(c)).

### **VIII. GROUND 3: ANTICIPATION BY DOWNS-BOILER**

#### **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 ¶¶235-238, 242. 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 ¶243. 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 ¶¶244-251. 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 ¶¶252-253.

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 ¶¶240-241.

**B. DISCLOSURE OF DOWNS-BOILER**

Parallel citations to written-description support in Downs-Boiler-Provisional (EX1007) are provided. EX1002 ¶430.

**1. Independent Claim 1**

**a. Element 1(Pre): “A method of 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 ¶¶431-432.

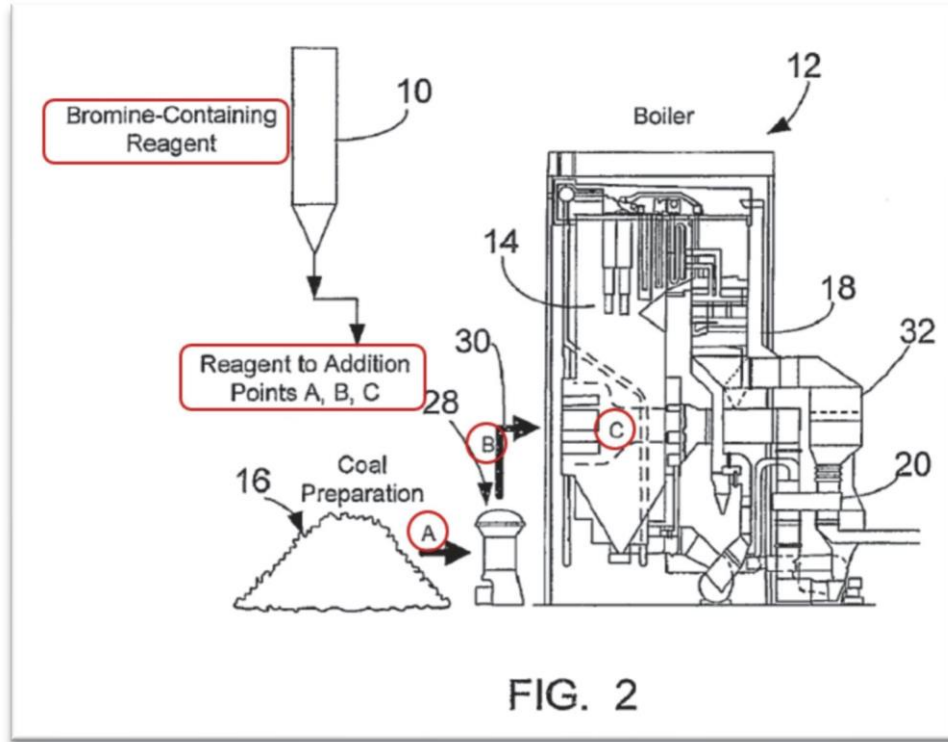
**b. Element 1(a): “combusting coal in a combustion chamber, to provide the mercury-containing gas”**

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 ¶¶433-435.

- c. Element 1(b): “wherein the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber, or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof or a combination thereof;”**

Downs-Boiler discloses applying a coal additive comprising bromine-containing reagents, including “alkali metal and alkaline earth metal bromides, hydrogen bromide (HBr) or bromine (Br<sub>2</sub>),” and “an aqueous solution of calcium bromide (CaBr<sub>2</sub>).” EX1006 ¶¶[0018]-[0019], [0021]; EX1007 ¶¶[0021]-[0022], [0024]. The bromine-containing reagents are applied to coal upstream of the combustion chamber (Points A and B) and/or to 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]; EX1002 ¶¶436-443.

Downs-Boiler describes calcium bromide ( $\text{CaBr}_2$ ) and other bromine-containing reagents “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 ¶¶436-443.

**d. Element 1(c): “injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent; and”**

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]. “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 ¶¶444-445.

Mercury in the mercury-containing gas contacts the sorbent, 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 ¶¶446-447.

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

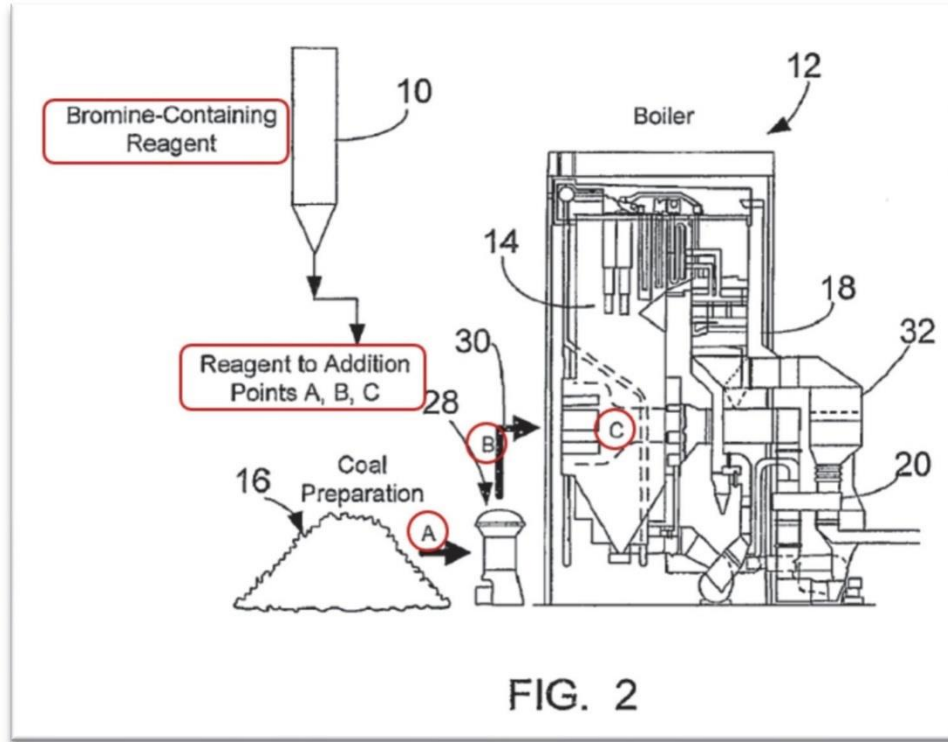
Downs-Boiler discloses that activated-carbon “sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector,” which separates the sorbent contacted with the mercury by removing it from the mercury-containing (flue) gas. EX1006 ¶[0004]; EX1007

¶[0005]; EX1002 ¶448. An ESP and FF, disclosed by Downs-Boiler, were well-known particulate control devices to separate particles (e.g., sorbent contacted with mercury) from mercury-containing gas. EX1006 ¶¶[0003], [0023], Figs. 4-6; EX1007 ¶¶[0004], [0026], Figs. 4-6; EX1002 ¶¶86-88, 448.

**2. Claims Depending from Claim 1**

- a. Claims 2-3: “wherein the [cl. 2-coal; cl. 3-combustion chamber] comprises the additive comprising the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, [cl. 2-wherein the additive is added to the coal before the coal enters the combustion chamber].”**

These claims are disclosed for the reasons discussed for Element 1(b). Regarding Claim 2, Downs-Boiler applies HBr, Br<sub>2</sub>, CaBr<sub>2</sub>, and other bromine-containing reagents to the coal before the coal enters the combustion chamber at Points A and B, as discussed for Element 1(b). Regarding Claim 3, the bromine-containing reagents are present in the combustion chamber after the treated coal is fed. Downs-Boiler also adds bromine-containing reagents directly to 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]. At Location C, the bromine-containing reagent is “fed to the boiler combustion zone 14 in gaseous, liquid, or solid form.” EX1006 ¶[0022]; see ¶[0019]; EX1007 ¶¶[0021], [0025]; EX1002 ¶¶449-450.

