

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UNION ELECTRIC COMPANY,
Petitioner,

v.

BIRCHTECH CORPORATION,
Patent Owner

Case: IPR2025-01118
Patent 10,343,114

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,343,114**

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TABLE OF AUTHORITIES

Cases

<i>Acceleration Bay, LLC v. Activision Blizzard Inc.</i> , 908 F.3d 765 (Fed. Cir. 2018)	41, 42
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<i>LizardTech, Inc. v. Earth Resource Mapping, Inc.</i> , 424 F.3d 1336 (Fed. Cir. 2005)	12
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<i>Medtronic, Inc. v. Teleflex Innov. SARL</i> , 70 F.4 th 1331 (Fed. Cir. 2023)	47

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<i>NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.</i> , IPR2020-00832, Paper 17 (P.T.A.B. Oct. 26, 2020).....	2
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Exhibit No.	Exhibit Description
1001	United States Patent No. 10,343,114 (“114 Patent”)
1002	Declaration of Dr. Radisav Vidic
1003	Curriculum Vitae of Dr. Radisav Vidic
1004	U.S. Patent Publication No. US 2008/0107579 (May 8, 2008) (“Downs”)
1005	U.S. Provisional Patent Application No. 60/555,353 (filed Mar. 22, 2004) (“Downs-Provisional”)
1006	Redline comparison between U.S. Patent Publication No. US 2008/0107579 (Downs, EX1004) and U.S. Provisional Patent Application No. 60/555,353 (Downs-Provisional, EX1005) using Downs-Provisional as the original version (“Downs-Redline”)
1007	U.S. Patent No. 5,827,352 (Oct. 27, 1998) (“Altman”)
1008	U.S. Patent Pub. No. 2004/0003716 to Nelson (published Jan. 8, 2004) (“Nelson”)
1009	U.S. Provisional Patent Application No. 60/377,790 (filed May 6, 2002) (“Nelson-Provisional”)
1010	Redline comparison between U.S. Patent Pub. No. 2004/0003716 (Nelson, EX1008) and U.S. Provisional Patent Application No. 60/377,790 (Nelson-Provisional, EX1009) using Nelson-Provisional as the original version (“Nelson-Redline”)
1011	US Patent Publication No. 2004/0013589 (Jan. 22, 2004) (“Vosteen”)
1012	Steve Blankinship, “A Variety of Hg Capture Solutions Are Available,” Power Engineering, Vol. 113, Issue 6, (Jan. 6, 2009) (“Blankinship”)
1013	U.S. Patent No. 8,652,235 (Feb. 18, 2014) (“Olson-235”)

Exhibit No.	Exhibit Description
1014	S. Julien et al., “The Effect of Halides on Emissions from Circulating Fluidized Bed Combustion of Fossil Fuels,” Fuel, 75(14):1644–1663 (1996) (“ Julien ”)
1015	Hawley’s Condensed Chemical Dictionary, (Van Nostrand Reinhold, 13 th Ed.), Definition of “Compound,” 291 (1997)
1016	Hawley’s Condensed Chemical Dictionary, (Van Nostrand Reinhold, 13 th Ed.), Definitions of “Alkaline-Earth Metals,” “Calcium Hydroxide” and “Lime, Hydrated,” 33, 196, 671-672 (1997)
1017	U.S. Provisional Application No. 60/605,640 as filed with U.S. Patent and Trademark Office (USPTO) (“ the Provisional ”)
1018	U.S. Application No. 11/209,163 as filed with USPTO (“ the ‘163 Application ”)
1019	U.S. Application No. 12/201,595 as filed with USPTO (“ the ‘595 Application ”)
1020	U.S. Application No. 12/429,058 as filed with USPTO (“ the ‘058 Application ”)
1021	U.S. Application No. 14/102,896 as filed with USPTO (“ the ‘896 Application ”)
1022	U.S. Application No. 15/295,594 as filed with USPTO (“ the ‘594 Application ”)
1023	File History for United States Patent No. 10,343,114 (U.S. Application No. 15/978,760)(“ the ‘760 CIP ”) – but NOT including prior art references therein
1024	Reserved
1025	Reserved

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1026	Reserved
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1028	Redline comparison between U.S. Application No. 11/209,163 and 12/201,595
1029	Redline comparison between U.S. Application No. 12/201,595 and 12/429,058
1030	Redline comparison between U.S. Application No. 12/429,058 and 14/102,896
1031	Redline comparison between U.S. Application No. 14/102,896 and 15/295,594
1032	Redline comparison between U.S. Application No. 15/295,594 and 15/978,760
1033	Reserved
1034	Reserved
1035	Reserved
1036	Reserved
1037	US Patent Publication No. US 2018/0280870A1 (“Olson-870”)
1038	Institution Decision, IPR2020–00832, Patent 10,343,114 (“832 DI”)
1039	Institution Decision, IPR2020–00834, Patent 10,343,114 (“834 DI”)
1040	Oxtoby et al., PRINCIPLES OF MODERN CHEMISTRY, 4 th ed (Saunders College Publishing: 1999) (“Oxtoby”)

Exhibit No.	Exhibit Description
1041	Evan J. Granite et al., “Sorbents for Mercury Removal from Flue Gas,” DOE/FETC/TR-98-01, U.S. Department of Energy (Jan. 1998) (“ Granite ”)
1042	Babcock & Wilcox, STEAM: ITS GENERATION AND USE, 40th ed. (The Babcock & Wilcox Company: 1992) (“ B&W: Steam ”)
1043	U.S. EPA, AP-42: External Combustion Sources, Chapter 1: Fifth Edition, Volume I (Sep. 1998), available at https://www3.epa.gov/ttn/chief/ap42/ch01/index.html (last visited Apr 10, 2020) (“ Chapter 1 of AP-42 ”)
1044	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 & R&D Program Review</i> (April 2003) (“ Feeley ”)
1045	Clean Air Mercury Rule: Basic Information, available at https://web.archive.org/web/20050920005951/http://www.epa.gov/mercuryrule/basic.htm (“ Clean Air Mercury Rule ”)
1046	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 https://www3.epa.gov/airtoxics/112nmerc/volume8.pdf (“ EPA 1997 Mercury Study Report Vol. VIII ”)
1047	Deposition Transcript of Edwin Olson (Aug. 26, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1048	Deposition Transcript of Michael Holmes (Aug. 24, 2022) (excerpted), taken in <i>Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al.</i> , No. 1:19-cv-01334-CJB.
1049	U.S. Patent No. 1,984,164 to Stock et al. (issued Dec. 11, 1934) (“ Stock ”)

Exhibit No.	Exhibit Description
1050	B.R. Puri, <i>Surface Complexes on Carbons</i> , in CHEMISTRY AND PHYSICS OF CARBON 191 (Philip L. Walker, ed.) (Marcel Dekker: 1970) (“ Puri ”)
1051	Roop Chand Bansal, et al., ACTIVE CARBON (Marcel Dekker:1988) 482 pages (“ Bansal ”)
1052	Frank E. Huggins et al., “XAFS Examination of Mercury Sorption on Three Activated Carbons,” <i>Energy & Fuels</i> 1999(13), p. 114–121 (1999) (“ XAFS ”)
1053	Charlene R. Crocker et al., “Mercury Control with the Advanced Hybrid Particulate Collector Technical Progress Report,” U.S. DOE–NETL (Nov. 2003) (“ Crocker ”)
1054	C. Eckberg et al., “Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler,” Track A, Session A3 (Mercury – Control), Presentation A3c, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (“ Eckberg ”)
1055	US Patent Publication No. 2006/0048646 (Mar. 9, 2006) (“ Olson-646 ”)
1056	Vosteen, B. W. et al.: Mercury-Related Chemistry in Waste Incineration and Thermal Process Flue Gases. Poster, Air Quality IV Conference. September 22nd – 24th, 2003, Arlington VA. (“ Vosteen poster ”)
1057	“Mercury Reduction Technology Shows Promise for Texas Lignite,” <i>Power Engineering</i> , Vol. 109, Issue 3, (Mar. 1, 2005)
1058	J. Bustard, S. Sjöstrom, et al., “Full Scale Evaluation of Sorbent Injection for Mercury Control on Coal-Fired Power Plants,” International Conference on Air Quality III, Paper No. A5–4 (Sept. 9–12, 2002: Arlington, VA) (“ Bustard ”)

Exhibit No.	Exhibit Description
1059	Sharon Sjostrom et al., “Field Studies of Mercury Control Using Injected Sorbents,” AWMA ANNUAL MEETING, Session Ae-1b (2002) (“Sjostrom-III”)
1060	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) (“EPA-Proposal”)
1061	Vosteen et al., “Energy Process Engineering and Environmental Protection,” Study commissioned by the State Environmental Agency of North Rhine-Westphalia (April 22, 2004)
1062	S. Sjostrom et al., “Full Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of a Spray Dryer and Fabric Filter,” POWER GEN CONFERENCE (Orlando, Florida: Nov. 29 – Dec. 2, 2004) (“Sjostrom-I”)
1063	Sjostrom, S., “Evaluation of Sorbent Injection for Mercury Control,” Report No. 41986R04 (Oct. 29, 2004)
1064	Sjostrom, S., “Evaluation of Sorbent Injection for Mercury Control,” Report No. 41986R05 (Feb. 2, 2005)
1065	Mercury Information Clearinghouse, “Quarter 6 – Mercury Control Field Demonstrations” (Apr. 2005)
1066	Sharon Sjostrom, “Full Scale Evaluations of Mercury Control Technologies with PRB Coals,” Track A, Session A3 (Mercury – Control), Presentation A3b, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) (“Sjostrom-II”)
1067	Sharon Sjostrom, “Evaluation of Sorbent Injection for Mercury Control,” Report No. 41986R08 (Aug. 2, 2005)

Exhibit No.	Exhibit Description
1068	Chu, P. and Porcella, D. B. “Mercury stack emissions from U.S. electric utility power plants,” <i>Water, Air, Soil Pollution</i> , 80, 135-144, 1995.
1069	Meij, R. “The fate of mercury in coal-fired power plants and the influence of wet flue-gas desulfurization,” <i>Water, Air, Soil Pollution</i> , 56, 21, 1991.
1070	Galbreath, K.C. and Zygarlicke, C.J. “Mercury transformations in coal combustion flue gas,” <i>Fuel Processing Technology</i> , 65–66, 289–310, 2000.
1071	Institution Decision, IPR2020–00928, Patent 8,168,147 (“928 DI”)
1072	Senior, C.L., Sarofim, A.F., Zeng, T., Helble, J.J., and Mamani-Paco, R. “Gas-phase transformations of mercury in coal-fired power plants,” <i>Fuel Processing Technology</i> , 63, 197–213, 2000.
1073	Sliger, R.M., Kramlich, J.C., Marinov, N.M. “Towards the development of a chemical kinetic model for the homogeneous oxidation of mercury by chlorine species,” <i>Fuel Processing Technology</i> , 65–66, 423–438, 2000.
1074	Chang, R. and Offen, G., “Mercury Emission Control Technologies: An EPRI Synopsis,” <i>Power Engineering</i> , Vol. 99, No. 11, pp. 51-57, 1995.
1075	Liu, W., Vidic, R.D., Brown, T.D. “Optimization of high temperature sulfur impregnation in activated carbon for permanent sequestration of mercury,” <i>Environmental Science Technology</i> , 34, 483-488, 2000.
1076	Liu, W., Vidic, R.D., Brown, T.D. “Impact of flue gas conditions on mercury uptake by sulfur-impregnated activated carbon,” <i>Environmental Science Technology</i> , 34, 154-159, 2000.
1077	Brief in Support of Plaintiff’s Motion for Transfer of Actions to the Southern District of Iowa, filed in <i>In re Midwest Energy Emissions Corp. Patent Litigation</i> , No. 4:24-md-1332 (S.D. Iowa).

Exhibit No.	Exhibit Description
1078	Granite, E.J., Pennline, H.W. and Hargis, R.A. “Novel sorbents for mercury removal from flue gas,” Industrial Engineering Chemistry Research, 39, 1020-1029, 2000.
1079	Lee, S.J., Seoa, Y-C., Jung, J., Lee, T.J. “Removal of gas-phase elemental mercury by iodine- and chlorine-impregnated activated carbons,” Atmospheric Environment, 38, 4887–4893, 2004.
1080	U.S. Patent No. 5,435,980 (“Felsvang”)
1081	U.S. Patent No. 6,878,358 to Vosteen
1082	Declaration of Tracey J. Olanyk (6/2/2025), authenticating various exhibits including Blankinship EX1012
1083	Expert Report of Philip J. O’Keefe, PE Regarding Infringement (Oct. 25, 2022) (excerpted), submitted by Patent Owner in Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al., No. 1:19-cv-01334-CJB
1084	Buschmann, J, et al., “The KNX™ Coal Additive Technology A Simple Solution for Mercury Emissions Control,” POWER GEN CONFERENCE (Las Vegas, Nevada: Dec. 6 – Dec. 8, 2005)
1085	Vassileva, S.V., et al., “Contents, modes of occurrence and origin of chlorine and bromine in coal,” Fuel 79 (2000) 903–921.

All exhibits not containing consecutive page numbers, including the prosecution history, are cited in this Petition using page numbers added by Petitioner. All other exhibits are cited by their original page or paragraph numbers.

TABLE OF CHALLENGED CLAIMS

Claim Element	Claim Language
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, wherein the mercury-containing gas comprises a halogen or halide promoter comprising HBr, Br ⁻ , or a combination thereof,
1(b)	the coal comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, or a combination thereof;
1(c)	injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;
1(d)	contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition;
1(e)	separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;
1(f)	monitoring the mercury content of the cleaned gas; and
1(g)	controlling, in response to the monitored mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, the sorbent composition, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.
2	2. The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas.
3	3. The method of claim 1, comprising removing greater than 70 wt % of the mercury in the mercury-containing gas on the sorbent.

Claim Element	Claim Language
4	4. The method of claim 1, wherein the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the halogen or halide promoter per 100 g of the sorbent material.
5	5. The method of claim 1, wherein the combustion chamber comprises the halogen or halide promoter.
6	6. The method of claim 1, wherein the coal comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, added to the coal upstream of the combustion chamber.
7	7. The method of claim 1, wherein the promoter is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.
8	8. The method of claim 1, further comprising injecting a secondary material into the mercury-containing gas downstream of the combustion chamber.
9	9. The method of claim 8, wherein the secondary material comprises a halogen, a compound derived from a halogen, a hydrohalide, a compound comprising a Group V or Group VI element and a molecular halogen, or a combination thereof.
10	10. The method of claim 1, wherein the sorbent material injected into the mercury-containing gas further comprises a non-carbon sorbent material.
11	11. The method of claim 10, wherein the non-carbon sorbent material comprises at least one of a porous felsic material, a vesicular felsic material, a porous basaltic material, a vesicular basaltic material, a clay-based compound, an alkaline compound, a calcium hydroxide compound, a sodium acetate compound, and a bicarbonate compound.
12	12. The method of claim 1, wherein the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.
13	13. The method of claim 1, wherein the sorbent material injected into the mercury-containing gas is substantially free of halogen and halide promotion.

Claim Element	Claim Language
14	14. The method of claim 1, wherein the sorbent material injected into the mercury-containing gas is a promoted sorbent obtained by contacting a base sorbent with another halogen or halide promoter.
15	15. The method of claim 1, wherein the combustion chamber comprises a boiler.
16	16. The method of claim 1, wherein the mercury-containing gas is a flue gas.
17	17. The method of claim 1, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of an air pre-heater.
18	18. The method of claim 1, wherein the injection of the sorbent material into the mercury-containing gas occurs upstream of a particulate separator or a scrubber.
19	19. The method of claim 1, wherein the coal comprises added halide sorbent enhancement additive.
20	20. The method of claim 1, wherein the combustion chamber comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof.
21	21. The method of claim 1, wherein the coal comprises added sorbent enhancement additive that comprises Br ⁻ .
22	22. The method of claim 21, wherein the sorbent enhancement additive comprises a bromide compound.
23(preamble)	23. A method of separating mercury from a mercury-containing gas, the method comprising:
23(a)	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 ⁻ , or a combination thereof, wherein
23(b)	the coal comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, or

Claim Element	Claim Language
	a combination thereof;
23(c)	injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;
23(d)	contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and
23(e)	separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.
24(preamble)	24. A method of separating mercury from a mercury-containing gas, the method comprising:
24(a)	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 ⁻ , or a combination thereof, wherein
24(b)	the coal comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br ₂ , HBr, Br ⁻ , or a combination thereof, or a combination thereof;
24(c)	injecting a sorbent material 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;
24(d)	contacting mercury in the mercury-containing gas with the promoted sorbent, to form a mercury/sorbent composition;
24(e)	separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;
24(f)	monitoring the mercury content of the cleaned gas; and
24(g)	controlling, in response to the mercury content of the cleaned gas,

Claim Element	Claim Language
	<p>an injection rate of injecting the sorbent into the mercury-containing gas,</p> <p>a rate of addition to the coal or the combustion chamber of the added Br₂, HBr, the bromide compound, or a combination thereof, or</p> <p>a combination thereof,</p> <p>so that the mercury content of the cleaned gas is maintained at or below a desired level.</p>
25(preamble)	25. A method of separating mercury from a mercury-containing gas, the method comprising:
25(a)	combusting coal in a combustion chamber, to provide the mercury-containing gas, wherein
25(b)	<p>the coal comprises added Br₂, HBr, a bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber, or</p> <p>the combustion chamber comprises added Br₂, HBr, a bromide compound, or a combination thereof, or</p> <p>a combination thereof,</p>
25(c)	injecting a sorbent material comprising activated carbon into the mercury-containing gas downstream of the combustion chamber;
25(d)	contacting mercury in the mercury-containing gas with the sorbent, to form a mercury/sorbent composition; and
25(e)	separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas.
26	26. The method of claim 25, wherein the coal comprises the added Br ₂ , HBr, the bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber.

