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Paper 19
Date: December 2, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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NRG ENERGY, INC. and
TALEN ENERGY CORPORATION
Petitioner,

v.

MIDWEST ENERGY EMISSIONS CORP.,
Patent Owner.

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IPR2020-00926
Patent 8,168,147 B2

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Before ZHENYU YANG, CHRISTOPHER M. KAISER, and AVELYN M. ROSS, *Administrative Patent Judges*.

ROSS, *Administrative Patent Judge*.

# DECISION
Granting Institution of *Inter Partes* Review
*35 U.S.C. § 314, 37 C.F.R. § 42.4*

# I. INTRODUCTION

NRG Energy, Inc., Talen Energy Corporation, and Vistra Corp. (formerly known as Vistra Energy Corp.), filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1, 2, 4–6, and 9–24 of U.S. Patent No. 8,168,147 B2 (Ex. 1001, "the '147 patent"). Pet. 1. Subsequently, Vistra Corp. and Midwest Energy Emissions Corp. ("Patent Owner") filed a Joint Motion to Terminate Vistra Corp. as a petitioner pursuant to settlement. Paper 8. That motion was granted. Paper 11. Therefore, NRG Energy, Inc. and Talen Energy Corporation (collectively "Petitioner") remain as petitioners. *Id.* at 4. Patent Owner filed a Preliminary Response. Paper 13 ("Prelim. Resp."). With our authorization, Petitioner filed a Reply (Paper 15, "Pet. Reply") and Patent Owner filed a Sur-reply (Paper 16, "Sur-reply").

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2019). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted "unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least [one] of the claims challenged in the petition."

For the reasons set forth below, upon considering the Petition, Preliminary Response, Reply, Sur-reply, and evidence of record, we determine the information presented in the Petition establishes a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. Accordingly, we institute an *inter partes* review.

*A. Real Parties-in-Interest*

Petitioner identifies the real parties-in-interest as NRG Energy, Inc., Talen Energy Corporation, and Vistra Corp. Pet. 1. Additionally, Petitioner identifies Brandon Shores LLC; Talen Generation LLC; H.A. Wagner LLC; IPH, LLC; Illinois Power Resources Generating, LLC; Dynegy Midwest Generation LLC; Dynegy Miami Fort, LLC; NRG Texas Power LLC; Midwest Generation EME, LLC; and Midwest Generation, LLC, as real parties-in-interest who are parties to the pending lawsuit identified below. *Id.* Talen and NRG also identify numerous *potential* real parties-in-interest—namely vendors and suppliers. *Id.* at 2–6.

*B. Related Matters*

Petitioner identifies a pending lawsuit between the parties, styled *Midwest Energy Emissions Corp. and MES Inc. v. Vistra Energy Corp*., No. 1:19-cv-01334-RGA (D. Del.), as a related proceeding in which the Patent Owner asserts the '147 patent. Pet. 6–7; *see also* Paper 6, 1 (Patent Owner's Mandatory Notices).

Petitioner filed a second petition challenging the '147 patent applying different prior art and a different priority date. IPR2020-00928, Paper 3.[1] Additionally, Petitioner filed concurrent petitions challenging U.S. Patent No. 10,343,114 B2 ("the '114 patent"), also asserted by Patent Owner in the district court proceeding. *See* IPR2020-00832, Paper 3; *see* IPR2020-00834, Paper 3. We instituted trial on IPR2020-00832 and IPR2020-00834 on

[1] In accordance with our Trial Practice Guide, Petitioner provides an explanation of material differences and ranking for the multiple petitions directed to each challenged patent. Paper 3 (Petitioner's Explanation Regarding the Necessity of Multiple Petitions, "Explanation").

October 26, 2020. *See* IPR2020-00832, Paper 17; *see also* IPR2020-00834, Paper 18.