**b. Claims 4, 6:**

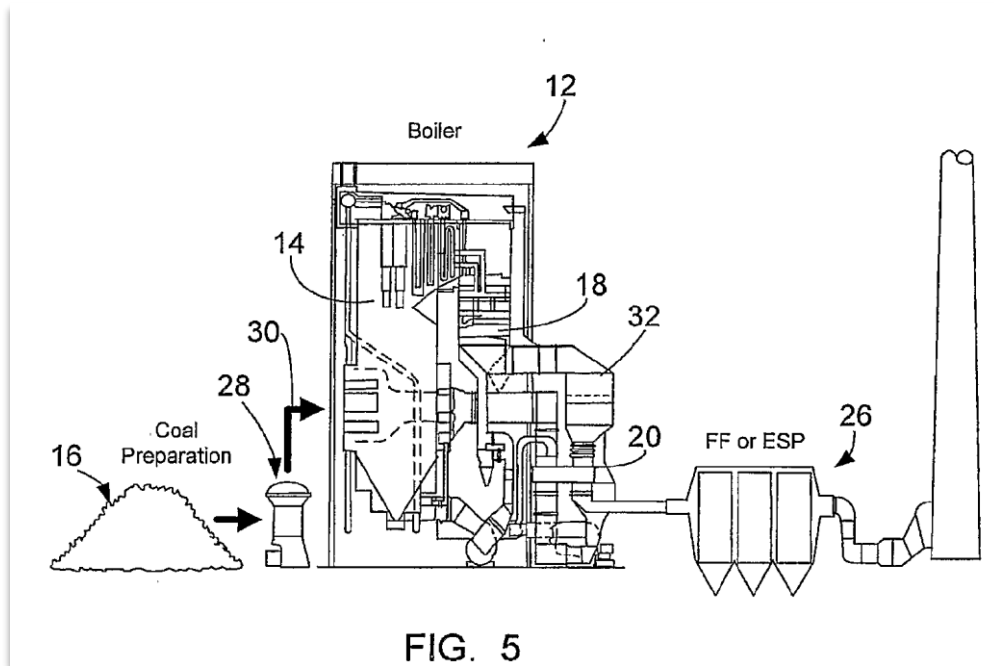
**4: “wherein the coal is combusted in the combustion chamber at a coal-combustion facility, wherein the additive comprising the Br<sub>2</sub>, HBr, bromide compound, or combination thereof, is added to the coal before the coal enters the combustion chamber, wherein the addition of the additive comprising the Br<sub>2</sub>, HBr, bromide compound, or combination thereof, to the coal is performed at the coal-combustion facility.”**

**6: “wherein the combustion chamber is an electric utility coal combustion chamber.”**

As discussed for Elements 1(a)-1(b), the coal is combusted in a combustion chamber and halogen additives are added to the coal upstream of the combustion chamber. The addition is performed at a coal-combustion facility, such as an “electric utility plant configuration representing a boiler equipped with ... downstream particulate collection means,” with a goal to “reduce the cost of mercury removal at coal-fired electric plants.” EX1006 (Downs-Boiler) ¶¶[0012]-[0014], [0016]; EX1007 (Downs-Boiler-Provisional) ¶¶[0019], [0026]; EX1002 ¶451. Regarding Claims 4 and 6, “electric plants” with coal-fired combustion chambers are examples of a coal-combustion facility. Regarding Claim 6, an “electric plant” or “electric utility plant” (disclosed in Downs-Boiler) is an electric utility. EX1002 ¶452.

**c. Claim 7: “wherein the combustion chamber is a coal combustion furnace.”**

Downs-Boiler discloses a combustion chamber (i.e., a “combustion furnace 14”). EX1006 ¶¶[0015], Figs. 2, 4-6; EX1007 ¶¶[0018], Figs. 2, 4-6.



EX1002 ¶453.

**d. Claims 8-9: “wherein the coal comprises a [cl. 8-subbituminous; cl. 9-lignite] coal”**

Downs-Boiler discloses these claims. Downs-Boiler discloses use of “western U.S. subbituminous coal” and describes that “the coal-fired boiler fuel 16 may include bituminous, subbituminous, and lignite coals and blends thereof.”

EX1006 (Downs-Boiler) ¶¶[0017], [0020]; EX1007 (Downs-Boiler-Provisional) ¶¶[0020], [0023]; EX1002 ¶¶454-455.

**e. Claims 14: “wherein the sorbent contacted with the mercury comprises the element bromine and mercury.”**

As described for Element 1(c), mercury in the flue gas is adsorbed onto activated carbon to form “particulate-bound mercury.” Adsorbed mercury includes “the oxidized form” of mercury (e.g.,  $\text{HgBr}_2$ ), so the sorbent comprises mercury and the element bromine. EX1006 ¶¶[0004], [0015]-[0016]; EX1007 ¶¶[005], [0018]-[0019]; EX1002 ¶456.

**f. Claims 15-16: “comprising removing greater than 70 wt % of the mercury in the mercury-containing gas [cl. 16-with the sorbent].”**

Downs-Boiler discloses Claims 15-16, removing 77 wt% of the mercury in the mercury-containing gas. Downs-Boiler removes  $7 \mu\text{g/dscm}$  of mercury (green), which is the difference between measured mercury content at the inlet of the fabric filter ( $9 \mu\text{g/dscm}$ , red) and at the outlet ( $2 \mu\text{g/dscm}$ , blue):