Claim Element	Claim Language
27	27. The method of claim 25, wherein the combustion chamber comprises the added Br ₂ , HBr, the bromide compound, or a combination thereof.
28	28. The method of claim 25, further comprising monitoring the mercury content of the cleaned gas; and controlling, in response to the mercury content of the cleaned gas, an injection rate of injecting the sorbent into the mercury-containing gas, a rate of addition to the coal or the combustion chamber of the added Br ₂ , HBr, the bromide compound, or a combination thereof, or a combination thereof, so that the mercury content of the cleaned gas is maintained at or below a desired level.
29	29. The method of claim 25, wherein the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent.
30	30. The method of claim 25, wherein the mercury/sorbent composition comprises the element bromine, the sorbent material, and mercury.

I. INTRODUCTION

Petitioner requests IPR of claims 1-30 of U.S. Patent 10,343,114 (“114 Patent”). EX1001. Dr. Radisav Vidic provided his expert declaration in support. EX1002-EX1003.

II. MANDATORY NOTICES UNDER 37 C.F.R. 42.8

A. Real Parties-in-Interest (42.8(b)(1))

The real parties-in-interest are the Petitioner and its parent, Ameren Corporation. No other person or entity is funding this Petition, advising on strategy for the Petition, or exercising any control over Petitioner’s decision to file the Petition or any arguments therein.

B. Related Matters (42.8(b)(2))

Patent Owner (“PO”) is currently asserting the Challenged Patent in the following proceedings:

- *Midwest Energy Emissions Corp. v. Ameren, Inc. et al.*, Case No. 4:24-cv-00980 (E.D. Mo.) (“the Missouri Case”);
- *Midwest Energy Emissions Corp. v. Berkshire Hathaway Energy Company et al.*, Case No. 4:24-cv-00243 (S.D. Iowa)
- *Midwest Energy Emissions Corporation v. Tucson Electric Power Company et al.*, Case. No. 3:24-CV-8145 (D. Ariz)
- *In re Midwest Energy Emissions Corp. Patent Litigation*, No. 4:24-md-1332 (S.D. Iowa) (consolidating the Iowa, Arizona, and Missouri cases) (“the MDL proceeding”).

Petitioner is a defendant in the Missouri case and MDL proceeding.

PO previously asserted the Challenged Patent in the District Court for the District of Delaware in *Midwest Energy Emissions Corp. v. Arthur J Gallagher & Co., et al.*, No. 1:19-cv-01334-RGA (D. Del.) (filed July 17, 2019) (“the Delaware Litigation”).

The Board previously granted institution of IPR on two Petitions against the Challenged Patent in the following proceedings:

- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00832, Paper 17 (P.T.A.B. Oct. 26, 2020) (“IPR832 Institution”);
- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00834, Paper 18 (P.T.A.B. Oct. 26, 2020) (“IPR834 Institution”).

The prior IPRs and district court matters involved Midwest Energy Emissions Corp. (“ME2C”) as Patent Owner/Plaintiff. On November 7, 2024, ME2C filed a notice with the USPTO that it had changed its name to Birchtech Corp. See Reel 069187, From 0413. ME2C has indicated it will nevertheless continue in the district court litigations under the name ME2C.

C. Lead and Back up Counsel (42.8(b)(3))

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Service information for lead and backup counsel is provided in the designation of lead and backup counsel, above. Petitioner consents to electronic service to lead and backup counsel, using the email addresses above.

III. PAYMENT OF FEES

Payment of any fees is authorized from Deposit Account No. 50-0975.

IV. GROUND FOR STANDING

Petitioner certifies the ‘114 Patent is available for *inter partes* review and Petitioner is not barred or estopped from requesting such review. This petition is being filed within one year of Petitioner being served with a complaint alleging infringement.

V. IDENTIFICATION OF CHALLENGED CLAIMS AND RELIEF SOUGHT

Petitioner requests (i) review of claims 1–30 of the ‘114 Patent (“Challenged Claims”) on the grounds set forth below and (ii) that these claims be found unpatentable.

Ground	Claim(s)	Basis for Unpatentability
1	1–30	Obvious over Downs and Altman; Downs Altman and Vosteen; or Downs, Altman, and Nelson**
2	1–30	Obvious over Vosteen and Altman; or Vosteen, Altman and Nelson**
3	23, 25–27	Anticipated by Blankinship
4	1–30	Obvious over Blankinship; Blankinship and Vosteen; or Blankinship and Olson-235**

** as evidenced by Julien for claims 1-24 and Felsvang for claims 1-22

VI. THE BOARD SHOULD NOT DENY INSTITUTION

The Board should not deny institution under 35 U.S.C. § 314(a) for several reasons. First, the Board twice previously instituted an IPR against this ‘114 Patent (*See* IPR2020-00832 and IPR2020-00834) finding a break in the priority chain which would invalidate all of the claims, but PO promptly settled with those petitioners and both IPRs were terminated without further action. The present Petition should proceed on the merits.

Second, the district-court proceeding in Missouri is in its early stages and was consolidated with several other lawsuits for pre-trial proceedings in an MDL in the Southern District of Iowa on December 12, 2024 (MDL No. 3132). The Iowa court

entered a Case Management Order on March 7, 2025, but no depositions have been taken yet and the first Markman Brief is not due until October 10, 2025. The “Ready for Trial” date is October 12, 2026, but trial will be long after as the Missouri court will have to receive the case back and set a trial date which will require at least six additional months—particularly given PO has stated it intends to pursue trial against other MDL defendants before trial against Petitioner. As the Iowa Court noted in an Order filed on May 22, 2025, “...the litigation is at a relatively early stage...” Doc. [131], 6. Accordingly, a Final Written Decision is due well before trial in any of the lawsuits after they are returned to their original jurisdictions following the conclusion of the MDL.

Third, institution should not be denied under 35 U.S.C. § 325(d) because the Examiner did not consider Blankinship or Downs during prosecution. *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 ‘114 Patent cites Olson-235 and Downs—in a list spanning *16 columns* (9 pages) of cited references—none were used in a substantive rejection. *Id.* at 17–18 (factors (a)–(d)). Further, Olson-235 and Downs are dated after the alleged earliest ‘114 Patent priority date, and patent examiners accept applicant’s asserted priority date without making findings concerning priority. M.P.E.P. § 201.08.

VII. OVERVIEW

A. POSITA

A person of ordinary skill in the art at the time of the alleged invention in August 2004 (“POSITA”) would have at least a bachelor’s degree in chemical engineering, mechanical engineering, environmental engineering, or a related field of study with at least two years of experience with investigating, researching, or implementing pollution control in natural gas or coal power generation plants and/or industrial waste incineration. EX1002, ¶ 33.

B. Alleged Invention

The ‘114 Patent relates to removal of mercury from flue gas. EX1001, 1:26–31. It admits known “mercury control methods” included “injection of fine sorbent particles into a flue gas duct” such as “activated carbon.” EX1001, 1:56–59.

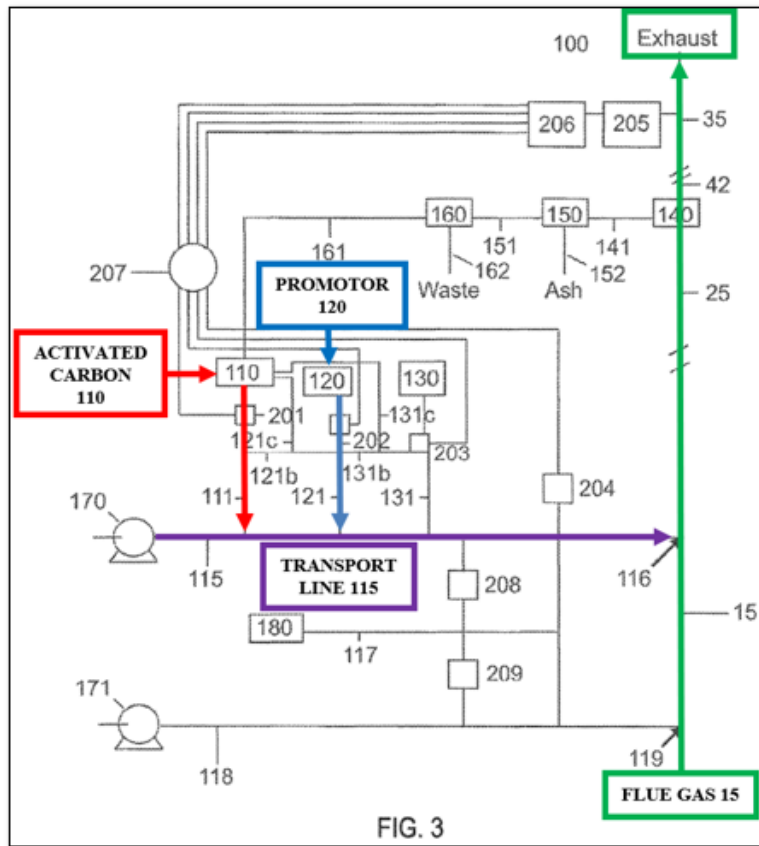
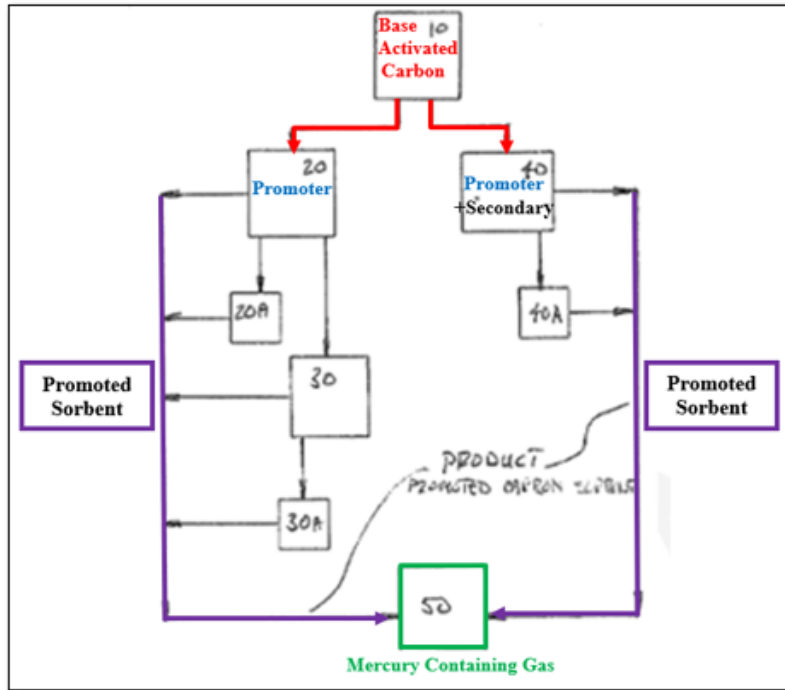
The ‘114 Patent discloses preparing a **promoted** sorbent **outside** the mercury-containing flue gas as shown in Figure 1, below,¹ and then injecting the promoted sorbent **into** the flue gas **downstream** from the combustion chamber as shown in Figure 3, below. Figure 3 is thus limited to injections into flue gas.

Each independent claim requires both (1) adding particular bromine-containing species (*i.e.*, Br₂, HBr, Br⁻ or a bromide compound, or a combination

¹ This version of Figure 1 is as originally filed. See § VII.B.5.b.

thereof) to coal and/or the combustion chamber and (2) injecting activated carbon sorbent into the mercury-containing gas. EX1001, Claims 1, 23-25. EX1002, ¶¶34-43.

There is no support for adding a promoter to coal in the application as filed or in any of its priority applications. EX1002, ¶¶ 58-109.



EX1001, Figures 1 & 3 (green, blue, purple and red annotations added).

1. The Application for the ‘114 Patent Fails to Provide Written Description Support for the Challenged Claims

The Challenged Claims are not entitled to a priority date before the May 14, 2018 filing date of the application for the ‘114 Patent (“the ‘760 Application”) for lack of written description support². Each independent claim requires coal, a combustion chamber, or both comprising added “Br₂, HBr, Br- or a bromide compound, or a combination thereof.”³ EX1001, Claims 1, 23-25. There is no disclosure of each such promoter being added to coal in the ‘760 Application.

2. ‘760 Application Does Not Disclose Br₂, HBr, Br- or Bromide Compound, or a Combination Thereof Added to Coal

a. ‘760 Application Disclosure

“Coal” is described in the ‘760 Application generally as a fossil fuel (EX1023, [0003]; citations are to paragraph numbers in the specification as filed in EX1023) or in the context of coal combustion facilities, coal-fired boiler or coal combustion flue gas (EX1023, [0003], [0048], [0085], [0093]-[0094], [0113]). None of these

² Petitioner is asserting this lack of written description to determine the priority date. Petitioner is not asserting invalidity under Section 112, an issue outside the scope of an IPR.

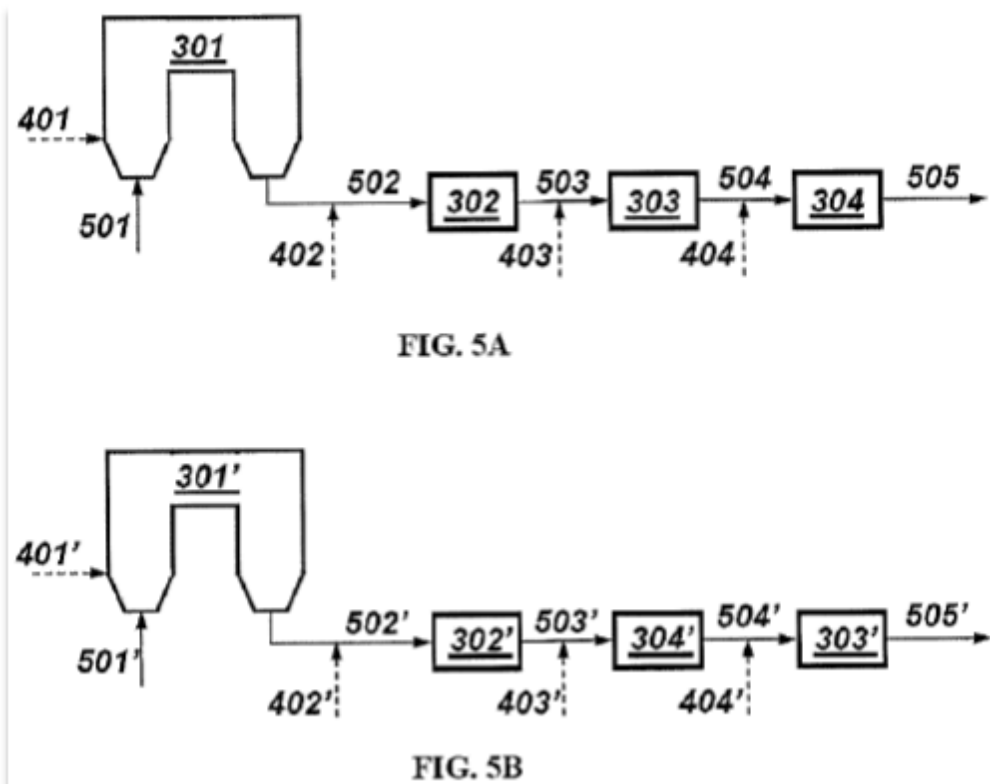
³ Claims 1, 23 and 24 require Br₂, HBr, Br-, or a combination thereof, and claim 25 requires Br₂, HBr, a bromide compound, or a combination thereof.

disclosures describe promoter compounds such as Br₂, HBr, Br⁻ or a bromide compound, or a combination thereof added to coal.

“Additive” is described generally in the ‘760 Application as “sorbent enhancement additives” (EX1023, [0010]), “optional additives discussed herein” (EX1023, [0051]), “additive to a treatment facility” (EX1023, [0101]) and “additive-sorbent ratios” (EX1023, [0106]). None of these disclosures describes a promoter added to coal as in the Challenged Claims.

PO asserted a disclosure of “multiple injection points” for the promoted carbon sorbents provided support for adding a promoter to coal in an IPR for the ‘114 Patent. The Board properly rejected that argument because the “multiple injection points” disclosure refers to injection points in the flue gas stream, not multiple injection points at different points in the process, such as before combustion. EX1038, 28–29. *See also* EX1023, [0072].

Figures 5A–5B, which were added for the first time in the ‘058 CIP and remain in the subsequent ‘896, ‘594 and ‘760 Applications, add a promoter to combustion chamber 301/301’ at injection stream 401/401’ and a sorbent at injection stream 402/402’:



EX1023, 32 at [0093]-[0096], 61 at Figures 5A-5B.⁴ This disclosure of adding a promoter to a combustion chamber is not a disclosure of adding a promoter (much

⁴ Although the Challenged Claims read on a method wherein the claimed promoter is added to a combustion chamber as in Figures 5A–5B, this does not mean the full scope of the claim has written description support. The issue is that the specification provides only one method for adding the promoter to the combustion chamber, which is to add the promoter via an injection stream into the chamber. But the Challenged Claims are far broader and expressly cover, as a claimed alternative, the promoter being added to the coal upstream of the combustion chamber and then feeding the coal into the chamber. There are no limitations in the Challenged Claims to exclude this claimed alternative for which there is no written description support.