*C. The '147 Patent*

*1. Specification*

The '147 patent, titled "Sorbents for the Oxidation and Removal of Mercury," issued on May 1, 2012. Ex. 1001, codes (45), (54). The '147 patent is directed to methods for capturing mercury using reactive bromine-promoted carbon sorbents. *Id.* at 6:19–24.

The '147 patent explains that combusting coal generates flue gas containing mercury and other trace elements. *Id.* at 1:29–40. "The release of the mercury (and other pollutants) to the environment must be controlled by use of sorbents," e.g., activated carbon particles. *Id.* at 1:37–40, 57–62. According to the '147 patent, "[a] major problem with existing carbon injection systems is that the sorbent is initially unreactive, and only after extended exposure to the flue gas does the sorbent become effectively seasoned and provide increased reactivity with the mercury in the gas." *Id.* at 2:10–14.

The '147 patent discloses that the "present invention provides a cost-effective way to capture pollutants by utilizing exceptionally reactive halogen/halide promoted carbon sorbents using a bromide (or other halogen/halide) treatment of the carbon, that capture mercury via mercury-sorbent surface reactions, at very short contact times of seconds or less." *Id.* at 6:19–24. To prepare bromine-carbon sorbents, the '147 patent describes methods for chemically combining molecular bromine with activated carbon. *Id.* at 11:45–49. Specifically, the '147 patent describes an "in-flight" method of producing a bromine-promoted carbon sorbent by:

> contacting the vapors of any combination of halogens and optionally a second component, in-flight, with very fine carbon particles. The particles may be dispersed in a stream of transport air (or other gas), which also conveys the halogen/halide promoted carbon sorbent particles to the flue gas duct, or other contaminated gas stream, from which mercury is to then be removed.

*Id.* at 12:44–53.

The '147 patent depicts a schematic flow diagram for a mercury control system including bromine-promoted carbon sorbents in Figure 3, reproduced below:

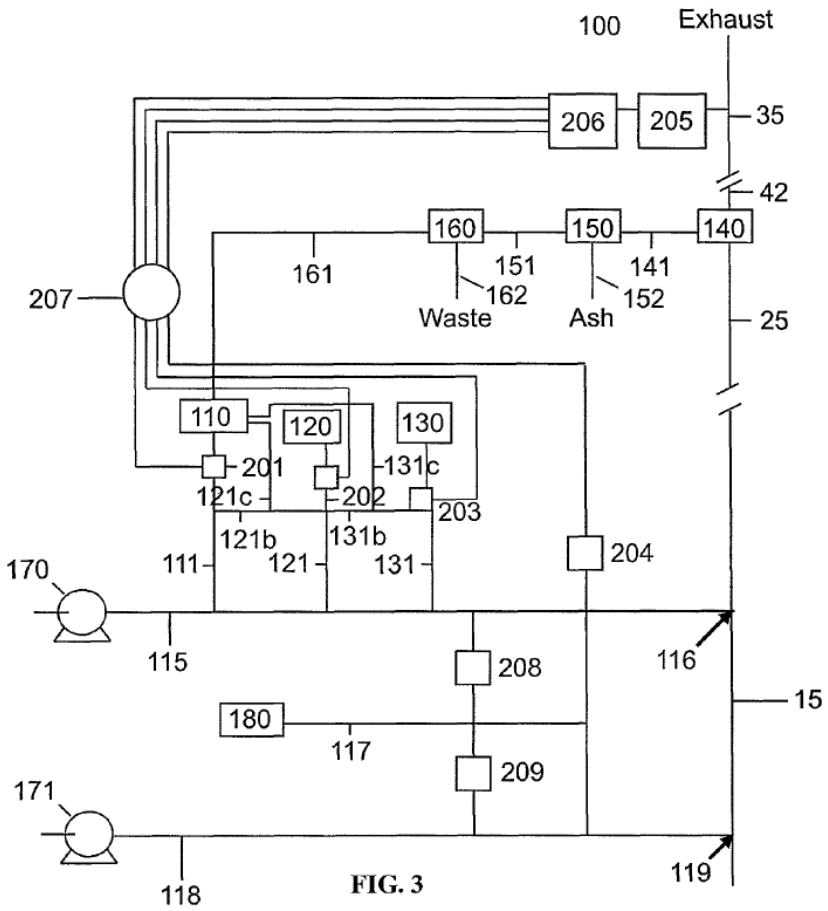


FIG. 3

Figure 3 "schematically illustrates preparation of promoted carbon sorbents and processes for flue gas mercury reduction in flue gases and/or product gases from a gasification system . . . including in-flight preparation of

promoted carbon sorbent." *Id.* at 5:47–51. Figure 3 depicts base activated carbon reservoir 110, halogen/halide promoter reservoir 120, optional secondary component reservoir 130, and corresponding flow control devices 201–203. *Id.* at 8:21–30. Transport line 115 carries material discharged from reservoirs 110, 120, and 130 in a transport gas, which injects the materials into contaminated flue gas stream 15 via injection point 116. *Id.* at 8:33–42. Particulate separator 140 collects and separates solid materials, including sorbent stream 151, which may be passed to sorbent regenerator 160 to yield regenerated sorbent stream 161. *Id.* at 8:61–9:10.

Figure 3 illustrates several preferred methods for preparing bromine-promoted carbon sorbents. *Id.* at 9:43–64. For example, the '147 patent first describes an in-flight preparation by discharging the halogen/halide "via line 121 directly into transport line 115, within which it contacts and reacts with the base activated carbon prior to injection point 116." *Id.* at 9:51–56. In a second embodiment, "the halogen/halide may be combined via line 121*b* with base activated carbon prior to entering transport line 115." *Id.* at 9:56–57. As a third alternate method, Figure 3 of the '147 patent describes introducing halogen/halide via line 121*c* into activated carbon reservoir 110 and reacting the compounds in reservoir 110. *Id.* at 9:58–64.

*2. Illustrative Claims*

Although Patent Owner disclaimed claim 1, claims depending from claim 1 and therefore including the limitations of claim 1, are challenged. Specifically, claim 17, from which the claims 18–20 depend, depends directly from claim 1. *See generally* Ex. 1001, claims. Claims 1 and 17 are reproduced below.

> 1. A method for separating mercury from a mercury containing gas comprising:
>
> (a) promoting at least a portion of a particulate sorbent material comprising activated carbon by chemically reacting the sorbent material with a bromine containing promoter to form a promoted brominated sorbent, wherein the bromine containing promoter is in gaseous form, vapor form, or non-aqueous liquid form, and wherein the activated carbon contains graphene sheets having carbene species edge sites which react with the bromine containing promoter to form a carbocation paired with a bromide anion in the promoted brominated sorbent for oxidation of the mercury;
>
> (b) chemically reacting elemental mercury in the mercury containing gas with the promoted brominated sorbent to form a mercury/sorbent chemical composition; and
>
> (c) separating particulates from the mercury containing gas, the particulates including ash and the mercury/sorbent chemical composition.

Ex. 1001, 23:34–52.

> 17. A method according to claim 1, further comprising
>
> injecting the particulate sorbent material at a sorbent material injection rate and
>
> injecting separately the bromine containing promoter into a gas stream whereby in-flight reaction produces the promoted brominated sorbent,
>
> wherein the promoter is reacted in the gas phase or as a vapor,
>
> wherein the promoter is added at from about 1 to about 30 grams per 100 grams of the sorbent material.

*Id.* at 24:34–41.

*D. Statutory Disclaimer*

Patent Owner states "[b]efore this petition was filed, ["Midwest Energy Emissions Corp.] statutorily disclaimed the non-'in-flight' claims of the '147 patent (1–16 and 21–25)." Prelim. Resp. 1 (citing Ex. 1019, 494).