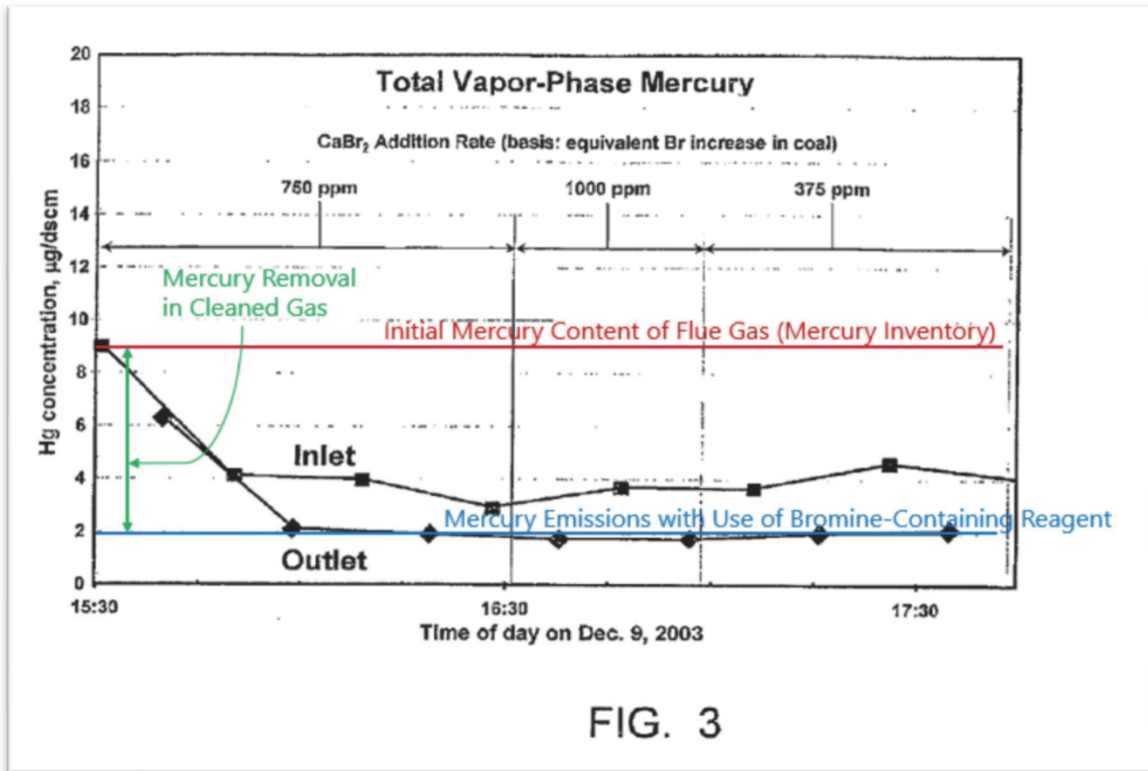


FIG. 3

EX1006, EX1007, Fig. 3 (annotated). This equates to removing 77% ( $=7\mu\text{g}/9\mu\text{g}$ ) of the mercury in the mercury-containing gas. EX1002 ¶457.

Regarding Claim 16, a POSITA would have understood that mercury removed on the sorbent alone would meet or exceed 70%. Downs-Boiler discloses that only “25% of the coal-fired power plants in the U.S. are equipped with wet FGD systems” (scrubbers), and the rest use “PAC injection systems” (activated carbon) as an alternative. EX1006 ¶¶[0007], [0015]; EX1007 ¶¶[0009], [0018]. Downs-Boiler also burns “lignite coals,” which natively produce a lower “percentage of oxidized mercury” on account of “low chloride content.” EX1006 ¶¶[0005], [0020]; EX1007 ¶¶[0006], [0023]. For plants burning lignite with only a dry-emission system, the

activated carbon would be the component that accounts for almost all the mercury removal. EX1002 ¶¶458-459.

**g. Claim 18: “wherein the Br<sub>2</sub>, HBr, or the bromide compound is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.”**

As discussed for Element 1(b), Downs-Boiler discloses adding Br<sub>2</sub>, HBr, or an “aqueous solution of calcium bromide” (CaBr<sub>2</sub>) to the coal and/or combustion chamber. EX1006, Fig. 2, ¶¶[0018]-[0019], [0021]-[0022]; EX1007 Fig. 2, ¶¶[0021]-[0022], [0025].

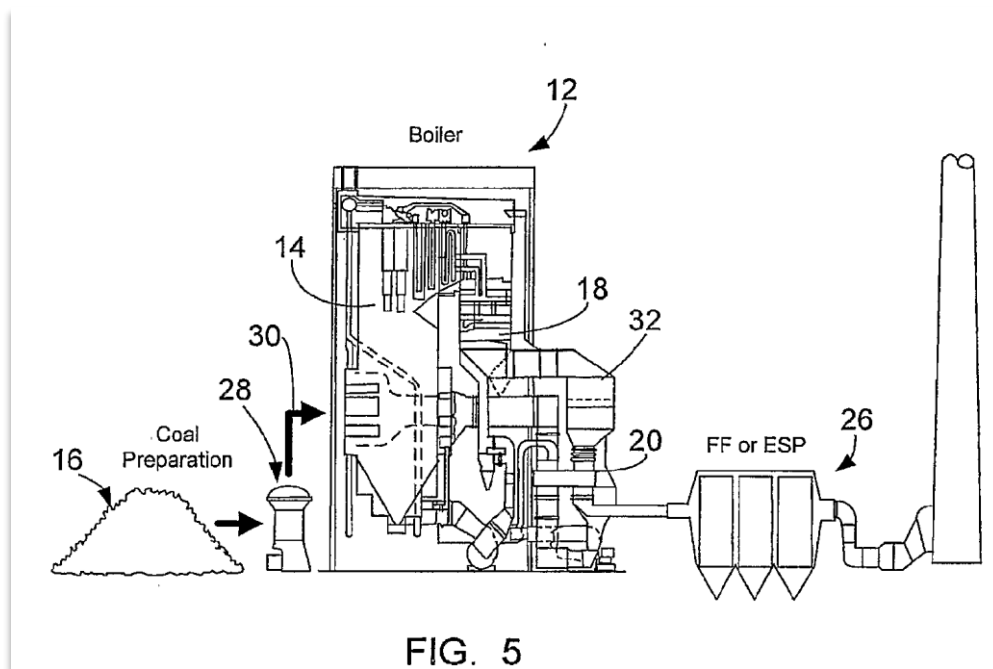
At the temperatures of the combustion chamber and flue gas, at least a portion of the Br added to coal and/or combustion chamber would have vaporized and reacted to form HBr in the combustion chamber, emerging in gaseous form to contact the sorbent in the mercury-containing flue gas. *See* EX1095 (Olson), 98:23-100:3, 231:3-9; EX1092, 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 ¶¶460-462 (further discussing EX1036).

**h. Claim 19: “wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.”**

Downs-Boiler discloses “powdered activated carbon (PAC).” EX1006 ¶¶0025]; EX1007 ¶¶0028]; EX1002 ¶463.

**i. Claim 22: “wherein the combustion chamber comprises a boiler.”**

Downs-Boiler discloses a combustion chamber (i.e., a “combustion furnace”) that comprises a “boiler.” EX1006 ¶¶0015], Figs. 2, 4-6; EX1007 ¶¶0018], Figs. 2, 4-6. Figure 5 (labeling “boiler”):



EX1002 ¶464.

**j. Claim 23: “wherein the mercury-containing gas is a flue gas.”**

Downs-Boiler discloses “[m]ercury appears in coal combustion flue gases.”

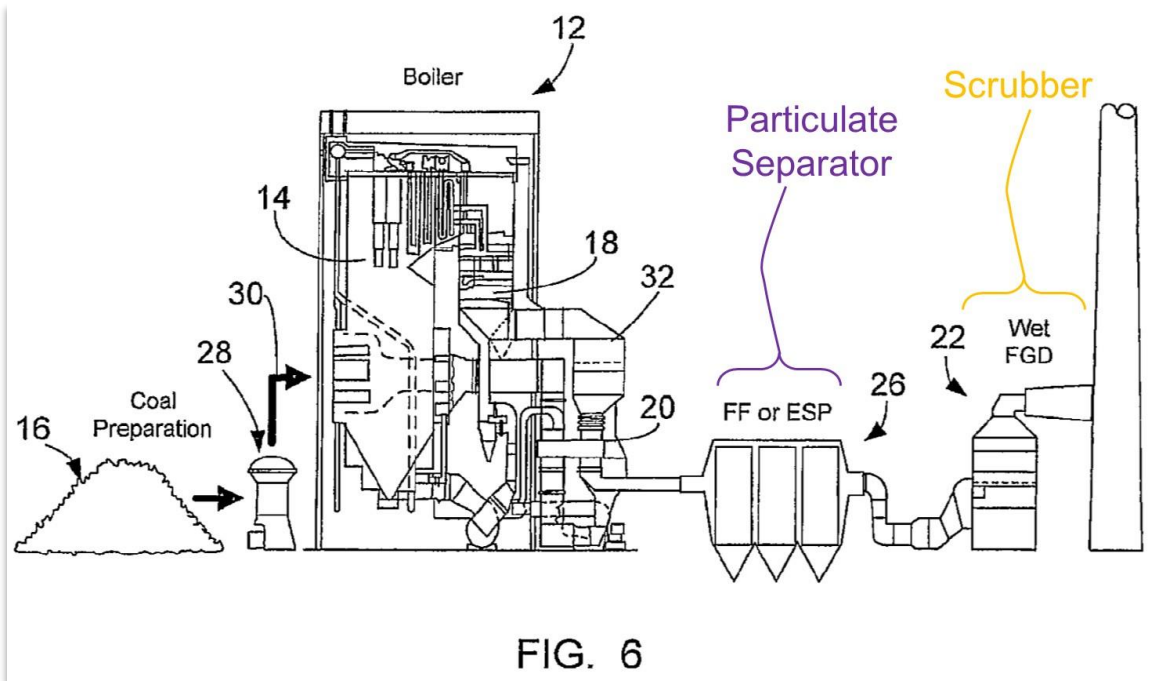
EX1006 ¶[0002]; EX1007 ¶[0003]; EX1002 ¶465.