Indeed, the contrary is true where the specification distinguishes injecting halogen “at some stage of the combustion process” as being inferior to using a “complexing method on a sorbent surface” because “gas-phase reactions of the halogens with Hg are hindered.” Ex1001, 3:5–21. The specification asserts “the present invention takes advantage of the Lewis acid complexes that rapidly form on the sorbent surface to effect Hg oxidation.” *Id.*

less adding Br₂, HBr, Br- or a bromide compound, or a combination thereof) to coal upstream of the combustion chamber, nor adding a promoter to both a combustion chamber and to coal upstream of the combustion chamber.

b. Provisional Disclosure

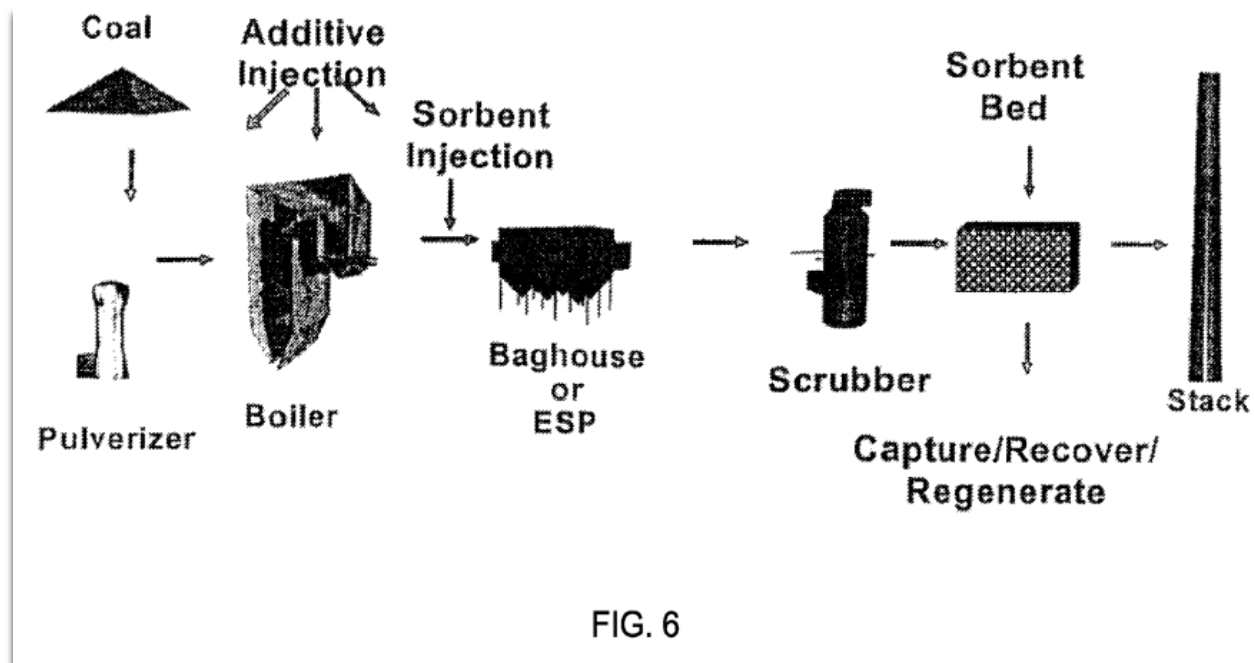
The '760 Application copies the entire disclosure of its earliest related application, 60/605,640 (“the Provisional”) into the specification. EX1001, 21:33–33:3. This Provisional section mentions mercury removal from “coal-fired utility or synthesis gas” (EX1023, [0138]; EX1017, 6), mercury within coal (EX1023, [0139]; EX1017, 6), coal combustion flue gas (EX1023, [0116], [0142]; EX1017, 7), and a facility fired with lignite coal (EX1023, [0172]; EX1017, 14). None of these disclosures describe promoter compounds added to coal.

The Provisional includes Figure 2 showing a “coal fueled facility” burning “pulverized coal” where “additive can be injected where desired (e.g., before, after or within the boiler).” EX1023, [0164], Figure 6; EX1017, 12, Figure 2. However, the term “additive” is undefined there. And additive injection “before, after or within

Simply put, a POSITA would not understand PO to have invented a method for adding the promoter to the combustion chamber, except by injection into the chamber. *See LizardTech, Inc. v. Earth Resource Mapping, Inc.*, 424 F.3d 1336, 1343–1347 (Fed. Cir. 2005).

The Challenged Claims are not entitled to the 4/23/2009 priority date of the '058 Application.

the boiler” is not a disclosure of additive injection to coal. There are common system components that supply an additive to the airstream before, after or within a boiler (and not to the coal) such as a separate feed inlet, a secondary-air system, or a low- No_x overfire air system. EX1002, ¶ 78.



The rest of the Provisional is no help to PO, either. The Provisional provides “an outline of [15] examples of the invention.” EX1023, [0117]; EX1017, 2. But none of these examples discloses applying Br_2 , HBr , Br^- or a bromide compound, or a combination thereof as an “additive” to coal.

More particularly, Examples 1–4 disclose a modified carbon sorbent prepared by reacting carbon with a Br_2 solution, a Br_2 gas, an HBr solution or an HBr gas. EX1023, [0118], [0124]-[0126]); EX1017, 2–3. Provisional Examples 5 and 6 further include a sulfur or selenium reagent when preparing the promoted sorbent.

EX1023, [0127]-[0128]; EX1017, 4. Example 7 treats “carbon with a Group V or VI element combined with Group VII element, such as PBr_3 .” EX1023, [0129]; EX1017, 4. These Provisional Examples 1-7 disclose methods of preparing a promoted sorbent by reacting a carbon sorbent with a reagent. These Examples do not disclose applying the promoted sorbent to coal or applying Br_2 , HBr, Br- or a bromide compound, or a combination thereof to coal.

Provisional Examples 1-3 may include an “additional promoting substance” in the Br_2 solution, Br_2 gas, or HBr solution used in preparing the promoted sorbent. EX1023, [0118], [0123]-[0125]; EX1017, 2-3. This additional promoter can be HBr. EX1023, [0123]; EX1017, 3. This additional substance is outlined under “1E” and “same additives as 1E” without indicating what the “additive” references. Again, this additional substance is used in preparing a promoted sorbent and not as an “additive” to coal, and only HBr and not Br_2 is disclosed. During prosecution of the ‘114 Patent, PO distinguished HBr from Br_2 . EX1023, 430 at ¶ 17. A disclosure of one species (HBr) in the Provisional does not support the genus of “bromide compounds.” See *Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1350 (Fed. Cir. 2010).

Provisional Example 8 describes injecting the promoted sorbents of Provisional Examples 1-6 into a contaminated gas stream. EX1023, [0130]; EX1017, 4. Provisional Example 9 refers to the promoted sorbents as “additives (1-

8)” and describes their use with sorbents to capture acid gases, further referring to these sorbents as “additives” or “additives of base chemistry.” EX1023, [0131]; EX1017, 4, 1. Thus, Provisional Example 9 uses the term “additive” to describe sorbents. Provisional Examples 10-15 do not use the term “additive.”

As a further point, the “additive” is not the modified carbon sorbents of the Provisional Examples 1–7 since Figure 6, above, separately depicts “sorbent injection,” and the figure description states “[i]n the example shown, the sorbent is injected into the flue gas after the boiler.” EX1023, [0164], Figure 6; EX1017, 12, Figure 2.

The remaining mentions of “additive” in the Provisional disclosure do not disclose what the “additive” is, either. EX1023, [0138]; EX1017, 6 (“a combination of additives to remove pollutants”); [0158]; EX1017, 11 (“additive to a treatment facility”); [0158]; EX1017, 11 (“additive-sorbent ratios”).

Thus, the ‘760 Application fails to provide written description support for promoter compounds such as Br₂, HBr, Br⁻ or a bromide compound, or a combination thereof being added to coal. Accordingly, none of the Challenged Claims have a priority date before the filing date of the ‘760 Application. Indeed, the Board previously examined this exact issue and concluded in the ‘832 IPR there was inadequate support for a priority date for the ‘114 Patent earlier than May 2018. *See* EX1038, 31 (“Patent Owner, on this record, has not presented persuasive

arguments or evidence that the ‘114 patent is entitled to a priority date earlier than the May 14, 2018 filing date of the ‘760 Application.”). Each reference relied upon in Grounds 1–4 thus qualifies as prior art under the AIA and renders the Challenged Claims not patentable.

3. The ‘760 Application Reveals that PO Was Not in Possession of Adding a Promoter to Coal at the Time of Invention

The ‘760 Application and Provisional teach adding bromine by itself to flue gas would not sufficiently oxidize mercury to allow easy capture by activated carbon, and so bromine was reacted with the activated carbon to make a promoted sorbent to add to the flue gas. EX1002, ¶¶ 90-91.

In particular, the ‘760 Application discloses:

1. Molecular bromine (Br_2) does not react fast enough with elemental mercury to form oxidized mercury in flue gas using conventional ash control and its “reaction with hot flue gas components leave little to react with elemental mercury.” EX1023, [0142], [0085].
2. Elemental bromine (Br) “is about a million times more reactive to mercury” but is in such “extremely low” concentration it will not result in mercury oxidation in flue gas. EX1023, [0142], [0085].
3. A halide (*e.g.*, a hydrohalide such as HBr) is “very much less reactive” than molecular halogen (*e.g.*, Br_2) and “cannot therefore oxidize anything by itself.” EX1023, [0143], [0086].

4. The Provisional states for these reasons, “it is not obvious that a halide-halogen treated activated carbon would be effective at oxidizing elemental mercury and provide effective capture of elemental mercury.” EX1023, [0143]. This Provisional disclosure was changed over time in the ‘760 Application to “[in] the conventional view, therefore, a halide-salt-treated sorbent will not effectively oxidize elemental mercury and capture elemental mercury,” recharacterizing PO’s rationale for nonobviousness of a promoted activated carbon sorbent as a “conventional view.” EX1023, [0086].

A POSITA would have known lignite or subbituminous coal contains very low amounts of bromine on the order of 1-3 ppm (median). EX1084, 1; EX1085, 905; EX1002, ¶ 92. Thus, a POSITA would have understood the ‘114 Patent’s disclosure of “extremely low” concentrations of elemental bromine (Br) being in the flue gas as meaning **native untreated coal** was being combusted in the combustion processes of the ‘114 Patent, and not **coal to which HBr, Br₂, Br- or a bromide compound or a combination thereof is added.** *Id.*

A POSITA would have known any bromine source added to the combustion chamber would completely convert to hydrogen bromide (HBr). EX1014, 1658; EX1002, ¶ 93. Thus, had **HBr, Br₂, Br- or a bromide compound or a combination thereof been added to the coal before combustion, the concentration of elemental**

bromine (Br) would have been much higher driving a POSITA to conclude the named inventors never described adding a promoter to coal or to the combustion chamber. *Id.* Instead, the named inventors described a promoted activated carbon sorbent which they introduced into the flue gas post-combustion. *Id.*

As the '114 Patent explains, “adding HBr or Br₂ to the carbon forms a similar carbon bromide, in which the positive carbon oxidizes the mercury with the assistance of the bromide ion.” EX1023, [0145]. This carbon bromide results from the reaction between the promoter and activated carbon when making the promoted sorbent before the promoted sorbent is injected into the flue gas. It is not a disclosure of what occurs in the combustion chamber or of adding a promoter to coal.

4. The Priority Applications Do Not Provide Written Description Support for Adding the Specified Promoters to Coal

Grounds 1–4 of this Petition establish invalidity of the Challenged Claims in light of the Downs, Altman, Nelson, Vosteen, Blankinship and Olson-235 references. Each of these references was published or was otherwise publicly available years before the filing date for the application for the '114 Patent. PO thus bears the burden to produce evidence “to prove entitlement to claim priority to an earlier filing date.” *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1304–05 (Fed. Cir. 2008). Petitioner may rebut such arguments.

Notably, patent examiners generally do not make priority findings during prosecution, and generally accept applicant's asserted priority date. *Id.* at 1305; M.P.E.P. § 201.08. Here, the examiner made no finding regarding priority to any earlier filed applications.

a. Legal Standards for Priority Claims

“To receive the benefit of the filing date of an earlier application under 35 U.S.C. § 120, each application in the chain leading back to the earlier application must comply with the written description requirement of 35 U.S.C. § 112.” *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571 (Fed. Cir. 1997). PO must prove the written description of each of the priority applications “convey[s] with reasonable clarity to those skilled in the art that, as of the filing date sought, [the inventor] was in possession of the invention. ... Entitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed.” *PowerOasis*, 522 F.3d at 1306.

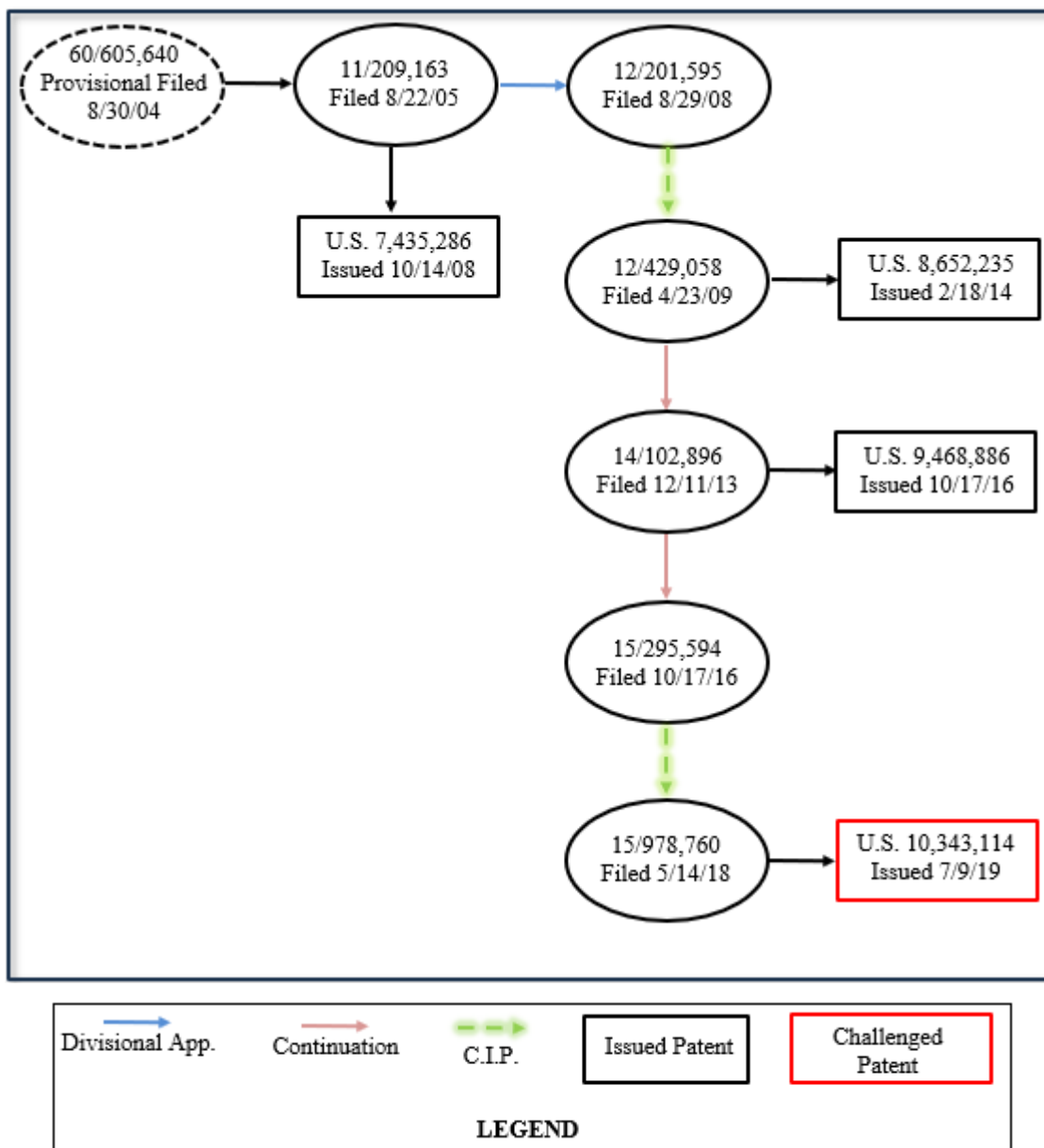
Thus, “[t]he question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification. Rather, **a prior application itself must describe an invention**, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention **as of the filing date sought.**” *Lockwood*, 107 F.3d at 1571–72 (emphasis added). Thus, to claim priority back to the Provisional, PO must demonstrate the Provisional, and **all**

intervening applications, expressly or inherently discloses adding each of the claimed bromine-containing species (Br₂, HBr, Br- or bromine compound and combinations thereof) to coal.

PO cannot meet this burden. Prior to May 14, 2018, a POSITA would not have concluded the applicant was in possession of the subject matter of the Challenged Claims because applications in the purported priority chain fail to disclose adding any type of bromine species to coal.

b. Priority Applications Do Not Provide Written Description Support

The '760 Application is a descendant of the Provisional application and a series of nonprovisional applications. *See* EX1001, 1:7–22. The following image shows the relationships between these applications:



Each priority application as filed and the file history for the ‘114 patent are submitted as Exhibits EX1017-EX1027.

The disclosures in each intervening non-provisional application between the Provisional and the ‘760 Application have “coal” and “additive” disclosures as discussed in § VII.B.2, with the exception that the Provisional disclosure was not

included in any of the intervening non-provisional applications, which have essentially the same specification, with minor differences. *See* EX1028–EX1032 (redline comparisons of each successive non-provisional application as compared to its predecessor). Thus, the priority applications fail to provide written description support for the same reasons provided above for the ‘760 Application in § VII.B.1.

Indeed, the Board found in its IPR2020–00832 Institution Decision for the ‘114 Patent that the first two non-provisional applications in the chain (the ‘163 and ‘595 Applications) do not disclose “(1) the addition of the promoter with the coal or the combustion chamber and (2) the injection of a sorbent material into the mercury-containing gas downstream of the combustion chamber,” both of which are required by each of the ‘114 Patent’s independent claims. EX1038, 28–29.