A "patent owner may file a statutory disclaimer under 35 U.S.C. [§] 253(a) in compliance with § 1.321(a) of this chapter, disclaiming one or more claims in the patent. No *inter partes* review will be instituted based on disclaimed claims." 37 C.F.R. § 42.107(e) (2019). A disclaimer under 35 U.S.C. § 253(a) is "considered as part of the original patent" as of the date on which it is "recorded" in the Office. 35 U.S.C. § 253(a). For a disclaimer to be "recorded" in the Office, the document filed by the patent owner must:

(1) Be signed by the patentee, or an attorney or agent of record;

(2) Identify the patent and complete claim or claims, or term being disclaimed. A disclaimer which is not a disclaimer of a complete claim or claims, or term will be refused recordation;

(3) State the present extent of patentee's ownership interest in the patent; and

(4) Be accompanied by the fee set forth in [37 C.F.R.] § 1.20(d). 37 C.F.R. § 1.321(a); *see also Vectra Fitness, Inc. v. TNWK Corp*., 162 F.3d 1379, 1382 (Fed. Cir. 1998) (holding that a § 253 disclaimer is immediately "recorded" on the date that the Office receives a disclaimer meeting the requirements of 37 C.F.R. § 1.321(a), and that no further action is required in the Office).

Patent Owner filed a statutory disclaimer of claims 1–16 and 21–25. Ex. 1019, 494. Based on our review of Exhibit 1019 and Office public records, we conclude that the disclaimer of claims 1–16 and 21–25 of

the '147 patent under 35 U.S.C. § 253(a) was recorded in the Office as of December 11, 2019. *Id.* at 493–495. Because claims 1–16 and 21–25 have been disclaimed under 35 U.S.C. § 253(a) in compliance with 37 C.F.R. § 1.321(a), no *inter partes* review shall be instituted as to those claims. 37 C.F.R. § 42.107(e); *Intuitive Surgical, Inc. v. Ethicon LLC*, IPR2018-01248, Paper 7 at 2 n.1, 9–10 (PTAB Feb. 7, 2019) (discussing interplay of a disclaimed claim, Federal Circuit precedent, and our governing statutes and rules); *Daikin Indus. Ltd. v. The Chemours Co.*, IPR2018-00993, Paper 12 at 5–7 (PTAB Nov. 13, 2018) (noting that adverse judgment following partial disclaimer was not appropriate at least because the nondisclaimed claims "ha[d] yet to be 'decided.'"); *cf. General Electric Co. v. United Techs. Corp.*, IPR2017-00491, Paper 9 (PTAB July 6, 2017) (precedential) (declining to institute *inter partes* review when all challenged claims were disclaimed under 35 U.S.C. § 253(a)).

*E. Prior Art and Asserted Grounds of Unpatentability*

Petitioner asserts that claims 1, 2, 4–6, 11, 12, 15, 16, 21–24 would have been unpatentable on the following grounds:

| Claim(s) Challenged | Statutory Basis | Reference(s)/Basis |
|---|---|---|
| 1, 2, 4–6, 9–17, 20–24 | § 103 | Nelson,[2] Olson-Paper[3] |
| 11, 12, 17–20 | § 103 | Nelson, Olson-Paper, Lissianski[4] |

[2] Nelson, Jr., US 6,953,494 B2, issued October 11, 2005 (Ex. 1012, "Nelson").
[3] E.S. Olson et al., *Chemical mechanisms in mercury emission control technologies*, 107 J. Phys. IV France 979–982 (2003) (Ex. 1079, "Olson-Paper").
[4] Lissianski et al., US 7,514,052 B2, issued April 7, 2009 (Ex. 1036, "Lissianski").

| Claim(s) Challenged | Statutory Basis | Reference(s)/Basis |
|---|---|---|
| 1, 2, 4–6, 11, 12, 15, 16, 21–24 | § 103 | Downs-Halogenation,[5] Olson-Paper |
| 17–20 | § 103 | Downs-Halogenation, Olson-Paper, Lissianski |

As discussed above, only the challenges to claims 17–20 are pending in this *inter partes* proceeding as the remaining claims were disclaimed prior to filing of the Petition.