**k. Claims 24-25:**

**24: “the injection of the sorbent into the mercury-containing gas occurs upstream of a particulate separator, a scrubber, or a combination thereof”**

**25: “the particulate separator comprises a baghouse, an electrostatic precipitator, a fabric filter, or a combination thereof.”**

As discussed above for Element 1(d), the “sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector” (i.e., the collector is downstream from sorbent injection), and Downs-Boiler provides examples of an electrostatic precipitator and fabric filter. Annotated Figure 6 is shown below:



EX1006 ¶¶[0003]-[0004], [0007], [0015], [0023], Figs. 4-6; EX1007 ¶¶[0004]-[0005], [0009], [0018], [0026], Figs. 4-6; EX1002 ¶¶466-468.

**I. Claims 26-27:**

**26: “wherein a halide sorbent enhancement additive comprises the added Br<sub>2</sub>, HBr, bromide compound, or combination thereof.”**

**27: “wherein the sorbent enhancement additive comprises the bromide compound.”**

As discussed above for Claim Element 1(b), Downs-Boiler applies bromine (Br<sub>2</sub>), hydrogen bromide (HBr), and other bromide compounds (calcium bromide, CaBr<sub>2</sub>) to the coal upstream of the combustion chamber and/or directly to the combustion chamber. EX1002 ¶¶469-472.

### 3. Independent Claim 28

Claim 28 is nearly identical to Claim 1, with minor changes, as shown in the redline below:

~~1~~28. A method of separating mercury from a mercury-containing ~~gas~~, the method comprising:  
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof, wherein  
the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber,  
or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, or a combination thereof;  
injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;  
contacting mercury in the mercury-containing gas with the sorbent; and separating the sorbent contacted with the mercury from the mercury-containing gas.

Claim 28 is disclosed for the reasons described for Claim 1. EX1002 ¶¶473-480.

The differences are discussed below.

**a. Element 28(b): “the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof...;”**

As discussed for Claim Element 1(b), Downs-Boiler discloses adding Br<sub>2</sub>, HBr, or an “aqueous solution of calcium bromide” (CaBr<sub>2</sub>) to the coal and/or combustion chamber. EX1006, Fig. 2, ¶¶[0018]-[0019], [0021]; EX1007, Fig. 2, ¶¶[0021]-[0022]. HBr and Br<sup>-</sup> are expressly disclosed by Element 28(b) as examples of “halogen or halide promoter.” Downs-Boiler expressly discloses aqueous

solutions of calcium bromide, which dissociate in water to form bromide ions (Br<sup>-</sup>). EX1006 ¶¶[0018]-[0019]; EX1007 ¶¶[0021]-[0022]. Downs-Boiler confirms that the bromine-containing species are also present in the mercury-containing flue gas, stating that they are responsible for “enhanc[ing] the removal of mercury across a PAC injection process.” EX1006 ¶¶[0015]-[0016]; EX1007 ¶¶[0018]-[0019]. At combustion temperatures (much greater than the boiling point of water), the HBr vaporizes such that the mercury-containing gas also includes HBr. At least a portion of the Br added to the coal and/or combustion chamber would have vaporized and reacted to form HBr in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. When bromine-containing species (e.g., HBr) and carbon contact one another in the flue gas, the bromide acts as a promoter. EX1002 ¶¶476-478, 129-130. Lead inventor Dr. Olson admitted that, “if calcium bromide is added to coal and put into the furnace and activated carbon is injected downstream of the furnace,” then there would be “in-flight promotion.” EX1095 at 231:3-9; *see id.* at 98:23-100:3; EX1002 ¶478 (further discussing EX1036).

**IX. GROUNDS 4-5: OBVIOUSNESS OVER DOWNS-BOILER/STARNS/MASS-EPA**

Ground 4 asserts obviousness of Claims 1-4 and 6-29 over Downs-Boiler (EX1007) and Starns (EX1008). Ground 5 asserts obviousness of Claims 1-4 and 6-29 over Downs-Boiler and Mass-EPA (EX1009). EX1002 ¶481.

**A. ANALOGOUS ART**

Starns and Mass-EPA are analogous art. *Supra* §VII.C. Downs-Boiler is analogous art to the '430 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 ¶¶239-241.

**B. OVERVIEW OF THE COMBINATIONS AND REASONS TO COMBINE**

A POSITA would have been motivated to combine Downs-Boiler with Starns (Ground 4) and Downs-Boiler with Mass-EPA (Ground 5), 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 ¶482.

As described above in Ground 3 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 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 '430 Patent. EX1001, 2:12-18, 7:48-55, 28:22-35; *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 ¶¶483-484.

**1. Ground 4 (Combination of Downs-Boiler 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 Downs-Boiler. EX1002 ¶¶485-489.

**2. Ground 5 (Combination of Downs-Boiler 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 ¶¶490-495.

**C. DISCLOSURE AND TEACHINGS OF THE COMBINATIONS**

Claims 1-4, 6-9, 14-16, 18-19, and 22-28 are obvious for the same reasons as in Ground 3, as anticipation is the epitome of obviousness. These and the other claims are also obvious for the reasons below. Elements and claims not mentioned below are disclosed or rendered obvious for the reasons stated above in Ground 3. EX1002 ¶¶496-497.

**1. Independent Claim 1**

- a. Element 1(c): “injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber; contacting mercury in the mercury-containing gas with the sorbent; and”**

In addition to the reasons stated in Ground 3, Claim Element 1(c) would have been obvious. EX1002 ¶497.

As described above for Ground 3, Downs-Boiler discloses that mercury in the flue gas is adsorbed, so it was contacted with the sorbent to form a mercury-laden sorbent. “[T]he sorbent, and its burden of adsorbed mercury” are separated from the flue gas. EX1006 ¶[0004]; EX1007 ¶[0005]. A POSITA would have understood the “burden” of adsorbed mercury refers to the loading of mercury on the activated-carbon sorbent. EX1002 ¶498.

**i. Ground 4**

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; EX1002 ¶499.

**ii. Ground 5**

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 ¶500.