In Example 10 of the ‘164 and ‘595 Applications, “the halogen/halide promoted carbon sorbent was injected into the flue gas after the boiler. In general, however, the inventive sorbent can be injected where desired (e.g., before, after or within the boiler.)” EX1023, 32:9-12. This disclosure is similar to the description for Figure 6, discussed above, and it indicates the promoted sorbent was injected into the flue gas downstream from the boiler, but could be injected before or within the boiler. Promoted sorbent injection before the boiler is not a disclosure of a promoter added to coal. Nor is it a disclosure of adding Br₂, HBr, Br- or a bromide compound, or a combination thereof before the boiler because, in making the

promoted sorbent, these promoters react with the activated carbon and no longer exist in the form of Br₂, HBr, Br⁻ or a bromide compound, or a combination thereof.

The Board found the disclosure per Example 10 of the '595 Application that the "halogen/halide promoted carbon sorbent was injected into the flue gas after the boiler" describes "a **combination of promoter and sorbent material being added at one single point**" (emphasis added). EX1038, 28. The Board also considered the disclosure in that same example "[i]n general however, the inventive sorbent can be injected where desired (e.g., before, after, or within the boiler)" *Id.* The Board stated "Although this describes other injection points ("e.g., before, after, or within the boiler"), this disclosure regards the promoted sorbent material. As a result, it describes the addition of both the promoter and the sorbent material at a single point, not (1) the addition of the promoter with the coal or the combustion chamber and (2) the injection of the sorbent material into mercury-containing gas downstream of the combustion chamber, as claims 1 and 23-25 of the '114 patent recite." *Id.* Thus, the Board did not find injection of a promoted sorbent before, after or within the boiler to be adding the promoter to coal, and injecting the sorbent into flue gas downstream of the combustion chamber.

Thus, none of the intervening applications filed before the '760 Application contains such a disclosure, either.

5. The Passages Cited During Prosecution Do Not Provide Written Description Support

During prosecution, the claims were amended to require, *inter alia*, that the promoter (Br₂, HBr, Br⁻ or a bromide compound, or a combination thereof) be added to the coal. EX1023, 467-470, 546-554.

None of these amendments nor the issued claim language is supported by the specification. Indeed, none of the '760 Application paragraphs cited by Applicant during prosecution discloses adding a promoter to coal. To wit (emphasis added):

- (1) [0035] states “the promoter is introduced upstream of a boiler or a combustion chamber” but fails to specify adding the promoter to coal. EX1023, 9.
- (2) [0050] describes “halogen/halide-promoted sorbents.” EX1023, 12.
- (3) [0064] describes a “new bromide complex with the metal oxide surface” of a sorbent.
- (4) [0088] and [0155] discuss adding “bromine” or “HBr” to form a “**chemical compound in the carbon structure.**”
- (5) [0098]–[0108] discuss purported advantages of “[i]n flight preparation of the halogen/halide **promoted sorbent**” wherein the “halogen/halide is introduced to the base sorbent-air ... mixture in a transport line (or flue gas duct part of the **base sorbent storage and injection system.**” *Id.*

(6) [0123]-[0125] describe an HBr additional promoting substance added to the reagent applied “to the carbon.” EX1023, 29-30.

(7) [0138] is a general statement regarding removing mercury with “a sorbent and/or a combination of additives” without more.

(8) [0164] is the description of Figure 6 that fails as explained in § VII.B.2.b.

None of these cited paragraphs provides written description support for adding a promoter to coal, much less adding Br₂, HBr, Br⁻ or bromine compound and combinations thereof to coal as recited in the Challenged Claims.

6. Breaks in Priority Preclude an Earlier Filing Date for the ‘114 Patent

a. Break in Continuity of Disclosure from Improper Incorporation by Reference of Provisional

The purported Provisional written description support for adding a promoter to coal, including the Provisional Figure 6 in the ‘114 Patent, was added to the ‘760 Application in May 2018.

To incorporate another document, “the host document must identify with detailed particularity what specific material it incorporates and clearly indicate where that material is found in the various documents.” *Callaway Golf Co. v. Acushnet Co.*, 576 F.3d 1331, 1346 (Fed. Cir. 2009).

Here, three of the intervening non-provisional applications between the Provisional and the ‘760 Application (*i.e.*, the ‘058, ‘896 and ‘594 Applications) do

not recite the Provisional disclosure in their specifications, and they only incorporate the Provisional by reference “to the extent appropriate.” EX1001, 1:18-22; EX1020-EX1023, [0001].

This limited incorporation language causes a break in the continuity of disclosure. *See Midwest Energy Emissions Corp. v. Arthur J. Gallagher*, No. 19-1334- CJB, 2023 WL 7411160, at *3 (D. Del. Nov. 3, 2023) (holding Provisional was not properly incorporated into ‘517 patent); *Zenon Env’tl., Inc. v. U.S. Filter Corp.*, 506 F.3d 1370, 1379, 1382 (Fed. Cir. 2007) (“The plain language expressly limits the incorporation to only relevant disclosures of the patents, indicating that the disclosures are not being incorporated in their entirety.... thus a lack of continuity of disclosure exists in the family chain.”).

The Board previously held that another application descending from the ‘595 Application, 12/419,219, “claims priority ‘to the extent appropriate’ and fails to identify with detailed particularity the specific material incorporated and fails to clear[ly] indicate where that material is found in the various documents ... This ambiguity creates an additional concern regarding the chain of priority for the ‘219 application.” EX1071, 32 (finding no priority to Provisional).

Since these three intervening applications fail to identify with detailed particularity the specific material incorporated from the Provisional and fail to clearly indicate where that material is found, there is a break in continuity of

disclosure and priority that prohibits PO from introducing the Provisional disclosure into the subsequent '760 Application or relying upon it for an earlier priority date.

b. Provisional was “Essential Material” to Claims of Intervening Patent 9,468,886

Rule 1.57(d) provides for applications filed on or after 9/21/2004 that “essential material”—which includes material that is “necessary to: provide a written description of the claimed invention”—“may be incorporated by reference, but *only* by way of incorporation by reference to a *U.S. patent or U.S. patent application publication.*” (emphasis added). The Provisional is neither, and thus an “incorporation by reference” of the Provisional cannot provide written description support for a patent’s claims.

U.S. Patent 9,468,886 in the priority chain for the '114 patent has claims 5, 11 and 18 for which the purported support derives from the Provisional. These claims require promoter introduction before, into or after a combustion chamber. The '896 application only discloses promoter introduction into or after a combustion chamber. EX1021, 22-23 at [0092]-[0095], Figures 5A-5B. Purported support from Provisional Figure 2 would make the Provisional “essential material” to these '886 Patent claims in violation of 37 CFR 1.57(d), breaking the chain of priority at the filing date of the '594 Application on 10/17/2016.

Thus, the '760 Application and its priority applications fail to provide written description support for adding any of the claimed promoters to coal. Breaks in

priority preclude PO from proving a filing date before 5/14/2018. Accordingly, none of the Challenged Claims are entitled to a priority date before the filing date of the '760 Application. Each of the references relied upon in Grounds 1–4 thus qualify as prior art under the AIA and render the Challenged Claims unpatentable.

C. State Of The Art

The obviousness inquiry “necessarily depends on such artisan’s knowledge,” including an “assessment of the background knowledge possessed” by a POSITA. *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337 (Fed. Cir. 2020). The subjects below would have been “within the general knowledge of a skilled artisan” by 2004. *Id.* at 1338.

1. Mercury and Halogens

Halogens were known as Group VII elements, which include fluorine (F), chlorine (Cl), bromine (Br), and iodine (I), and are highly reactive oxidizing agents that cause other species to give up electrons (become more positively charged). EX1040, 788, 791, A.44. Halogens were known to exist naturally as diatomic molecules (*e.g.*, Br₂), halides/halide compounds (*e.g.*, NaBr, CaBr₂), and hydrohalides (*e.g.*, HBr).

Mercury was a known metal in an elemental/metallic (Hg⁰) form and as oxidized (either Hg₂²⁺ (mercurous) or Hg²⁺ (mercuric)). EX1002, ¶ 47; EX1041, 12.

2. Coal Combustion

Pulverized-coal was commonly combusted in a combustion chamber known as a “boiler” and produced a mercury-containing flue gas. EX1042, 13–1, 18–1, 19–1. Coal emissions also included particulate matter (fly ash and unburned carbon), mercury (Hg), sulfur oxides (SO_x), and nitrogen oxides (NO_x). EX1043, 1.1–3 to 1.1–6. Downstream components used to control flue gas pollutants included electrostatic precipitators (ESP) and fabric filters (FF) for particulates, and wet or dry flue gas desulfurization (FGD) systems. EX1043, 1.1–6 to 1.1–9; EX1002, ¶ 45.

3. EPA Regulations

Mercury posed known health concerns. EX1046, 4–11 to 4–20. In 2000, the EPA announced plans to regulate mercury-emissions from coal-fired power plants with rules to be proposed by December 2003 and finalized by December 2004. EX1044, 2, 7–9. The Clean Air Mercury Rule passed in 2005 and required 70% mercury removal. EX1045. The power-generation industry mobilized a massive response to develop mercury-emissions control technologies in the early 2000s. EX1044; EX1002, ¶¶ 46-50.

4. Activated Carbon and Halogens for Mercury Removal

Adsorption is a process where adsorbate (*e.g.*, mercury) in a fluid (*e.g.*, flue gas) binds to a sorbent’s surface (*e.g.*, activated carbon). “Reducing” mercury in

flue gas results from adsorbing mercury to the sorbent surface and then removing the sorbent using particulate separators such as ESPs. EX1002, ¶¶ 51-58.

By 1934, it was shown halogens improved the ability of activated carbon to remove mercury. *See* EX1049, 1:33–41. By 1970, bromine was known to adsorb up to a 31–38% saturation limit (adsorption equilibrium) in carbon materials. EX1050, 260. By 1988, bromine (Br) was shown to react with activated carbon to provide “carbon-bromine surface structures (surface compounds).” EX1051, 259.

By 1998, “[a]ctivated carbons ha[d] been the most thoroughly studied sorbent for the capture of mercury.” EX1041, 22. Indeed, two named inventors, Dr. Olson and Mr. Holmes, admitted “activated carbon was the most common [or heavily] studied sorbent for mercury control.” EX1047, 41:5-9; EX1048, 114:21-25.

In 1999, researchers demonstrated that mercury from flue gas formed chemical bonds with halogen species on activated carbons. EX1052, 119. And researchers were investigating improving their effectiveness and cost. EX1001, 1:55-60; EX1046, 2–54 to 2–57; EX1041, 1.

By 2003, bromine was known to be more than 25 times more effective than chlorine for metallic mercury oxidation in coal combustion. EX1049, 2. In 2003, Vosteen’s group was testing to achieve 95% mercury removal by combining

bromine injection with powdered activated carbon (“PAC”) injection and to reduce PAC consumption to one-fifth. EX1061, 96.

By 2004, halide addition was observed to “improve Hg capture both by conversion of the Hg^0 to the more easily removed Hg^{2+} forms and by enhancing the reactivity of Hg^0 with activated carbons”). EX1053, 2–3. It was known halogens, particularly bromine-containing species, improved the effectiveness of activated carbon in removing mercury. *See, e.g.*, EX1004; EX1012; EX1008; EX1066.

Calcium bromide was known to achieve the highest mercury removal at the lowest dosage rate as compared to other halogens tested in lignite coal combustion in March 2005. EX1057, 12; EX1054, 15.

It was also well known that adjusting the sorbent injection rate would control mercury emissions. EX1058, 14; EX1059; EX1060, 4676.

Coal-fired power plants used bromide compounds pre-combustion and activated carbon post-combustion to remove mercury from flue gas and sold the electric power generated in June 2004 at Holcomb Station (EX1062, 11, 15; EX1063, EX1064; EX1066), by March 2005 at Laramie River (EX1067, 11, 23), and by September 2005 at Meramec Station (EX1065, 17–18; EX1066, 16; EX1063; EX1064).

VIII. CLAIM CONSTRUCTION

Petitioner does not contend that any term requires construction and has given all terms their plain and ordinary meaning consistent with the construction provided by Magistrate Judge Burke in the District of Delaware. EX1002, ¶¶ 110-115.

IX. THE CITED REFERENCES QUALIFY AS PRIOR ART

Petitioner relies on six references: Downs (EX1004); Altman (EX1007); Nelson (EX1008); Vosteen (EX1011); Blankinship (EX1012); and Olson-235 (EX1013). These references render the Challenged Claims unpatentable as anticipated or obvious.

A. Downs

Downs was published as US2008/0107579 on 5/8/2008 before the 5/14/2018 effective filing date of the '114 patent, and is a prior art patent publication under 35 U.S.C. §§ 102(a)(1) (as of its 5/8/2008 publication date) and 102(a)(2) (AIA) (as of its 3/22/2004 provisional filing date). If the effective filing date of the '114 patent is instead determined to be 8/30/2004, then Downs is prior art under 35 U.S.C. § 102(e) (pre-AIA) as of its 3/22/2004 provisional filing date because the provisional application has proper support for the subject matter relied upon as prior art and at least one claim of the Downs patent is supported by the written description of the provisional application under pre-AIA 35 U.S.C. 112, first paragraph. *In re Riggs*, 131 F.4th 1377, 1384-85 (Fed. Cir. 2025); *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 PTAB previously found Downs qualifies as prior art back to 3/22/2004. EX1045, 29, 32.

The disclosure of Downs is supported by Downs-Provisional, as illustrated by a redline comparison (EX1006) and confirmed by Dr. Vidic. EX1002, ¶¶ 119-143. At least Downs' claim 1 has written description support in Downs-Provisional, which describes: a “method of removing elemental mercury from coal combustion flue gases” (EX1005, Title, [0021]); providing a “bromine-containing reagent” to mercury-containing flue gas in the combustion chamber to “promote the oxidation of elemental mercury” and create an oxidized form (EX1005, Title, Fig. 2, [0002]-[0006], [0018]-[0019], [0021], [0027], claim 1); and removing “both oxidized and elemental mercury species” from the flue gas (EX1005, [0004]-[0005], [0018]-[0019]).

Downs explains “[b]romine-containing compounds, added to the coal, or to the boiler combustion furnace, are used to enhance the oxidation of mercury, thereby enhancing the overall removal of mercury in downstream pollution control devices.” EX1004, Abstract, [0001], [0010]; EX1005, [0009], [0018]. Downs' schematic is reproduced below:

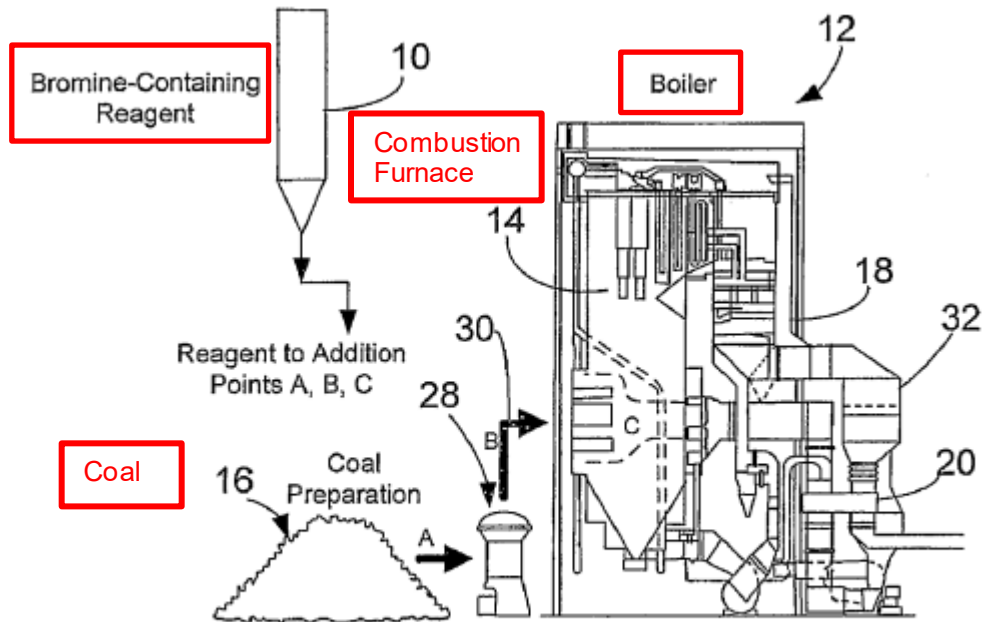


FIG. 2

EX1004, Figure 2 (annotations added in red); EX1005, Figure 2. Figure 2 shows adding bromine-containing reagent 10 to boiler 12 of combustion furnace 14 “either directly or by premixing with the incoming coal 16.” EX1004, [0015]; EX1005, [0018]. Downs describes injecting an aqueous solution of calcium bromide into furnace 14, and using “alkali metal and alkaline earth metal bromides, hydrogen bromide (HBr) or bromine (Br₂)” as the bromine-containing reagent 10. EX1004, [0018], [0021]; EX1005, [0021], [0024]. Downs describes “downstream pollution control systems such as wet 22 and SDA 24 FGD systems, and PAC injection systems” with “powdered activated carbon (PAC)” as a sorbent. EX1004,[0015],

[0025]; EX1005, [0018], [0028]. Wet 22 and SDA 24 FGD systems and ESP or FF particulate collectors 26 are shown in Figures 4 and 6, below:

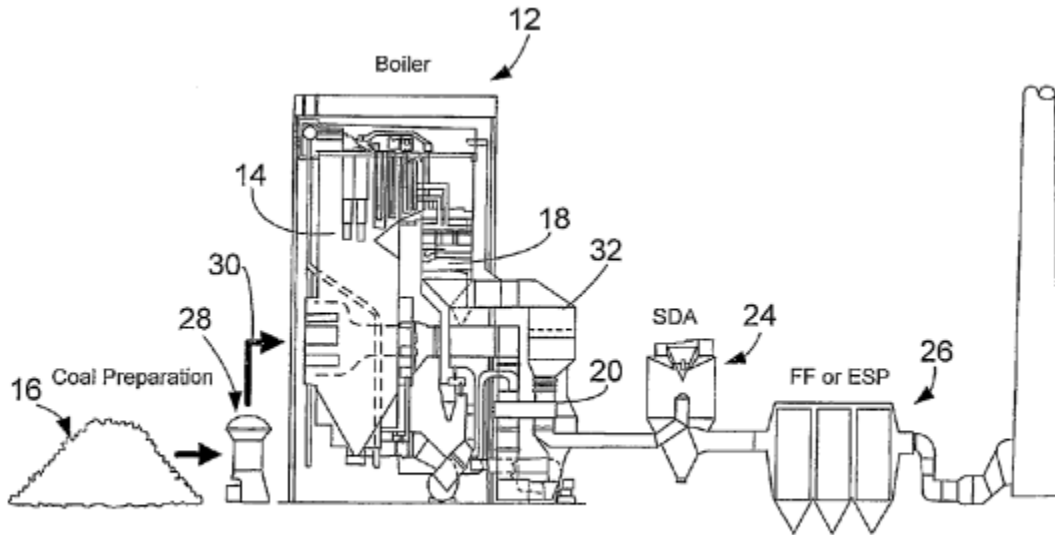


FIG. 4

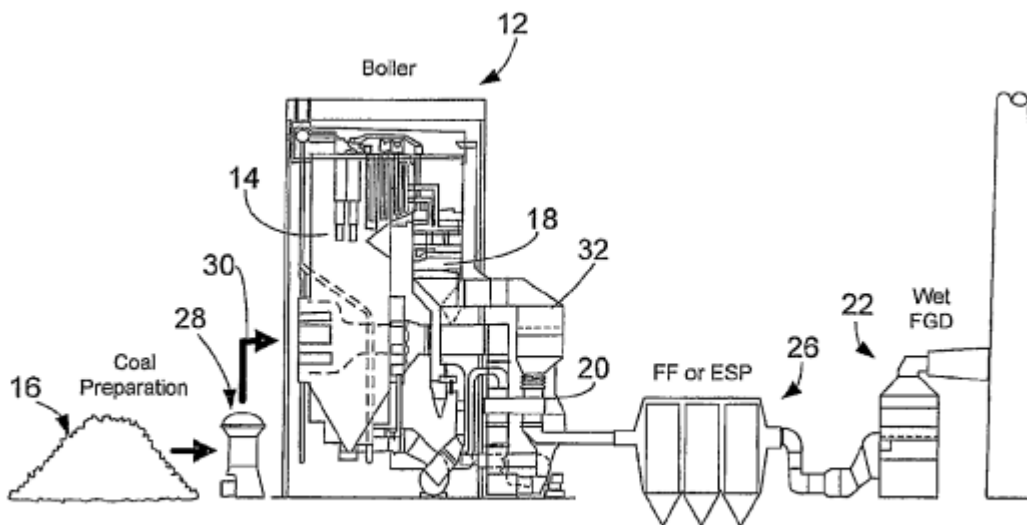


FIG. 6

EX1004, Figures 4 & 6; EX1005, Figures 4 & 6. Downs states “experimental results indicate that bromine addition also results in an increased fraction of particulate-

bound mercury,” enhancing mercury removal from particulate collectors 26 (FF or ESP). EX1004, [0015]; EX1005, [0018].

B. Altman

Altman issued as US Patent 5,827,352 on 10/27/1998 and is a prior art patent under 35 U.S.C. §§102(a)(1) and 102(a)(2) (AIA) or 35 U.S.C. §§102(a) and 102(b) (pre-AIA) regardless of the effective filing date of the ‘114 patent.

Altman relates to removing mercury from flue gas of a coal-fired boiler 12 by injecting activated carbon sorbent into the flue gas. EX1007, 1:5–9, 3:41–45, 4:57–58. Flue gas exiting boiler 12 is processed through ESP 19 to remove fly ash 21 and then through tower 24 and silo 27:

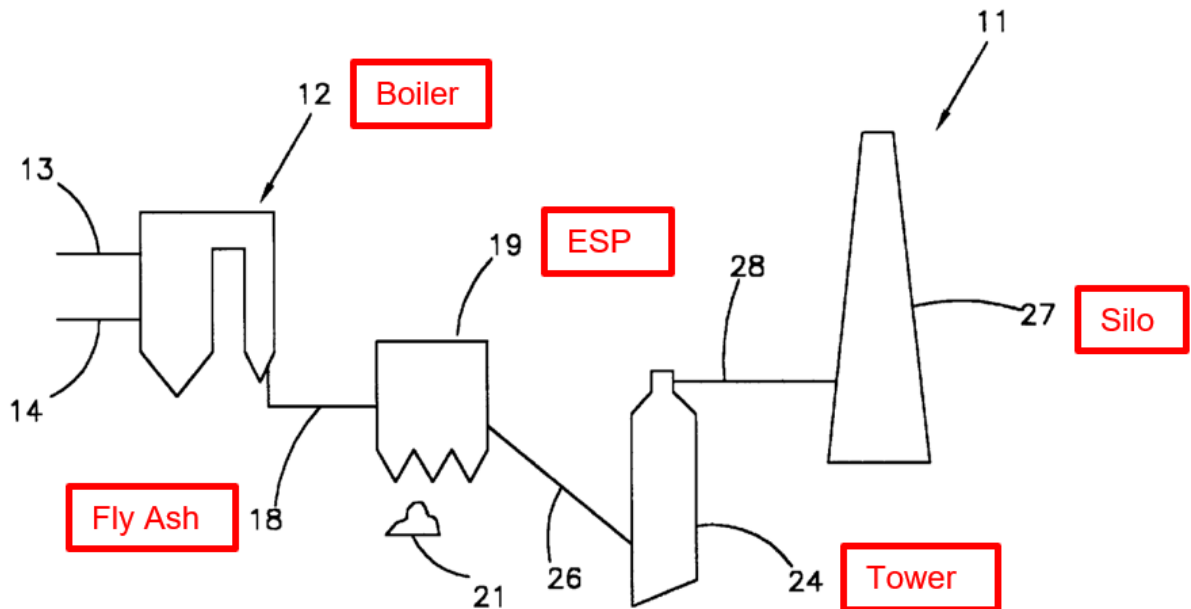
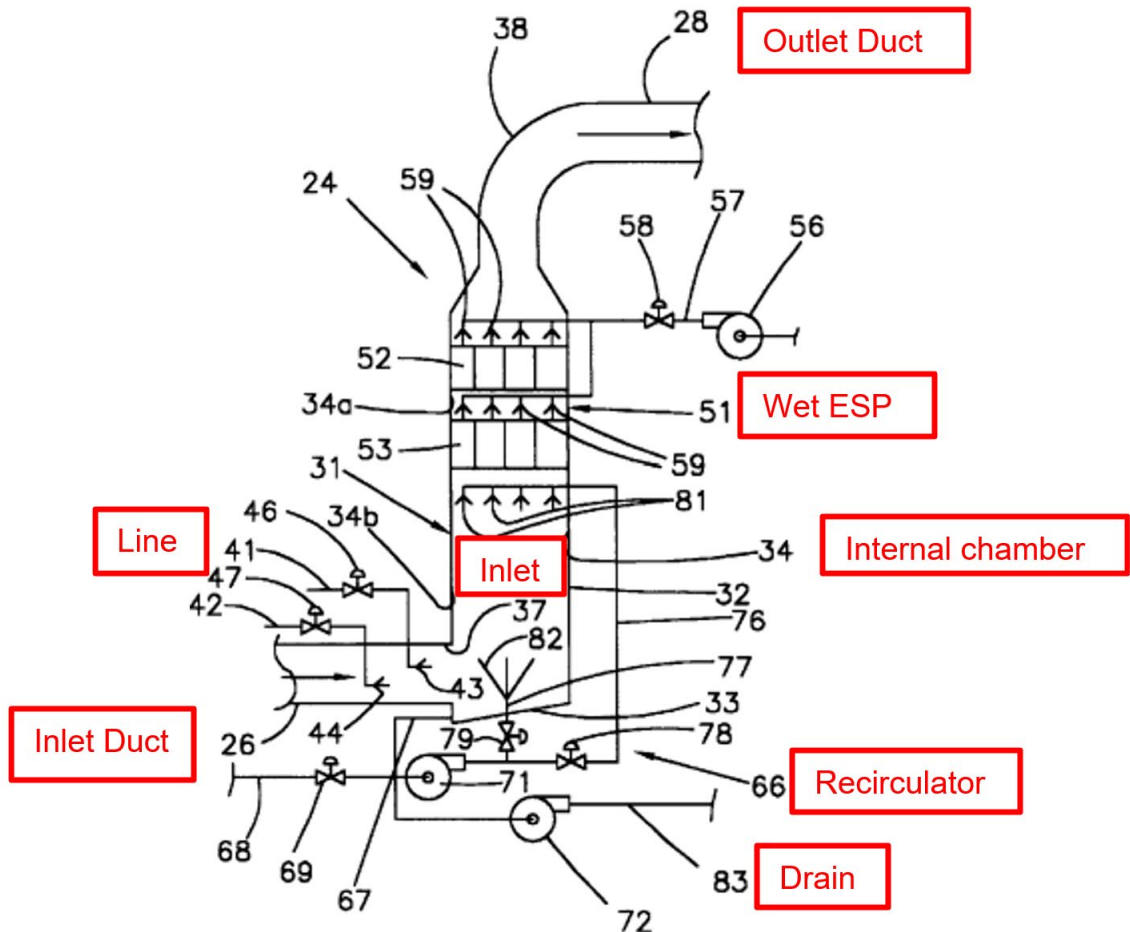


FIG. 1

EX1007, Figure 1, 3:53–65 (annotations added in red). Tower 24 includes a particulate control device (wet ESP 51) located above internal chamber 34:



EX1007, Figure 2, 3:66–4:4, 17–20 (annotations added in red).

The flue “gas stream from ESP 19 thus enters internal chamber 34 through inlet 37 and travels upwardly through the chamber before exiting through outlet duct 28.” EX1007, 4:6–9. The activated carbon sorbent is “injected into the flue gas” – either “injected into chamber 34” or into inlet duct 26 via line 41. EX1007, 4:53–61.

Water or a water/sorbent mixture is injected into chamber 34 to lower the temperature of the flue gas such that temperature and sorbent injection rate provide “optimal mercury sorption” by activated carbon sorbent. EX1007, 4:62–5:5.

Flue gas residence time within chamber 34 ranges from 1–20 seconds, preferably 5–10 seconds, to “allow a large portion of the mercury in the flue gas to be removed by the injected sorbent.” EX1007, 5:6–12.

The flue gas rises through chamber 34 into wet ESP 51 where sorbent, remaining fly ash and condensed water are collected and either removed from tower 24 through drain 83 or partially recycled by recirculator 66. EX1007, 5:18–22, 41–49. *See* EX1002, ¶¶ 144-152.

C. Nelson

Nelson published as US Patent Application Publication US2004/0003716 on 1/8/2004, and is a prior art published patent application under 35 U.S.C. §§ 102(a)(1) (as of its 1/8/2004 publication date) and 102(a)(2) (AIA) (as of its 5/6/2002 provisional filing date). If the effective filing date of the ‘114 patent is instead determined to be 8/30/2004, then Nelson is prior art under 35 U.S.C. §§ 102(a) (as of its 1/8/2004 publication date) and 102(e) (pre-AIA) as of its 5/6/2002 provisional filing date for the reasons provided in § IX.A, above. The disclosure of Nelson is supported by Nelson-Provisional, as illustrated by a redline comparison (EX1010) and confirmed by Dr. Vidic. EX1002, ¶¶ 156-173. At least Nelson’s claim 18 has

written description support in Nelson-Provisional, which describes “exposing powdered activated carbon (PAC) to gaseous bromine, Br₂ (g), or gaseous hydrogen bromide, HBr (g), significantly increases its ability to remove elemental mercury when injected into coal-fired flue-gas compositions at high temperatures...By simply exposing PAC to concentrated bromine gas, a relatively large quantity of this gas appears to react with the carbon, forming surface compounds on the large surface-area of the carbon.” EX1010, 4.

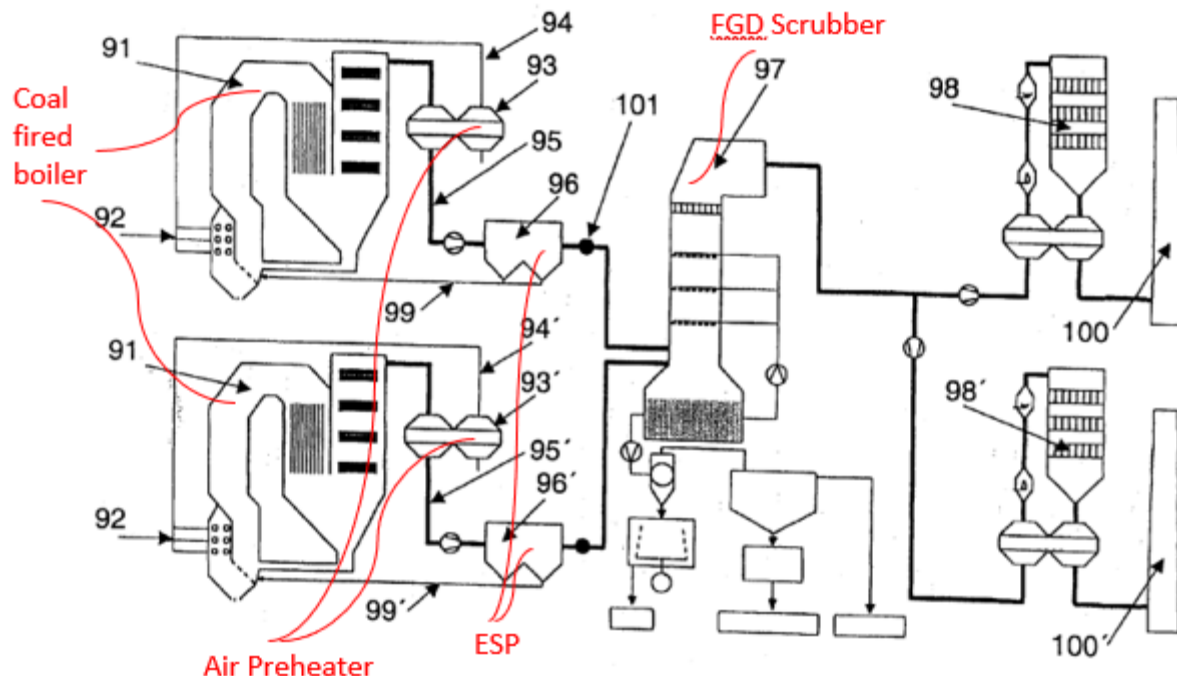
Nelson describes exposing activated carbon sorbent to a bromine-containing gas before the sorbent is mixed with mercury-containing flue gas. EX1008, [0040]; EX1009, 4. Nelson indicates exposure of sorbent to Br₂ or HBr gas “significantly increases the carbonaceous materials ability to remove mercury species.” EX1008, [0041]; EX1009, 4.

D. Vosteen

Vosteen published as US2004/0013589 on 1/22/2004, and is a prior art published patent application under 35 U.S.C. §§ 102(a)(1) (as of its 1/22/2004 publication date) and 102(a)(2) (as of its 7/24/2002 filing date) (AIA). If the ‘114 Patent’s effective filing date is determined to be 8/30/2004, then Vosteen is prior art under 35 U.S.C. §§ 102(a) (as of its 1/22/2004 publication date) and 102(e) (pre-AIA) (as of its 7/24/2002 filing date).

Vosteen describes “a process for removing mercury from flue gases of high temperature plants, in particular power stations” EX1011, [0001]. Vosteen discloses “addition of bromine or bromine compounds to the furnace causes ... a substantial, essentially complete, oxidation of the mercury” allowing “substantially complete removal of mercury (Hg), from flue gases.” EX1011, [0005], [0007]. More than 90% mercury removal is reported. EX1011, Figure 5, [0028], [0042].

Vosteen reports adding sodium bromide (NaBr), a bromide compound, into coal-fired boilers 91 of a power plant to “demonstrate the effect of bromine on Hg oxidation.” EX1011, Example 5, [0047]. Vosteen describes a flue gas emissions control system as known in the art “based either on wet scrubbing or dry cleanup or a combination of the two.” EX1011, [0017]. Vosteen exemplifies a boiler flue gas fed through air preheaters 93,93’ ESPs 96,96’ and FGD scrubber 97 as depicted below.



EX1011, Figure 9 (annotations added in red), Example 5, [0047]. Vosteen discloses activated carbon and alkaline materials such as lime for use in the flue gas emissions control system. EX1011, [0019]. See EX1002, ¶¶ 174-183

E. Blankinship

Blankinship published on 6/2/2009, before the '114 Patent's 5/14/2018 effective filing date, and is a prior art printed publication as of 6/22/2009 under 35 U.S.C. §§ 102(a)(1) (AIA) or 35 U.S.C. §§ 102(a) and 102(b) (pre-AIA).

“A reference is considered publicly accessible if it was disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, can locate it.” *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 772 (Fed. Cir. 2018) (internal quotation omitted). Blankinship was in Volume 113, Issue 6 of

Power Engineering magazine, as received by the University of Pittsburgh Libraries on June 22, 2009 (confirmed by date stamp) and made publicly available within days of receipt. EX1082, ¶¶ 3-4, 4a, Exhibit A. This Library subscribed to the print version of Power Engineering magazine from 1950 to 2018. *Id.*

Blankinship describes Alstom’s approach to removing 80–90% mercury from flue gases in coal-fired power plants burning subbituminous or lignite coal by using a bromide compound pre-combustion and activated carbon injection post-combustion “upstream of a particulate control device.” EX1012, 58. Alstom’s KNX™ calcium bromide solution is “added to the boiler or to the coal” pre-combustion in concentrations where it “enhances mercury oxidation without causing other concerns such as corrosion in the boiler.” *Id.*, 56, 58. A MER-CURE™ activated carbon sorbent injection system is used post-combustion to capture mercury on activated carbon particles injected into the flue gas upstream of the air heater to provide “more residence time for the sorbent to absorb the mercury,” reducing “sorbent usage about 50 percent compared to traditional activated carbon systems.” *Id.*, 58. *See* EX1002, ¶¶ 184-189.