**2. Claims Depending from Claim 1**

**a. Claims 8-9: “wherein the coal comprises a [cl. 8-subbituminous; cl. 9-lignite] coal”**

These claims are obvious for the reasons described above in Ground 3. EX1002 ¶¶508, 511.

**i. Ground 4**

Claim 8 is further obvious over Starns, which discloses removing mercury from flue gas from “Powder River Basin (PRB) low sulfur, sub-bituminous coals.” EX1008, 4; EX1002 ¶509.

**ii. Ground 5**

Claims 8-9 are further obvious over Mass-EPA, which discloses removing mercury from flue gas from “Powder River Basin (PRB) subbituminous coal” and from “lignite” coal. EX1009, 24, 29, 77; EX1002 ¶¶510-512.

**b. Claims 10-11:**

**10: “measuring the mercury content of the mercury-containing gas; and modifying, in response to the measured mercury content of the mercury-containing gas, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof”**

**11: “the measuring of the mercury content comprises continuous measurement.”**

These claims are disclosed by Downs-Boiler alone (Grounds 4-5) and by combining with Starns (Ground 4) and Mass-EPA (Ground 5). All three references disclose continuously measuring mercury content. Based on the continuous mercury measurements, Downs-Boiler achieves mercury-removal targets by modifying halogen-injection rates, and Starns and Mass-EPA modify sorbent-injection rates. Each control scheme satisfies Claims 10-11. EX1002 ¶¶513-523.

**i. Grounds 4-5**

Figure 3 of Downs-Boiler illustrates monitoring mercury content of the cleaned gas (“Hg concentration”) and modifying the injection rate (purple) of the bromide compound (CaBr<sub>2</sub>) from 375-1000 ppm:

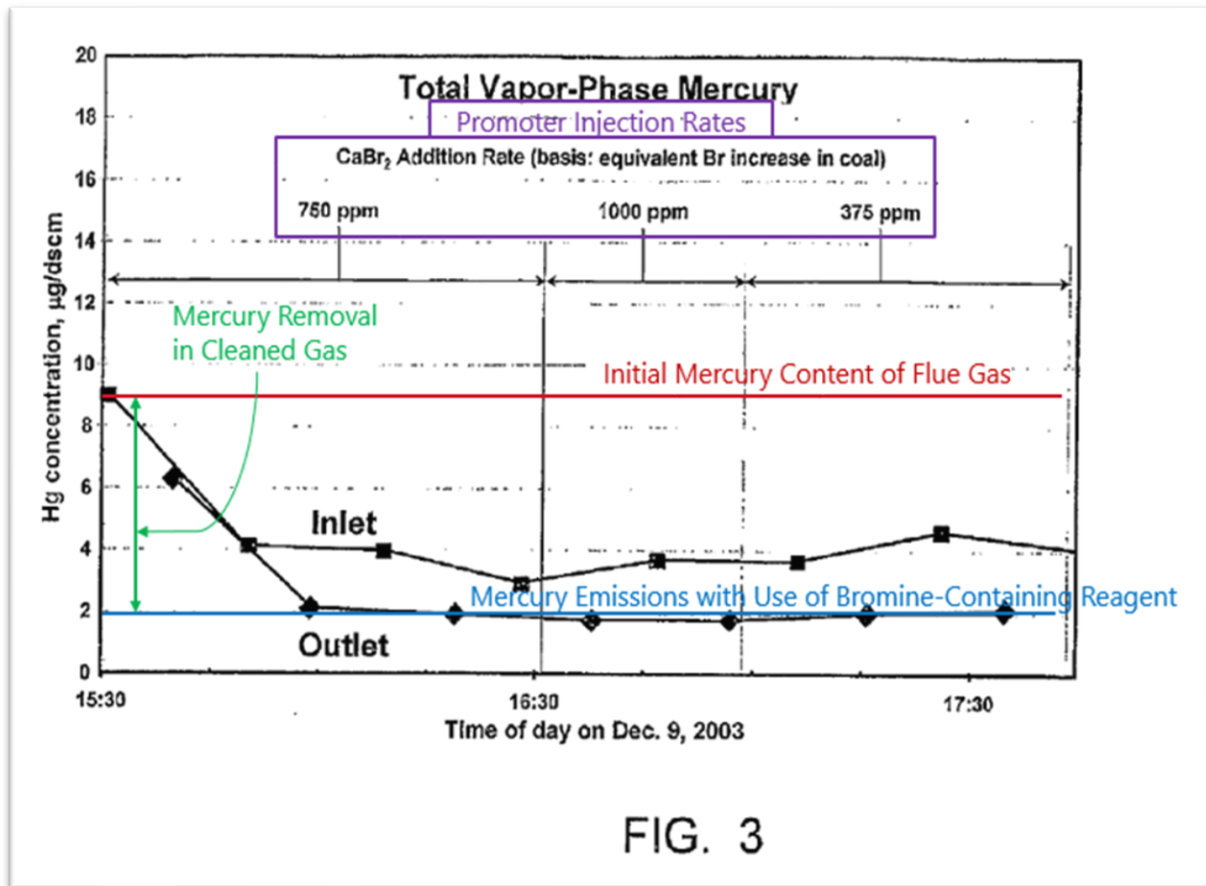


FIG. 3

EX1006, Fig. 3 (annotated), ¶[0018]; EX1007, Fig. 3, ¶[0021]. This graph “illustrat[es] the effect of the addition of ... calcium bromide, CaBr<sub>2</sub> on the total vapor-phase mercury produced during the combustion of coal .... [U]pon injection of the calcium bromide, the vapor-phase mercury exiting the system dropped.” EX1006 (Downs-Boiler) ¶¶[0011], [0018]; EX1007 ¶¶[0013], [0021]. A POSITA would have understood that measured-mercury content would be used to control a rate of addition of the bromine-containing reagent (e.g., one of the four rates provided: 0, 375, 750, and 1000 ppm) by selecting a given rate or by interpolating an intermediate value in response to the monitored mercury content of the cleaned

gas. A POSITA would have done so to avoid waste while also achieving removal-target limits, such as those imposed by EPA standards regulating mercury emissions, in order to avoid regulatory penalties. EX1006 ¶¶[0001]; EX1007 ¶¶[0002]; EX1002 ¶¶513-514.

Claims 10-11 are further obvious over Starns (Ground 4) and Mass-EPA (Ground 5). Each modifies sorbent-injection rate into the flue gas based on mercury-content measurements. A POSITA would have used such a control scheme either in place of the control scheme of Downs-Boiler (modifying halogen rate), or in addition to that control scheme (e.g., modifying both sorbent rate and halogen rate) for additional process flexibility. EX1002 ¶¶515, 518. It would have been obvious that modifying sorbent-injection rate would be performed as part of routine process control and optimization to account for variances in the coal. EX1002 ¶¶517, 522. Upon reviewing the measured-mercury data presented in Starns (Ground 4) and Mass-EPA (Ground 5), a POSITA would have understood that adding excessive sorbent would be wasteful, and adding insufficient sorbent may not achieve mercury-removal targets, and would have modified sorbent-injection rate accordingly. EX1002 ¶¶516, 521.

**ii. Ground 4**

Starns discloses substantially-continuously monitoring mercury content and modifying sorbent-injection rates in response, as described above for Ground 1 (Claims 10-11). EX1002 ¶516; *supra* §VII.E.2.f.ii.