F. Olson-235

Olson-235 issued as U.S. Patent 8,652,235 on 2/18/2014 before the ‘114 Patent’s 5/14/2018 effective filing date and is a prior art patent as of 2/18/2014 under 35 U.S.C. §§ 102(a)(1) and as of 4/23/2009 under 102(a)(2) (AIA).

Olson-235 discloses a method for removing mercury in flue gas by injecting a promoted sorbent into the gas. EX1013, 5:30–36. Olson-235 discloses the promoted sorbent “comprises from about 1 to about 30 grams of promoter per 100 grams of base sorbent.” EX1013, 4:53–60, Claims 3, 17. Olson-235 also discloses an embodiment wherein “the injected sorbent is prepared in-flight by reacting a base sorbent (carbon, non-carbon or their combination) and a promoter within a pneumatic transport line from which the reaction product is injected to the mercury-containing flue gas stream.” EX1013, 5:43–48. In that embodiment, “the promoter is added at from about 1 to about 30 grams per 100 grams of the base sorbent.” EX1013, 6:17–31. EX1002, ¶¶ 191-192.

X. OBVIOUSNESS CONSIDERATIONS

A. Reasons To Combine

A POSITA would have been motivated to combine Downs/Altman, Downs/Altman/Vosteen or Downs/Altman/Nelson (Ground 1), Vosteen/Altman or Vosteen/Altman/Nelson (Ground 2), or Blankinship/Vosteen, or Blankinship/Olson-235 (Ground 4) with reasonable expectation of success, because all of these references are directed towards the same goal (removing mercury from coal-combustion flue gases) and are directed to using known techniques to improve similar devices. More particularly, these references (i) add a promoter to coal or a combustion chamber (Downs, Vosteen or Blankinship) to oxidize mercury and (ii)

add (Vosteen) or inject (Downs, Blankinship, Altman, Nelson, Olson-235) sorbent post-combustion to adsorb the mercury and use a particulate control device (*i.e.*, an ESP) to collect the sorbent containing the mercury and remove it from the cleaned gas. It follows these references are analogous art to the '114 Patent, in the same field of endeavor, and reasonably pertinent to the problems the inventors faced. EX1002, ¶¶ 198-204, 433-441, 680-688.

1. Downs/Altman or Vosteen/Altman

A POSITA would have combined Downs or Vosteen with Altman.

Downs discloses a power plant equipped with a Flue Gas Desulfurization System (FGD) can have a wet scrubber to remove oxidized mercury. EX1004, [0003]. Downs describes also using a PAC “sorbent injection system” and states many “studies have focused on the injection of a carbonaceous sorbent (*e.g.*, powdered activated carbon, or PAC) into the flue gas The sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector.” EX1004, [0004], [0025], claims 15–16.

Vosteen suggests using wet scrubbers or dry systems or a combination as known in the art. EX1011, [0017]. Vosteen describes wet scrubbing “performed, for example, in a quench sprayed with circulated scrubbing water, a pressurized nozzle scrubber or rotary atomizer scrubber or a packed-bed scrubber” without indicating what packing was used in the packed-bed. *Id.*

Altman discloses that while flue gas can be passed through a packed bed of activated carbon sorbent to remove mercury, packed beds “are complex to design and operate” and “produce high pressure drops and require periodic regeneration.” EX1007, 1:30–40. Instead of using a packed bed with stationary sorbent, Altman injects activated carbon and lime sorbent particles into flue gas in his emission control system such that the sorbents flow with the flue gas. EX1007, 4:53–61, 5:50–61. Altman also discloses injection of activated carbon into flue gas was known in the art for removing mercury in coal-fired boilers before April 1997. EX1007, 2:23–31, 1:41–2:22, 32–46.

A POSITA had reason to substitute Altman’s wet flue gas emissions system (including tower 24 having chamber 34 and wet ESP 51) for Vosteen’s packed bed wet scrubber or Down’s wet FGD system 22 because: (i) Altman discloses activated carbon sorbent injection into flue gas entering a wet scrubber avoids the disadvantages of high pressure drop and sorbent regeneration associated with Vosteen’s packed-bed wet scrubbers; (ii) Altman’s tower ensures “there is sufficient activated carbon mercury adsorption capacity at reasonable adsorption injection rates” to achieve “optimal mercury sorption” in a flue gas residence time of only 1 to 20 seconds; (iii) Altman discloses its tower 24 is also suitable for desulfurizing flue gas; and (iv) Altman’s wet ESP captures sorbent particles for recycling or disposal. EX1007, 1:23–40, 2:23–31, 4:62–5:17, 50–67.

2. Downs/Altman/Nelson, Vosteen/Altman/Nelson or Blankinship/Olson-235

A POSITA had reason to substitute Nelson's brominated-activated carbon sorbent for Altman's activated carbon sorbent in the Vosteen/Altman or Downs/Altman process or Olson-235's brominated-activated carbon sorbent for Blankinship's activated carbon sorbent because Nelson indicates exposure of sorbent to Br₂ or HBr gas "significantly increases the carbonaceous materials ability to remove mercury species" and Olson-235 states it "increases the surface reactivity toward mercury." EX1008, [0041]; EX1009, 4; EX1013, 11:50-52. A POSITA would have known this approach would have increased overall mercury capture. EX1002, ¶¶ 440, 514, 688. For example, mercury vapors were removed in the 1930s by injecting halogen-impregnated activated-carbon sorbents into a mercury-containing flue gas. EX1041, 1:33-41.

3. Downs/Altman/Vosteen or Blankinship/Vosteen

Regarding claims 8-9, a POSITA had reason to inject Br₂ or HBr downstream of the combustion chamber of Downs/Altman or Blankinship because Vosteen describes "bromine and/or a bromine compound ... is fed ... to the flue gas in a plant section downstream of the furnace." EX1011, cl. 1, [0006]. Vosteen's bromine compounds include hydrogen bromide (HBr). *Id.*, cl. 2.

B. Simultaneous Invention

“Independently made, simultaneous inventions, made within a comparatively short space of time, are persuasive evidence that the claimed apparatus was the product only of ordinary mechanical or engineering skill.” *Geo. M. Martin Co. v. Alliance Mach. Sys. Int’l LLC*, 618 F.3d 1294, 1305 (Fed. Cir. 2010). *See also Medtronic, Inc. v. Teleflex Innov. SARL*, 70 F.4th 1331, 1339-40 (Fed. Cir. 2023) (“a competitor’s independent and contemporaneous development of a similar product may, in some cases, even suggest the patented product *would* have been obvious.”). Notably, simultaneous invention(s) need not be prior to the purported ‘114 Patent invention date to be pertinent to the obviousness determination. *Trustees of Columbia Univ. v. Illumina*, 620 Fed.Appx 916, 920 (Fed. Cir. 2015).

In the Iowa MDL, PO emphasized that the ‘114 Patent (as well as each of the other patents asserted in the lawsuits) is directed to a straightforward two-step mercury capture process: (1) apply a halogen, and more specifically bromine, to coal and/or the combustion chamber; and (2) inject activated carbon into the flue gas as a sorbent. EX1077, 4-5. But this two-step process was developed, tested, and implemented by many others at the time of the alleged invention. Such simultaneous invention by others is further evidence the Challenged Claims would have been obvious to a POSITA at the time of the invention.

For example, Downs used such a two-step process before the Provisional filing date. *See* § IX.A. Alstom also developed a bromine-promotor added to coal or the combustion chamber for mercury control by 2004 that sold as KNX™. ADA-ES performed testing by the third quarter of 2004 under a Department of Energy Cooperative Agreement wherein Alstom’s KNX product was applied to coal at Sunflower Electric’s Holcomb Station and “enhance[d] the performance of standard activated carbon,” achieving “[m]ercury removal of 86%.” EX1063, 3, 25. Similar tests were also performed by ADA-ES in the fourth quarter of 2004 at AmerenUE’s Meramec Station using Alstom’s KNX as a coal additive in combination with activated carbon. EX1064, 8, 21. Similar processes were also tested by EPRI and others at Texas Genaco’s Limestone Electric Generating Station combusting lignite coal with injection of calcium bromide into the boiler and an ESP for particulate reduction and 81% mercury removal. EX1057, 12. These stations were in commercial operation supplying electricity to customers during the testing. EX1002, ¶¶ 804-811.

XI. INDEPENDENT CLAIMS 1 AND 23–25 ARE UNPATENTABLE AS ANTICIPATED OR OBVIOUS

This section addresses each limitation of claims 1 and 23–25 together since the independent claims are nearly the same.

**A. Element 1(Preamble), 23(Preamble), 24(Preamble), 25(Preamble)–
"A method of separating mercury from a mercury-containing gas,
the method comprising:"**

1. Ground 1 – Downs/Altman

Downs and Altman disclose processes for removing mercury from flue gas by adsorbing the mercury with PAC sorbent and separating the sorbent from the flue gas via particulate collectors. EX1004, [0001], [0004], [0015]–[0016], [0025], claims 15–16; EX1005, [0005], [0018]–[0019], [0028]; EX1007, 1:6–9, 4:57–58, 5:6–10. Altman discloses “some of the sorbent is collected by wet ESP 51 and similarly rained down into chamber lower portion 34b for further mercury capture.” EX1007, 5:27–29. Part of the water, sorbent and fly ash slurry is removed from chamber 34 of tower 24 via drain 83. EX1007, 5:41–44, 47–49. It follows that sorbent collected by ESP 51 and removed separates the sorbent from the mercury-containing gas which exits ESP 51 through outlet duct 28. EX1007, 4:6-9; EX1002, ¶¶ 214, 317, 351, 392.

2. Ground 2 – Vosteen/Altman

See § XI.A.1 regarding Altman. Vosteen discloses processes for removing/separating mercury from flue gas. EX1011, Title; [0001]; [0007]–[0008]; EX1002, ¶¶ 447, 536, 562, 594.

3. Grounds 3-4 – Blankinship

Blankinship discloses a process for removing 80–90% of mercury from a coal combustion flue gas. EX1012, 58. EX1002, ¶¶ 633, 659, 696, 768.

- B. Element 1(a), 23(a), 24(a), 25(a)—“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⁻, or a combination thereof—cl. 1(a), 23(a), 24(a)]”**

Element 1(b), 23(b), 24(b), 25(b)—“wherein the coal comprises added Br₂, HBr, [Br⁻—cl. 1, 23, 24(b)] [a bromide compound—cl. 25(b)], or a combination thereof, added to the coal upstream of the combustion chamber, or the combustion chamber comprises added Br₂, HBr, [Br⁻—cl. 1, 23, 24(b)] [a bromide compound—cl. 25(b)], or a combination thereof, or a combination thereof;”

1. Ground 1 –Downs/Altman

Downs reports adding alkali metal or alkaline earth metal bromides (*i.e.*, bromide compounds), HBr or Br₂ as the bromine-containing reagent 10 premixed with incoming coal 16. EX1004, [0015], [0021]; EX1005, [0018], [0024]. Downs also discloses calcium bromide injected into the combustion chamber through a coal burner. EX1004, [0018]; EX1005, [0021].

Regarding the requirement that the mercury-containing gas comprises HBr, Br⁻, or a combination thereof in elements 1(a), 23(a), 24(a), Julien discloses that when calcium bromide is added to a coal combustor, “[f]ree energy calculations suggest that complete decomposition of CaBr₂ to HBr and CaO in the presence of

water vapour is favoured over the full range of temperatures in the [circulating fluidized bed combustor] CFBC.” EX1014, 1658. Thus, HBr is in vapor or gaseous form in the mercury-containing flue gas after combustion of a bromide compound such as calcium bromide or sodium bromide. EX1002, ¶¶ 215-227, 318-330, 352-364, 393-401.

2. Ground 2 – Vosteen/Altman

Vosteen discloses a “coal-fired power station, including a “combustion chamber.” EX1011, [0005]. Vosteen further discloses “addition of bromine or bromine compounds to the furnace causes . . . a substantial, essentially complete, oxidation of the mercury and therefore allows substantial removal of the mercury from flue gases.” EX1011, [0007]. Vosteen adds Br₂, HBr, and bromide compounds (e.g., NaBr) to the combustion chamber and/or to the coal upstream of the combustion chamber:

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 appropriate multistage furnace....

[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....

The bromine compound ... can be added ... **to the ... coal or the like to be burnt, upstream of the furnace.... The compound can also be fed during the combustion process ... [or] after the combustion...**

EX1011, [0006], [0009], [0013] (emphasis added). Vosteen discloses addition of bromine or a bromine compound, in forms such as HBr, Br, and sodium bromide (NaBr). EX1011, [0009].

Vosteen describes “the mass ratio of bromine to mercury in the flue gas.” EX1011, [0025], [0028], [0031]. *See* § XI.B.1 regarding Julien for elements 1(a), 23(a), 24(a). EX1002, ¶¶ 448-458, 538-548, 563-573, 595-604.

3. Grounds 3-4 – Blankinship

Blankinship discloses “Alstom is attacking Hg from two different approaches that, in some cases, might be used simultaneously.” EX1012, 58. Blankinship explains Alstom’s KNX™ calcium bromide solution “can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers” or in electrostatic precipitators (ESPs). EX1012, 56, 58. Calcium bromide is a “bromide compound” because it is “a substance composed of atoms or ions of two or more elements in chemical combination” in which “constituents are united by bonds or valence forces.” EX1015, 291. *See* § XI.B.1 regarding Julien for elements 1(a), 23(a), 24(a). Thus, HBr is in vapor or gaseous form in the flue gas post-combustion. EX1002, ¶¶ 634-643, 660-666, 697-705, 769-778.

- C. Element 1(c), 23(c), 24(c), 25(c)—“injecting a sorbent material 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—cl. 24(c);” and

Element 1(d), 23(d), 24(d), 25(d)—”contacting mercury in the mercury-containing gas with the [promoted—cl. 24(d)] sorbent, to form a mercury/sorbent composition;” and

Element 1(e), 23(e), 24(e), 25(e)—”separating the mercury/sorbent composition from the mercury-containing gas, to form a cleaned gas;”

1. Ground 1 – Downs/Altman

Downs discloses using a PAC sorbent injection system to remove mercury from coal combustion flue gas downstream from the combustion chamber via particulate collectors such as ESPs. EX1004, [0004], [0015]–[0016], [0023], [0025], claims 15–16; EX1005, [0005], [0018], [0026], [0028]. The “increased fraction of oxidized mercury” resulting from bromine addition “enhances the removal of mercury across a PAC injection process, due to the higher reactivity of oxidized mercury with PAC.” EX1004, [0015]–[0016], EX1005, [0018]. Downs describes “injection of a carbonaceous sorbent (*e.g.*, powdered activated carbon, or PAC) into the flue gas ... to adsorb vapor-phase mercury” and the “sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector.” EX1004, [0004]; EX1005, [0005].

Altman describes activated carbon sorbent “injected into the flue gas” – either “injected into chamber 34” or into inlet duct 26 via line 41. EX1007, 4:53–61, Figure 2. Flue gas residence time within chamber 34 ranges from 1–20 seconds to

“allow a large portion of the mercury in the flue gas to be removed by the injected sorbent.” EX1007, 5:6–12.

Regarding element 24(c), it is obvious the activated carbon reacts with promoter in the mercury-containing gas to form a promoted sorbent when the HBr in the gas contacts the 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* § VII.C.4. Lead inventor Dr. Olson admitted, when bromides are added to coal “and activated carbon is injected downstream of the furnace,” then there would be “in-flight promotion.” EX1047, 231:3-9, 98:23-100:3. “[P]romotion” of activated carbon by halogens is a reaction. EX1083, 156 (labeled as limitation 24e, O’Keefe explaining how bromine containing ingredients added to coal would contact and react with sorbent); EX1002 ¶¶ 236, 339, 373, 411.

2. Ground 2 – Vosteen/Altman

See § XI.C.1 regarding Altman and element 24(c). Vosteen discloses “removal of mercury from the flue gases in a flue gas emission control system downstream of the combustion” EX1011, [0007]. One sorbent disclosed by Vosteen is “finely pulverulent slaked lime/activated carbon.” *Id.*, [0019]. The mercury/sorbent composition is separated from the flue gas in an ESP. *Id.*, [0019], [0047]–[0049]. EX1002 ¶¶ 463, 554, 578.

3. Grounds 3-4 – Blankinship

Blankinship discloses that KNX can be “applied in combination with another mercury control technology such as our Mer-Cure post-combustion technology or activated carbon injection.” EX1012, 58. Blankinship reports “[t]here are many cases where the combination of the two work very effectively together” because the “KNX applied to the coal provides better oxidation of the mercury at a lower cost than brominated sorbents, allowing the Mer-Cure system further downstream to capture the mercury more efficiently.” EX1012, 58. The Mer-Cure system “inject[s] the activated carbon into the duct work.” *Id.*

Blankinship reports mercury removal of 80–90% for the Alstom process. EX1012, 58. A POSITA would understand the activated carbon sorbent in the Mer-Cure system collected the mercury from the flue gas.

Blankinship describes using Alstom’s KNX process of calcium bromide addition “to the boiler or to the coal” and “injecting activated carbon upstream of the [flue gas desulfurization] FGD to improve its mercury capture performance even more. Power plants without an FGD would likely use sorbent injection, mostly an activated carbon, upstream of a particulate control device.” EX1012, 56. A POSITA would know a particulate control device separates and removes the sorbent from the flue gas. EX1002 ¶¶ 652, 674, 711, 787.