**iii. Ground 5**

Mass-EPA discloses substantially-continuously monitoring mercury content and modifying sorbent-injection rates in response, as described above for Ground 2 (Claims 10-11). EX1002 ¶¶519-520; *supra* §VII.E.2.f.iii.

- c. Claim 12: “modifying, in response to a measured mercury content, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.”**

Claim 12 is obvious for the reasons discussed for Claims 10-11. EX1002 ¶524.

- d. Claim 13: “wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.”**

This claim is obvious over the combinations of Downs-Boiler with Starns (Ground 4) and Mass-EPA (Ground 5). Downs-Boiler identifies bromine concentration in the mercury-containing flue gas, and Starns and Mass-EPA describe

the sorbent concentration. The ratio of the two is within the claimed range. EX1002 ¶¶525-534.

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

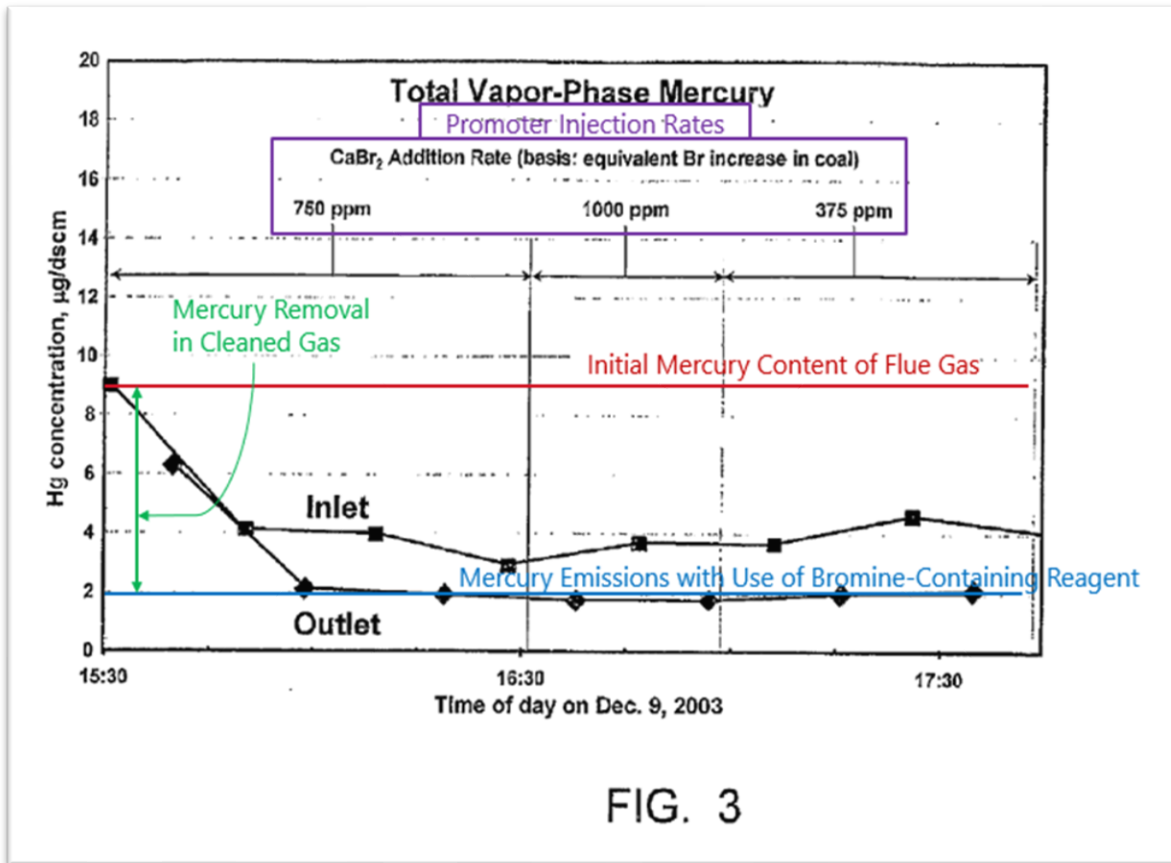


FIG. 3

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]; EX1002 ¶¶525, 528-531.

Downs-Boiler discloses using activated carbon, but not 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 ¶¶114-115, 525. This is the sorbent-injection rate in Starns (Ground 4) and Mass-EPA (Ground 5). EX1008, 20; EX1009, 12, 73; EX1002 ¶¶525-527.

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  $\text{ft}^3$  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), yields a mercury-containing gas with 21 grams of the element bromine per 100 grams of sorbent, which is within the claimed range of 1-30. EX1002 ¶¶528-533. Using the highest sorbent-injection rate tested in Chart 2 of Mass-EPA (Ground 5), which is 30 lb/MMacf (EX1009, 12), would still provide a ratio of 6.9, which is within the claimed range. It would have been obvious to try other ratios, such as increasing

halogen concentration (while reducing ACI rates), or decreasing halogen concentration (while increasing ACI) as part of routine process optimization to achieve desired mercury removal. EX1002 ¶¶533-534.

Claim 13 is merely an attempt to claim a workable range for combining a conventional halogen (bromine), used in a conventional way (to oxidize mercury and promote activated carbon), with a conventional sorbent (activated carbon). Nothing in the '430 Patent attributes significance to the claimed range or establishes that the claimed range “achieves unexpected results.” The range presents mere optimization of “result-effective” variables that would have been obvious to a POSITA. *Applied Materials*, 692 F.3d at 1297-98; EX1002 ¶534. PO’s expert in the Delaware Litigation stated the ratio in this claim limitation would “necessarily” be present. EX1092 (O’Keefe), 153 ('114 Patent cl. 4, ratio is “necessarily present”), 158 ('114 Patent cl. 29, cross-citing the “necessarily present” language of claim 4), 170 ('517 cl. 19, same language), 175-176 ('430 cl. 13, 17).

**e. Claims 14: “wherein the sorbent contacted with the mercury comprises the element bromine and mercury.”**

As described above for Element 1(c) in Grounds 3-5, a mercury-sorbent composition is formed when “sorbent ... adsorb[s] vapor-phase mercury.” EX1006 ¶[0004]; EX1007 ¶[0005]. It would have also been obvious to a POSITA that the composition also includes bromine, because the activated-carbon sorbent adsorbs

“oxidized mercury” (e.g., HgBr<sub>2</sub>).<sup>6</sup> EX1006 ¶[0016]; EX1007 ¶[0019]; EX1002 ¶[535-537].

**f. Claims 15-16: “comprising removing greater than 70 wt % of the mercury in the mercury-containing gas [cl. 16-with the sorbent].”**

Claims 15-16 would have been obvious over Downs-Boiler and Starns (Ground 4) and Downs-Boiler and Mass-EPA (Ground 5). Each reference achieves greater than 70 wt% mercury removal.

**i. Grounds 4-5**

Downs-Boiler discloses Claim 15, removing 77 wt% of the mercury in the mercury-containing gas. Downs-Boiler removes 7 µg/dscm of mercury (green), which is the difference between measured mercury content at the inlet of the FF (9 µg/dscm, red) and at the outlet (2 µg/dscm, blue):

---

<sup>6</sup> To the extent PO narrowly construes the claim to require that the sorbent first contact bromine before contacting mercury, such a read would be unsupported. Nevertheless, the claim would still have been obvious for the reasons discussed *infra* Claim 20.