D. Element 1(f), 24(f)—“monitoring the mercury content of the cleaned gas;” and

Element 1(g), 24(g)—“controlling, in response to the [monitored-cl. 1(g)] mercury content of the cleaned gas,

an injection rate of injecting the sorbent into the mercury-containing gas, [the sorbent composition,—cl. 1(g)]

[a rate of addition to the coal or the combustion chamber of the added Br₂, HBr, the bromide compound, or a combination thereof—cl. 24(g)]

or a combination thereof,

so that the mercury content of the cleaned gas is maintained at or below a desired level.”

See § VII.C.3 regarding EPA Rules. A POSITA would have known that by 2004 the EPA put the industry on notice of requiring 70% mercury removal, including EPA’s Clean Air Mercury Rule (CAMR). EX1045. It thus would have been obvious to a POSITA the mercury content of the cleaned gas must be measured (either continuously or not) and maintained at a desired level—*e.g.*, 70% removal. EX1002, 242.

1. Ground 1 – Downs/Altman

Downs describes an “on-line mercury analyzer” to detect “vapor-phase mercury species.” EX1004, [0018]; EX1005, [0021]. Downs measured vapor-phase mercury in flue gas and adjusted the amount of calcium bromide applied to the coal from 750 ppm to 1,000 ppm to 375 ppm in testing. EX1004, Figure 3; EX1005, Figure 3.

Altman describes achieving “optimal mercury sorption” and ensuring there is “sufficient activated carbon mercury adsorption capacity at reasonable adsorption injection rates.” EX1007, 4:62-5:5. A POSITA would have considered it obvious to optimize Altman’s sorbent injection rate since the sorbent injection rate affects mercury removal from a flue gas. Adjusting sorbent injection rates based on measured mercury content of a flue gas was known to a POSITA by at least 1995, as evidenced by EX1080, Abstract (“By adjusting ... the absorbent a permanent high Hg removal is achieved.”), 6:42-46 (The amount of ... activated carbon ... may be adjusted also on basis of the Hg content of the treated gas measured by means of a device 18 arranged in the duct 9.”)EX1002, ¶¶ 241, 380.

2. Ground 2 – Vosteen/Altman

See § XI.D.1 regarding Altman. Vosteen discloses “mercury content of the flue gas, in particular the content of metallic mercury, is measured continuously . . . and on the basis of the measured mercury content the amount of bromine fed and/or bromine compounds . . . is controlled.” EX1011, [0022], claim 10; EX1002, ¶¶ 469, 585.

3. Ground 4 – Blankinship

A POSITA would have considered it obvious to optimize sorbent injection rate to maintain the mercury content at or below a desired level in the Alstom KNX™/Mer-Cure process since the sorbent injection rate affects mercury removal

from a flue gas. Adjusting sorbent injection rates based on measured mercury content of a flue gas was known to a POSITA by at least 1995, as evidenced by EX1080, Abstract (“By adjusting ... the absorbent a permanent high Hg removal is achieved.”), 6:42-46 (The amount of ... activated carbon ... may be adjusted also on basis of the Hg content of the treated gas measured by means of a device 18 arranged in the duct 9.”) EX1002, ¶¶ 715, 792.

XII. CLAIMS DEPENDING FROM CLAIM 1 ARE UNPATENTABLE

A. Claims 2–3—“removing greater than 70 wt % of the mercury in the mercury-containing gas” and “removing greater than 70 wt % of the mercury in the mercury-containing gas on the sorbent.”

1. Ground 1 – Downs/Altman

Downs’ Figure 3 reports reducing vapor-phase mercury of flue gas by 77% from 9 µg/dscm mercury (red) at FF-inlet to 2 µg/dscm mercury (blue) at FF-outlet:

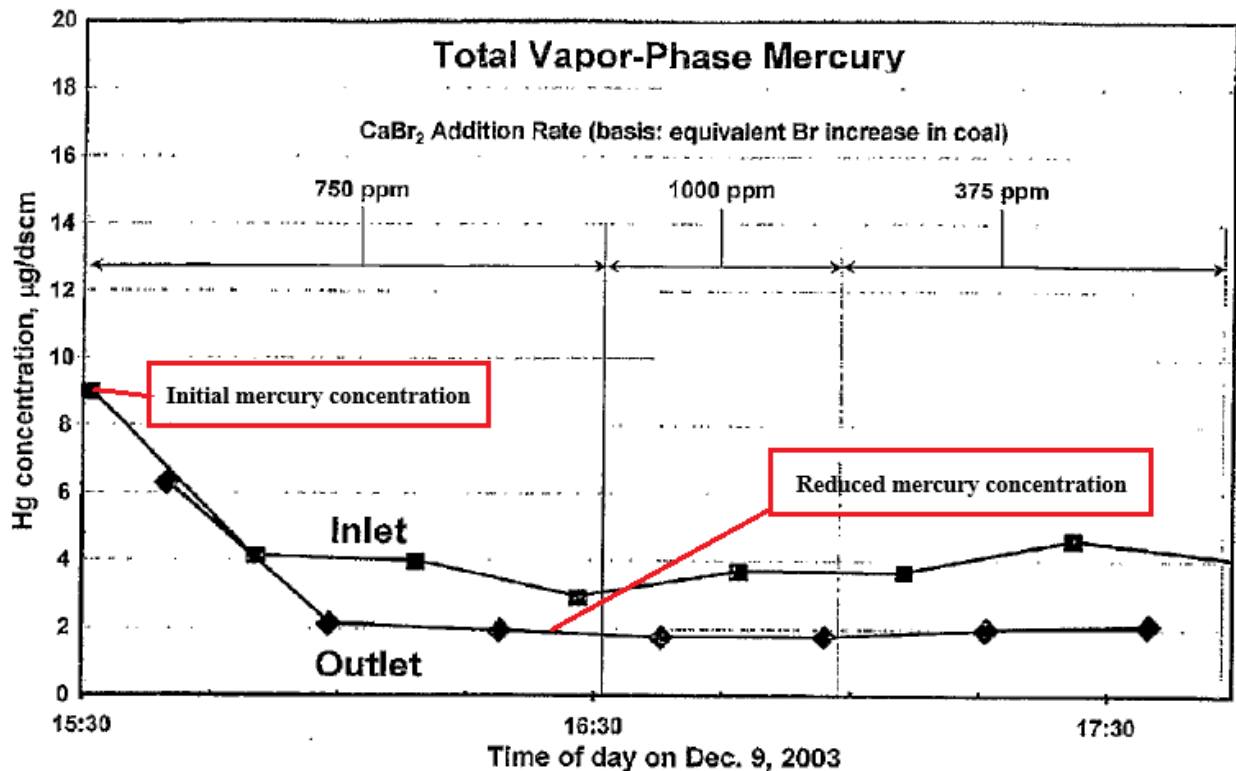


FIG. 3

EX1004, Figure 3, [0018]; EX1005, Figure 3, [0021] (red annotations added).

Downs describes “an increased-fraction of particulate-bound mercury” that enhances removal across particulate collectors such as ESPs. EX1004, [0015]; EX1005, [0018]. Altman also notes it was known in the art that “90%” of mercury can be removed “when an ‘appropriate absorbent’ is used.” EX1007, 2:14-22. A POSITA would have understood Altman’s activated carbon sorbent would have collected the mercury from the flue gas. EX1002, ¶¶ 242-249.

2. Ground 2 – Vosteen/Altman

Vosteen reports mercury removal greater than 70 wt.% because flue gas Hg_{met} content was about 40 wt.% and was reduced to 10 wt.% at time 10:30. EX1011, Figure 8, [0049], Figure 5, [0042], [0015], [0037]. A POSITA would have reasonably expected the Vosteen/Altman combination of bromide and sorbent treatments to achieve greater than 70% mercury removal by the sorbent due to bromide's ability to increase oxidized mercury and higher reactivity of oxidized mercury with PAC. A POSITA would have understood Altman's activated carbon sorbent would have collected the mercury from the flue gas. EX1002, ¶¶ 470-480.

3. Ground 4 – Blankinship

Blankinship reports mercury removal of 80–90% for the Alstom process where the sorbent absorbs the mercury. EX1012, 58. A POSITA would have understood the activated carbon sorbent of the Mer-Cure system collected the mercury from the flue gas. A POSITA would have reasonably expected Blankinship's combination of bromide and sorbent treatments to achieve greater than 70% mercury removal by the sorbent due to bromide's ability to increase oxidized mercury. EX1002, ¶¶ 716-721.

B. Claim 4—“the sorbent in the mercury-containing gas comprises about 1 g to about 30 g of the halogen or halide promoter per 100 g of the sorbent material.”

Claim 4 claims a workable range for a conventional halogen (bromine) used in a conventional way (to promote activated carbon) with a conventional sorbent (activated carbon) and is obvious. Nothing in the ‘114 Patent specification attributes any particular significance to the claimed range or establishes any “unexpected results” in mercury removal. Rather, the range presents nothing more than optimization of “result-effective” variables that would have been obvious to a POSITA. *See In re Applied Materials, Inc.*, 692 F.3d 1289, 1297–98 (Fed. Cir. 2012); EX1002, ¶¶ 250-251.

A POSITA knew since the 1970s that the saturation limit of bromine in activated carbon was around 31–38 grams per 100 grams of activated carbon. EX1050, 260; EX1002, ¶ 256.

1. Ground 1 – Downs/Altman or Downs/Altman/Nelson

Given its ordinary meaning, “the sorbent” in claim 4 is a promoted brominated activated carbon sorbent because it “has a composition comprising” both bromine and activated carbon. Nelson discloses brominated PAC sorbents having 1, 5, 9, 15, and over 30 wt.% loading of HBr or Br₂ (i.e., 1, 5, 9, 15 or over 30g bromine to 100g PAC). EX1008, [0054], Example 6; EX1009, 5 (15 wt.% loading for 500-1000% increase in mercury capacity). EX1002, ¶ 252.

If claim 4 is construed as not requiring “the sorbent” be a promoted sorbent, then given the residence times in flue gas, a POSITA would have understood that bromine loaded onto activated carbon would be less than the 31-38g per 100g maximum. EX1050, 260. A POSITA had reason to load the activated carbon with bromine sufficiently to increase its ability to adsorb mercury given Altman’s emphasis on achieving optimal mercury sorption by ensuring sufficient activated carbon mercury adsorption capacity. EX1007, 4:66–5:5. EX1045, 2–3. Indeed, PO’s expert in the Delaware lawsuit stated “power plants employing bromine additives and activated carbon would necessarily produce a sorbent that is 1g to 30g bromine per 100g of activated carbon.” EX1083, 153. EX1002, ¶¶ 253-258.

2. Ground 2 – Vosteen/Altman or Vosteen/Altman/Nelson

If claim 4 is construed as requiring “the sorbent” be a promoted sorbent, then *see* Nelson discussion in § XII.B.1. EX1002, ¶¶ 481-483.

If claim 4 is construed as not requiring “the sorbent” be a promoted sorbent, then see the analysis in § XII.B.1. EX1002, ¶¶ 484-489. A POSITA would have recognized there would be sufficient bromine in the flue gas to provide a ratio of 1–30 g of bromine per 100 g of activated carbon since Vosteen discloses that, while an excess of a bromine compound can be used to achieve complete mercury oxidation, cost is a consideration. EX1011, [0007], [0015].

3. Ground 4 – Blankinship or Blankinship/ Olson-235

If claim 4 is construed as requiring “the sorbent” be a promoted sorbent, then Olson-235 discloses the promoted sorbent “comprises from about 1 to about 30 grams of promoter per 100 grams of base sorbent.” EX1013, 4:53–60, Claims 3, 17. Olson-235 also discloses an embodiment wherein “the injected sorbent is prepared in-flight by reacting a base sorbent (carbon, non-carbon or their combination) and a promoter within a pneumatic transport line from which the reaction product is injected to the mercury-containing flue gas stream.” EX1013, 5:43–48. In that embodiment, “the promoter is added at from about 1 to about 30 grams per 100 grams of the base sorbent.” EX1013, 6:17–31. EX1002, ¶¶ 722-725.

If claim 4 is construed as not requiring “the sorbent” be a promoted sorbent, then see the analysis in § XII.B.1. EX1002, ¶¶ 726-728.

C. Claims 5–6—“the combustion chamber comprises the halogen or halide promoter” (cl. 5) or “the coal comprises added Br₂, HBr, Br⁻, or a combination thereof, added to the coal upstream of the combustion chamber.” (cl. 6)

1. Ground 1 – Downs/Altman

See § XI.B.1. EX1002, ¶¶ 259-263.

2. Ground 2 – Vosteen/Altman

See § XI.B.2. EX1002, ¶¶ 490-492.

3. Ground 4 – Blankinship

See § XI.B.3. EX1002, ¶¶ 729-730.

D. Claim 7—“the promoter is contacted with the sorbent in vapor form, gaseous form, liquid form, or in an organic solvent.”

1. Ground 1 –Downs/Altman

Downs describes “gaseous, liquid or solid form” for the bromine-containing reagent 10, which can be HBr, Br₂ or a bromide compound such as a metal bromide. EX1004, [0021]–[0022]; EX1005, [0024]–[0025]. The bromine in the flue gas is contacted with the activated carbon sorbent when the activated carbon is injected into the flue gas. EX1004, [0016]; EX1005, [0019]. Thus, the bromide compound is contacted with Altman’s sorbent in gaseous form. EX1002, ¶¶ 264-270.

2. Ground 2 – Vosteen/Altman

Vosteen describes “addition of a bromine compound ... leads to a gas-phase reaction between mercury and bromine.” EX1011, [0010]. At least a portion of Vosteen’s NaBr added to the coal would have vaporized during combustion and reacted to form HBr in the flue gas. EX1014, 1658. Thus, HBr is contacted with Altman’s sorbent in vapor form. EX1048, 98:23–100:3, 231:3–9; EX1083 154, 170; EX1007, 6; EX1002, ¶¶ 493-495.

3. Ground 4 – Blankinship

See § XI.B.1 regarding Julien. Thus, HBr is in vapor or gaseous form in the flue gas post-combustion in the Alstom process described by Blankinship. The flue gas containing HBr from KNX decomposition as in Blankinship is contacted with

the activated carbon in the Mer-Cure system when the activated carbon is injected into the flue gas. EX1012, 56; EX1002, ¶¶ 731-733.

E. Claims 8–9—“injecting a secondary material into the mercury-containing gas downstream of the combustion chamber” (cl. 8), “the secondary material comprises a halogen, a compound derived from a halogen, a hydrohalide, a compound comprising a Group V or Group VI element and a molecular halogen, or a combination thereof.” (cl. 9)

1. Ground 1 – Downs/Altman or Downs/Altman/Vosteen

Altman describes “additional sorbent such as hydrated lime” “injected into the flue gas upstream of chamber 34.” EX1007, 5:50–61.

Vosteen states “bromine and/or a bromine compound ... is fed ... to the flue gas in a plant section downstream of the furnace.” EX1011, cl. 1, [0006], *see* [0014] (adding Br to “recirculated flue gas”); [0016] (also adding iodine). Vosteen’s bromine compounds include hydrogen bromide (HBr). *Id.*, cl. 2. HBr injected into the flue gas is a secondary material comprising a hydrohalide. EX1002, ¶¶ 271-274.

2. Ground 2 – Vosteen/Altman

Vosteen injects “a sulphur compound ... to the flue gas in a plant section downstream of the furnace.” EX1011, [0013]. In addition to the halogens added to coal and the combustion chamber, bromine is also injected directly into the mercury-containing gas downstream of the combustion chamber: “bromine and/or a bromine compound ... is fed to the if appropriate multistage furnace and/or to the flue gas in a plant section downstream of the furnace.” EX1011, cl. 1, [0006]; *see* [0014]

(adding Br to “recirculated flue gas”); [0016] (also adding iodine). A sulphur compound and additional halogens injected into the flue gas are examples of a secondary material. EX1002, ¶¶ 496-500.

3. Ground 4 – Blankinship/Vosteen

See § XII.E.2. Blankinship explains Alstom’s KNX™ calcium bromide solution “can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers” or in electrostatic precipitators (ESPs). EX1012, 56, 58. It would have been obvious to a POSITA that adding the KNX™ reagent to the coal or combustion chamber and to the flue gas downstream of the boiler would oxidize elemental mercury to form oxidized mercury which is easier to remove using a sorbent. EX1002, ¶¶ 734-739.

- F. Claims 10–11—**“the sorbent material injected into the mercury-containing gas further comprises a non-carbon sorbent material.” (cl. 10); “the non-carbon sorbent material comprises at least one of a porous felsic material, a vesicular felsic material, a porous basaltic material, a vesicular basaltic material, a clay-based compound, an alkaline compound, a calcium hydroxide compound, a sodium acetate compound, and a bicarbonate compound.” (cl. 11)

1. Ground 1 – Downs/Altman

Altman describes “additional sorbent such as hydrated lime” “injected into the flue gas upstream of chamber 34.” EX1007, 5:50–61. Hydrated lime is alkaline. EX1016, 33, 196, 671-672. EX1002, ¶¶ 275-276.

2. Ground 2 – Vosteen/Altman

See § XII.F.1, above. Vosteen discloses adding “lime” and “slaked lime” to mercury-containing flue gas, including by mixing lime with activated carbon. EX1011, [0019]. Lime contains calcium oxide, CaO, and slaked lime contains calcium hydroxide, Ca(OH)₂, which are alkaline compounds. EX1016, 33, 196, 671-672. EX1002, ¶¶ 501-504.

3. Ground 4 – Blankinship or Blankinship/Vosteen

Regarding claim 10, Blankinship discloses non-carbon sorbents “show some promise” and “are designed to be tolerant to higher temperatures.” EX1012, 58. *See* § XII.F.2 regarding Vosteen for claims 10-11. EX1002, ¶¶ 740-742.