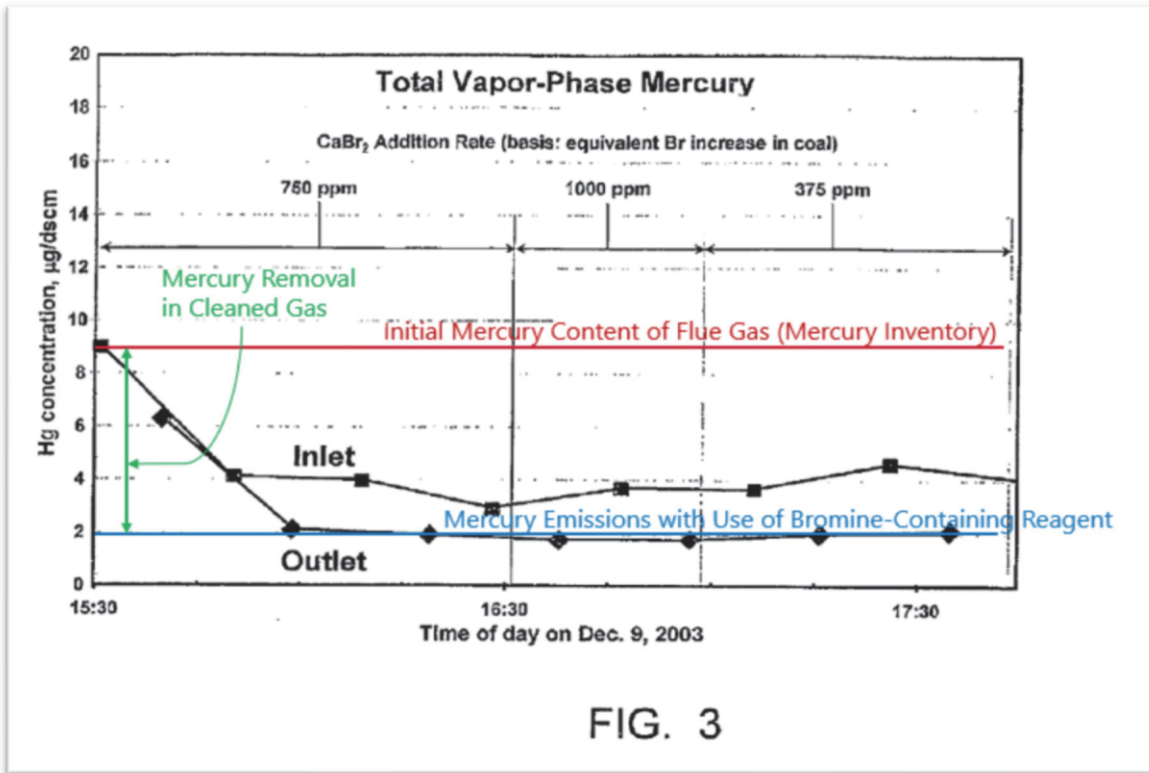


FIG. 3

EX1006, Fig. 3 (annotated); EX1007, Fig. 3 (annotated). This equates to removing 77% ( $=7\mu\text{g}/9\mu\text{g}$ ) of the mercury in the mercury-containing gas. EX1002 ¶538.

Regarding Claim 16, a POSITA would have understood that mercury removed on the sorbent alone would meet or exceed 70%. Downs-Boiler discloses that only “25% of the coal-fired power plants in the U.S. are equipped with wet FGD systems” (scrubbers), and it discloses “PAC injection systems” (activated carbon) as an alternative. EX1006 ¶¶[0007], [0015]; EX1007 ¶¶[0009], [0018]. Downs-Boiler also burns “lignite coals,” which natively produce a lower “percentage of oxidized mercury” on account of “low chloride content.” EX1006 ¶¶[0005], [0020]; EX1007 ¶¶[0006], [0023]. For plants burning lignite with only a dry-emission system, the

activated carbon would be the component that accounts for almost all the mercury removal. EX1002 ¶¶542-544.

Downs-Boiler further renders Claims 15-16 obvious, because it teaches compliance with EPA standards regulating mercury emissions from coal-fired plants. EX1006 ¶[0001]; EX1007 ¶[0002]. A POSITA would have been motivated, with reasonable expectation of success through routine process optimization, to adjust the rates of adding bromine and/or activated-carbon sorbent to meet and surpass (e.g., for safety margin) well-known regulatory proposals calling for at least 70% mercury removal. *See supra* §V.D.3; *Koninklijke*, 948 F.3d at 1337; EX1002 ¶541.

**i. Ground 4**

Claims 15-16 would be further obvious over Starns, which discloses removing 70% mercury using solely dry-emission controls. EX1008, 2, 20. When combined with the halogen improvements of Downs-Boiler, the removal would be even greater. EX1002 ¶¶539, 545.

**ii. Ground 5**

Claims 15-16 would be further obvious over Mass-EPA, which discloses removing more than 70% mercury with dry-emission systems. EX1009, 11-12 (Chart 2), 70-71, 74; EX1002 ¶¶540, 546.

**g. Claim 17: “wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the added Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, per 100 g of the sorbent.”**

This claim is obvious for the reasons discussed for Claim 13. PO’s expert treats Claim 17 the same as Claim 13, including arguing that the claimed ratios are “necessarily” present. EX1092 (O’Keefe), 153 (’114 Patent cl. 4, ratio is “necessarily present”), 158 (’114 Patent cl. 29, cross-citing the “necessarily present” language of claim 4), 170 (’517 cl. 19, same language), 175-176 (’430 cl. 13, 17); EX1002 ¶¶547-550.

**h. Claim 18: “wherein the Br<sub>2</sub>, HBr, or the bromide compound is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.”**

Downs-Boiler discloses this claim for the reasons discussed above for Element 1(b). Downs-Boiler adds bromine-containing reagent to the coal and/or combustion chamber, including that the reagent “may be fed to the boiler combustion zone 14 in gaseous, liquid, or solid form.” EX1006 ¶[0022]; *see* ¶[0019]; EX1007 ¶¶[0022], [0025]. At the temperatures of the combustion chamber and flue gas, the bromine-containing reagent is vaporized and reacts to form HBr in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. EX1008, 10; EX1009, 26; EX1002 ¶¶551-554 (discussing EX1036, 4-53, 4-65);

EX1095 (Olson), 98:23-100:3, 231:3-9; EX1092, 154, 176 (Br “exits the combustion chamber and contacts the sorbent in a gaseous state”).

- i. Claim 20: “wherein the sorbent injected into the mercury-containing gas is a sorbent obtained by contacting a sorbent with a halogen or halide promoter prior to the injection of the sorbent into the mercury-containing gas.”**

Claim 20 is obvious in Grounds 4-5 for the reasons discussed for this claim in Grounds 1-2 (Claim 20), respectively. EX1002 ¶¶558-560; *Koninklijke*, 948 F.3d at 1337; *supra* §VII.E.2.n.

- j. Claim 21: “wherein the sorbent injected into the mercury-containing gas is free of contact with a halogen or halide promoter prior to injection of the sorbent into the mercury-containing gas.”**

Downs-Boiler acknowledges the well-known nature of “removal of elemental mercury from coal combustion gases...through the application of a conventional PAC injection process.” EX1006 ¶[0016]; *see* EX1006 ¶¶[0004], [0025]; EX1007 ¶¶[0005], [0019], [0028]. A POSITA would have understood that “conventional PAC injection process” refers to untreated activated carbon (i.e., substantially free of halogen/halide promotion prior to injection). EX1002 ¶561.