G. Claim 12—“the activated carbon comprises powdered activated carbon, granular activated carbon, or a combination thereof.”

1. Ground 1 – Downs/Altman

Downs discloses using a PAC sorbent injection system. EX1004, [0004], [0015]–[0016], claims 15–16; EX1005, [0005], [0018]. Altman discloses activated carbon sorbents are particles. EX1007, 5:59–61. EX1002, ¶¶ 277-279.

2. Ground 2 – Vosteen/Altman

See § XII.G.1 regarding Altman. Vosteen describes granulated or pulverant activated carbon in its flue gas emission control systems. EX1011, [0019]. EX1002, ¶¶ 505-507.

3. Ground 4 – Blankinship

Blankinship discloses the Mer-Cure system differs from other post-combustion activated carbon sorbent systems because it “has an on line processor that keeps the resulting material from sticking together and de-agglomerates it to create smaller particle sizes and greater surface area.” EX1012, 58. Thus, small activated carbon particles are powdered or granular. Blankinship explains “[t]here are also variations of sorbent injection that provide ways to introduce activated carbon into flu[e] gas. . . . There are also ways to agglomerate the carbon or grind it finer on site to achieve better mass transfer.” EX1012, 56. EX1002, ¶¶ 743-744.

H. Claim 13—“the sorbent material injected into the mercury-containing gas is substantially free of halogen and halide promotion.”

A POSITA had reason to select halogen-free activated carbon due to its lower cost as compared to halogen-activated carbons especially where sufficient mercury removal can be achieved without resorting to halogen-activated carbons. EX1002, ¶ 280.

1. Ground 1 – Downs/Altman

Downs and Altman did not characterize their activated carbon sorbent as having been pre-brominated or otherwise impregnated with halogens prior to injection. EX1004; EX1005; EX1007; EX1002, ¶¶ 281-285.

2. Ground 2 – Vosteen/Altman

Vosteen and Altman did not characterize their activated carbon sorbent as having been pre-brominated or otherwise impregnated with halogens prior to injection. EX1011; EX1007; EX1002, ¶¶ 508-511.

3. Ground 4 – Blankinship

Blankinship describes “activated carbon and brominated activated carbon injection technology are being deployed at a number of power plants.” EX1012, 56; EX1002, ¶¶ 745-747.

I. Claim 14—”the sorbent material injected into the mercury-containing gas is a promoted sorbent obtained by contacting a base sorbent with another halogen or halide promoter.”

1. Ground 1 –Downs/Altman/Nelson

Nelson describes exposing activated carbon sorbent to a bromine-containing gas before the sorbent is mixed with mercury-containing flue gas. EX1008, [0040]; EX1009, 4. A POSITA had reason to substitute Nelson’s brominated-activated carbon sorbent for Altman’s activated carbon sorbent in the Downs/Altman process because Nelson indicates exposure of sorbent to Br₂ or HBr gas “significantly increases the carbonaceous materials ability to remove mercury species.” EX1008, [0041], Figures 12 & 14; EX1009, 4. A POSITA would have known this approach would have increased overall mercury capture. 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. EX1049, 1:33–41. EX1002, ¶¶ 286-289.

2. Ground 2 –Vosteen/Altman/Nelson

See § XII.I.1 regarding Nelson. A POSITA had reason to substitute Nelson’s brominated-activated carbon sorbent for Altman’s activated carbon sorbent in the Vosteen/Altman process for the stated reasons. EX1002, ¶¶ 512-515.

3. Ground 4 – Blankinship

Blankinship describes use of a bromine-treated or untreated activated carbon sorbent and indicates both sorbent types are being “deployed at a number of power plants.” EX1012, 56. A brominated sorbent would have been brominated prior to injection of the sorbent to the mercury-containing gas. EX1002, ¶¶ 748-751.

J. Claim 15—“the combustion chamber comprises a boiler”

1. Ground 1 – Downs/Altman

Downs describes combustion systems including “boiler 12.” EX1004, [0015]; EX1005, [0018]. Altman describes a plant with “fossil-fuel-fired boiler 12.” EX1007, 3:41-45. EX1002, ¶¶ 290-291.

2. Ground 2 – Vosteen/Altman

See § XII.J.1 regarding Altman. Vosteen discloses “a coal-fired power station” that has a “boiler.” EX1011, [0005], [0034], [0046]–[0047], Fig. 9. EX1002, ¶¶ 516-518.

3. Ground 4 – Blankinship

Blankinship explains “[b]romide can be added to the **boiler** or to the coal” EX1012, 56. EX1002, ¶¶ 752-753.

K. Claim 16—“the mercury-containing gas is a flue gas.”

1. Ground 1 - Downs/Altman

Downs describes “removal of mercury from flue gas.” EX1004, Title, [0018]; EX1005, Title, [0021]. Altman is directed to “removal of ... mercury from the flue gas of a combustor.” EX1007, 1:5-10. EX1002, ¶¶ 292-295.

2. Ground 2 – Vosteen/Altman

See § XII.K.1 regarding Altman. Vosteen is titled “Process for Removing Mercury from Flue Gases.” EX1011, Title, Abstract, cl. 1. EX1002, ¶¶ 519-522.

3. Ground 4 – Blankinship

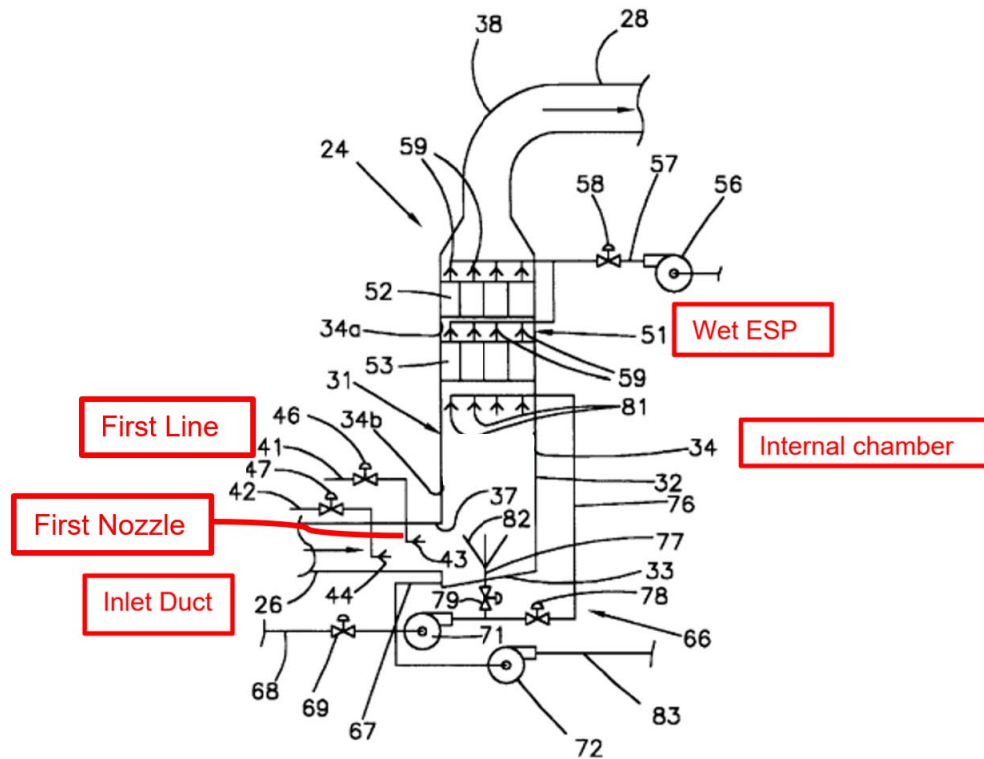
Blankinship describes “variations of sorbent injection that provide ways to introduce activated carbon into flu[e] gas.” EX1012, 56. EX1002, ¶¶ 754-755.

L. Claims 17–18—“injection of the sorbent material into the mercury-containing gas occurs upstream of an air pre-heater”–(cl. 17) and “injection of the sorbent material into the mercury-containing gas occurs upstream of a particulate separator or a scrubber.”–(cl. 18)

1. Ground 1 – Downs/Altman or Downs/Altman/Nelson

Regarding claim 18, Downs describes “sorbent ... removed from the flue gases in a downstream particulate collector” 26 such as an ESP or FF, or a wet FGD system 22. EX1004, [0004], [0015], [0023], Figures 4–6; EX1005, [0005], [0018],

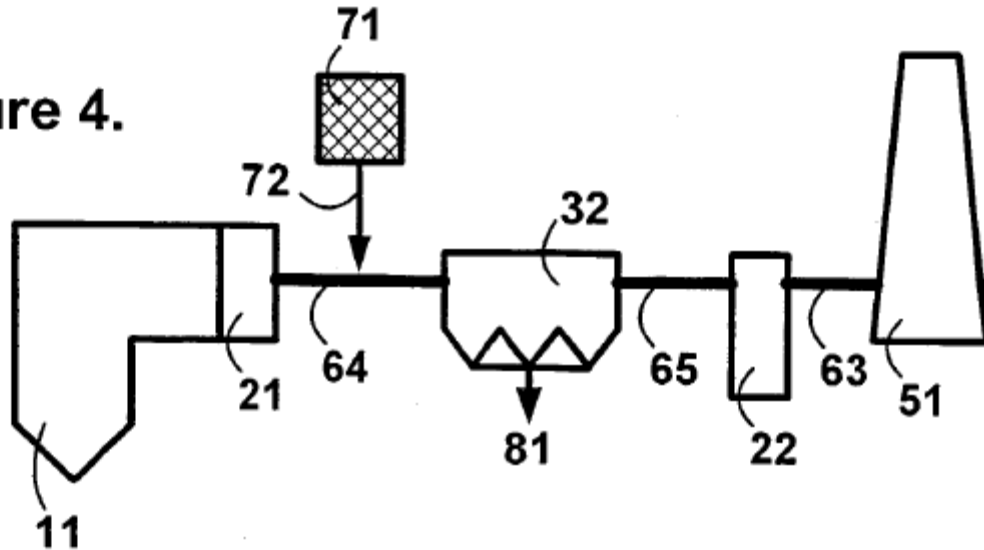
[0026], Figures 4–6. Altman’s Figure 2 depicts sorbent injection into duct 26 upstream of chamber 34 by means of first line 41 and first nozzle 43. Chamber 34 is upstream of wet electrostatic precipitator (ESP) 51, which is a “particulate control device” that collects sorbent.



EX1007, 4:17–21, 58–61; 5:27–29; Figure 2.

Regarding claims 17-18, Nelson describes injecting sorbent from bin 71 upstream of air preheater 22 and ESP 32. EX1008, [0062], Figure 4.

Figure 4.



EX1002, ¶¶ 296-300.

2. Ground 2 – Vosteen/Altman or Vosteen/Altman/Nelson

See § XII.L.1. EX1002, ¶¶ 523-526.

3. Ground 4 – Blankinship

Blankinship explains “[t]here are also variations of sorbent injection that provide ways to introduce activated carbon into flu[e] gas. It can be injected in front of the air heater instead of behind it to provide more flue gas reaction time.” EX1012, 56. Blankinship further explains “[p]ower plants without an FGD would likely use sorbent injection, mostly an activated carbon, upstream of a particulate control device. The particulate control can be either the plant’s existing device or a compact baghouse installed following the primary particulate control, with sorbent injection between the primary control and the new baghouse.” *Id.*

Blankinship explains Mer-Cure systems are “targeted primarily to ESP configurations, [but] Alstom has also installed it on wet scrubber applications where the combination of Mer-Cure and KNX worked well.” EX1012, 58. EX1002, ¶¶ 756-757.

- M. Claims 19–22—**“the coal comprises added halide sorbent enhancement additive” (cl. 19); “the combustion chamber comprises added Br₂, HBr, Br⁻, or a combination thereof” (cl. 20); “the coal comprises added sorbent enhancement additive that comprises Br⁻” (cl. 21); “the sorbent enhancement additive comprises a bromide compound” (cl. 22)

The ‘114 Patent does not define “sorbent enhancement additive.”

1. Ground 1 – Downs/Altman

Downs reports adding bromide compounds, HBr or Br₂ as the bromine-containing reagent 10 that is premixed with incoming coal 16. EX1004, [0015], [0021]; EX1005, [0018], [0024]. Downs also discloses calcium bromide injected into the combustion chamber through a coal burner. EX1004, [0018]; EX1005, [0021]. EX1002, ¶¶ 301-305.

2. Ground 2 – Vosteen/Altman

Vosteen discloses “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 waste mixture, 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.... The compound can also be fed during the combustion process....

[or] after the combustion, for example in a downstream waste-heat boiler.” EX1011, [0013]. When Vosteen’s sodium bromide is in liquid form, it dissociates into its ions Na^+ and Br^- . EX1002, ¶¶ 527-530.

3. Ground 4 – Blankinship

Blankinship explains Alstom’s KNX^{TM} calcium bromide solution “can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers” or in electrostatic precipitators (ESPs). EX1012, 56, 58. Calcium bromide is a “bromide compound” because it is “a substance composed of atoms or ions of two or more elements in chemical combination” in which “constituents are united by bonds or valence forces.” EX1015, 291. Blankinship’s calcium bromide is in solution which dissociates into its ions Ca^{2+} and Br^- . EX1002, ¶¶ 758-761.

XIII. CLAIMS DEPENDENT FROM CLAIM 25 ARE UNPATENTABLE

A. Claims 26–27—“the coal comprises the added Br_2 , HBr, the bromide compound, or a combination thereof, added to the coal upstream of the combustion chamber” (cl. 26); or “the combustion chamber comprises the added Br_2 , HBr, the bromide compound, or a combination thereof.” (cl. 27)

1. Grounds 1-4 – Downs/Altman, Vosteen/Altman and Blankinship

Claims 26 and 27 are virtually identical to Claims 6 and 20 with replacement of “ Br^- ” with “a bromide compound.” See §§ XII.C and XII.M, above. EX1002, ¶¶ 412-415, 612-613, 675-677.

B. Claim 28—the “monitoring,” “controlling,” and “maintained” limitations

1. Grounds 1, 2 & 4 – Downs/Altman, Vosteen/Altman and Blankinship

Claim 28 is virtually identical to Claim 24, with replacement of “Br-” with “a bromide compound.” See § XI, above, regarding claim 24. EX1002, ¶¶ 416-424, 614-621, 793-797.

C. Claim 29—“the mercury-containing gas comprises about 1 g to about 30 g of the element bromine per 100 g of the sorbent”

1. Grounds 1, 2 & 4 – Downs/Altman, Vosteen/Altman, Blankinship or Blankinship/Olson-235

This claim lacks written description support in the ‘760 application for the ‘114 patent and all earlier priority applications because the promoted sorbent (not the mercury-containing gas) is described as comprising about 1-30g promoter per 100g base sorbent. EX1001, 4:39-41; 5:4-6; 5:67-6:3; 6:32-47; 16:5-7; 22:12-15; 23:3-6, 22-25, 33-36, 51-53; 31:10-13. See also § XII.B.

Claim 29 claims a workable range for combining a conventional halogen (bromine) used in a conventional way (to promote a sorbent) with a conventional sorbent (activated carbon). Nothing in the ‘114 Patent indicates any criticality to the claimed range or establishes any “unexpected results.” The range presents nothing more than optimization of “result-effective” variables that would have been obvious to a POSITA. *Applied Materials*, 692 F.3d at 1297-98. EX1083, 153 (ratio is

“necessarily” present for ‘114 claim 4 accordingly to PO’s expert), 158, (applying same analysis for ‘114 Patent’s claim 29). EX1002 ¶¶ 425-426, 622-623, 798-799.

D. Claim 30—“the mercury/sorbent composition comprises the element bromine, the sorbent material, and mercury”

1. Ground 1–Downs/Altman or Downs/Altman/Nelson

See § XI.C.1 regarding discussion of element 24(c). It follows the sorbent of Downs/Altman comprises bromine, sorbent and mercury when in-flight promotion occurs.

Nelson explains “in exposing PAC to concentrated bromine gas, ... the bromine reacts with the carbon, forming surface compounds on ... the carbon. When the PAC is then injected into the flue gas, the elemental mercury and oxidized mercury species there appear to react with at least one form of the bromine-carbon surface compounds When the carbon particles are removed from the flue gas ... the mercury is removed with them.” EX1008, [0043]; EX1009, 4. EX1002, ¶¶ 427-430.

2. Ground 2–Vosteen/Altman or Vosteen/Altman/Nelson

See § XI.C.1 regarding discussion of element 24(c). It follows the sorbent of Vosteen/Altman comprises bromine, sorbent and mercury when in-flight promotion occurs. *See* § XIII.D.1 regarding Nelson’s explanation of how the sorbent comprises bromine, sorbent and mercury. EX1002, ¶¶ 624-627.

3. Ground 4 –Blankinship

See § XI.C.1 regarding discussion of element 24(c). It follows the sorbent in Blankinship comprises bromine, sorbent and mercury when in-flight promotion occurs. EX1002, ¶¶ 800-803.

XIV. CONCLUSION

Petitioner respectfully requests that IPR of the ‘114 Patent be instituted and the Challenged Claims be cancelled as unpatentable.

Dated: June 6, 2025

Respectfully submitted,

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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 13,829 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 Table of Contents, the Exhibit List, the Mandatory Notices, the Certificate of Compliance, and the Certificate of Service.

This paper also complies with the typeface requirements of 37 C.F.R. § 42.6(a)(2)(ii) and the type style requirements of 37 C.F.R. § 42.6(a)(2)(iii) and (iv).

Dated: June 6, 2025

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. §§ 42.6(e) and 42.105, the undersigned certifies that on June 6, 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,

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Via Priority Mail Express or by means at least as fast and reliable as Priority Mail Express.

Further, a courtesy copy was served via electronic mail on the Patent Owner’s counsel at the following addresses:

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