As discussed in Grounds 1-2, Claim 21 would have been obvious over Starns (Ground 4) and Mass-EPA (Ground 5), respectively, as each discloses Norit “Darco

FGD,” which is substantially free of halogen/halide promotion. EX1008, 3; EX1009, 73-74; EX1002 ¶¶562-563 (discussing EX1048).

**k. Claims 24-25:**

**24: “the injection of the sorbent into the mercury-containing gas occurs upstream of a particulate separator, a scrubber, or a combination thereof”**

**25: “the particulate separator comprises a baghouse, an electrostatic precipitator, a fabric filter, or a combination thereof.”**

Downs-Boiler discloses these claims, as discussed above for Ground 3. The claims are further obvious in view of Starns (Ground 4) and Mass-EPA (Ground 5), each of which disclose plants using an electrostatic precipitator (ESP) downstream from sorbent injection. The disclosure of Starns and Mass-EPA is discussed above for Grounds 1-2 (Claims 24-25), respectively. EX1002 ¶¶566-571; *supra* §VII.E.2.r.

**3. Other Dependent Claims**

Claims 2-4, 6-7, 19, 22-23, and 26-27 are anticipated by Downs-Boiler, as addressed in Ground 3. Because anticipation is the epitome of obviousness, these claims are obvious as well. EX1002 ¶¶501-507, 555-557, 564-565, 572-573.

**4. Independent Claim 28**

In addition to the reasons set forth in Ground 3, Claim 28 would have been obvious over Downs-Boiler and Starns (Ground 4) and Mass-EPA (Ground 5). EX1002 ¶¶574-582. Claim Element 28(b) additionally recites that “the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof.” At the temperatures of the combustion chamber and flue gas, the bromine-containing reagents are vaporized and reacted to form HBr in the combustion chamber, emerging to contact the sorbent as vapor-phase HBr. EX1002 ¶¶577-579 (discussing EX1036, 4-53, 4-65); EX1095 (Olson), 98:23-100:3, 231:3-9.

**i. Ground 4**

The flue gas in Starns for example is typically at a temperature of 290°F (143°C), so Br<sub>2</sub> and HBr would be present in the gas phase in mercury-containing gas. EX1008, 10; EX1002 ¶580.

**ii. Ground 5**

The flue gas in Mass-EPA ranges from 140-160°C after the air heater or 350-450°C (before the air heater), so Br<sub>2</sub> and HBr would be present in the gas phase in mercury-containing gas. EX1009, 26; EX1002 ¶580.

**5. Independent Claim 29**

Claim 29 is nearly identical to Claims 1 and 10, with minor changes, as shown in the redline below:

~~129~~. A method of separating mercury from a mercury-containing gas, the method comprising:  
combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof, wherein  
the coal comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, wherein the additive is added to the coal before the coal enters the combustion chamber,  
or the combustion chamber comprises an additive comprising Br<sub>2</sub>, HBr, a bromide compound, or a combination thereof, or a combination thereof;  
injecting a sorbent comprising activated carbon into the mercury-containing gas downstream of the combustion chamber such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;  
contacting mercury in the mercury-containing gas with the promoted sorbent; ~~and~~ separating the promoted sorbent contacted with the mercury from the mercury-containing gas;  
~~10. The method of claim 1, further comprising~~  
measuring the mercury content of the mercury-containing gas; and  
modifying, in response to the measured mercury content ~~of the mercury-containing gas~~, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the Br<sub>2</sub>, HBr, the bromide compound, or a combination thereof, added to the coal or the combustion chamber, or a combination thereof.

For the same reasons as Claims 1 and 10, Claim 29 is also disclosed. EX1002 ¶¶583-591. The differences are discussed below.

- a. Element 29(b): “the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br<sup>-</sup>, or a combination thereof...;”**

Claim Element 29(b) would have been obvious for the reasons explained above for Claim Element 28(b).

**b. Element 29(c): “such that the activated carbon reacts with the halogen or halide promoter in the mercury-containing gas to form a promoted sorbent;”**

Claim Element 29(c) is obvious for the same reasons as stated above for Element 1(c). EX1002 ¶587. As described above for Claim 14, when bromine and carbon contact one another (e.g., upon adsorption in Downs-Boiler), the bromine and activated carbon react to form a promoted sorbent. Indeed, Downs-Boiler teaches that halogens may be “incorporated into the carbonaceous sorbent” to “yield sorbents that more strongly bond with adsorbed mercury species” (i.e., forming a promoted sorbent). EX1006 ¶[0004]; EX1007 ¶[0005]. *See supra* §V.D.4; EX1002 ¶¶587-589; *Koninklijke*, 948 F.3d at 1337. Lead inventor Dr. Olson admitted that, “if calcium bromide is added to coal and put into the furnace and activated carbon is injected downstream of the furnace,” then there would be “in-flight promotion.” EX1095, 231:3-9; *see* 98:23-100:3.

**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. Petitioner WEC is not a party to the district-court proceedings, and discovery has not opened (other than limited discovery regarding a preliminary-injunction motion). The MDL Panel consolidated

the Arizona<sup>7</sup>/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. None of the cases against Petitioners have a scheduling order, let alone trial date. For Petitioners remaining in MDL, the cases will be remanded to their respective district courts for trial. Trial dates are not known, and any Final Written Decision would likely conclude before trial.

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).

While the '430 Patent cites Vosteen589 and Downs-Boiler (EX1006) on the cover—among **18 columns** (9 pages) of cited references—the examiner did not use Downs-Boiler or Vosteen589 in a substantive rejection. *Id.*, 17-18 (factors (a)-(d)). Furthermore, the Examiner erred by not citing Downs-Boiler during prosecution.

---

<sup>7</sup> The Arizona action since settled.

*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.

**XI. CONCLUSION**

Petitioners respectfully request that IPR of the '430 Patent be instituted and that the Challenged Claims be cancelled as unpatentable.

Respectfully submitted,

February 11, 2025

\_\_\_\_\_  
Date

*/s/Brian W. Oaks*

\_\_\_\_\_  
Brian W. Oaks (Reg. No. 44,981)  
McDermott Will & Emery LLP  
300 Colorado Street, Suite 2200  
Austin, TX 78701  
Tel: 512-726-2574  
Email: boaks@mwe.com

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 13,613 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: February 11, 2025

/s/Brian W. Oaks

Brian W. Oaks (Reg. No. 44,981)  
McDermott Will & Emery LLP  
300 Colorado Street, Suite 2200  
Austin, TX 78701  
Tel: 512-726-2574  
Email: boaks@mwe.com

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 11th day of February 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  
MINNEAPOLIS MN 55402

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:

**CALDWELL CASSADY CURRY PC**  
2121 N Pearl Street, Suite 1200  
Dallas, Texas 75201

Bradley W. Caldwell (Texas Bar No. 24040630)  
bcaldwell@caldwellcc.com  
Justin T. Nemunaitis (Texas Bar No. 24065815)  
jnemunaitis@caldwellcc.com

Dated: February 11, 2025

/s/Brian W. Oaks

Brian W. Oaks (Reg. No. 44,981)  
McDermott Will & Emery LLP  
300 Colorado Street, Suite 2200  
Austin, TX 78701  
Tel: 512-726-2574  
Email: [boaks@mwe.com](mailto:boaks@mwe.com)

LEAD ATTORNEY FOR PETITIONERS