Petitioner also relies on declaration testimony of Stephen Niksa, Ph.D. (Ex. 1003, "the Niksa Declaration").

Patent Owner disputes that Petitioner's asserted grounds render any of the challenged claims unpatentable and that the asserted references are not prior art. *See generally* Prelim. Resp. Patent Owner relies on declaration testimony of the named inventors and additional evidence to support its contention of an earlier invention date. *See* Ex. 2024.

## II. ANALYSIS

### *A. Legal Standards*

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics,*

[5] Downs et al., US 2007/0180990 A1, published August 9, 2007 (Ex. 1015, "Downs-Halogenation").

*Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under 35 U.S.C. § 103(a) if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness.[6] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

To show obviousness, it is not enough to merely show that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). "This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." *KSR*, 550 U.S. at 418–419.

On the other hand, an obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 418; *accord In re Translogic Tech., Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007). However,

[6] The parties have not asserted or otherwise directed our attention to any objective evidence of non-obviousness.

Petitioner cannot satisfy its burden of proving obviousness by employing "mere conclusory statements." *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). Instead, Petitioner must articulate a reason why a person of ordinary skill in the art would have combined or modified the prior art references. *In re NuVasive, Inc.*, 842 F.3d 1376, 1382 (Fed. Cir. 2016); *see also Metalcraft of Mayville, Inc. v. The Toro Co.*, 848 F.3d 1358, 1366 (Fed. Cir. 2017) ("In determining whether there would have been a motivation to combine prior art references to arrive at the claimed invention, it is insufficient to simply conclude the combination would have been obvious without identifying any reason why a person of skill in the art would have made the combination."); *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) ("[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.") (citing *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)).

At this preliminary stage, we determine whether the information presented shows a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed prior art.

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

*B. Level of Ordinary Skill in the Art*

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of invention. *Graham*, 383 U.S. at 17. Petitioner contends that

> [a] person of ordinary skill in the art ("POSITA") would have at least a bachelor's degree in chemical engineering, mechanical engineering, or a related field of study with at least two years of experience with implementing pollution control in power generation plants for natural gas, coal, and/or industrial waste incineration.

Pet. 13 (citing Ex. 1003 ¶¶ 63–66).

Patent Owner does not identify the level of skill necessary for a person having ordinary skill in the art. *See generally* Prelim. Resp. And, neither party indicates that the outcome of any arguments made in this case would change depending on the level of ordinary skill in the art. For purposes of this Decision, and based on the record currently presented, we adopt Petitioner's definition of the level of ordinary skill in the art. Further, we find that the prior art of record reflects the level of skill in the art at the time of the invention. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). We will make any final determination pertaining to the level of ordinary skill in the art, however, on the full trial record.

*C. Claim Construction*

In an *inter partes* review filed on or after November 13, 2018, we construe claims "using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. § 42.100(b) (2019); *see Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

Petitioner does not propose any claim construction and asserts all claim terms should be accorded their plain and ordinary meaning. Pet. 20 (citing Ex. 1003 ¶ 211).

Patent Owner requests that we construe the term "in-flight." Prelim. Resp. 14. Patent Owner argues that "in-flight" describes "reacting bromine and activated carbon on-site in the gas transport system at a power plant" and not "pre-treating sorbents before using them at a power plant." *Id.*; *see also id.* at 19 ("an 'in-flight' reaction . . . require[s] a reaction on-site within the gas transport system at a power plant, not pre-treatment of sorbents.").

Patent Owner argues that the claims themselves, the specification, and the prosecution history of the '147 patent each support its proposed construction. *Id.* at 15–19. Patent Owner argues that disclaimed "[i]ndependent claim 1 broadly covers both pre-treatment and 'in-flight' treatment. Claim 17's use of the phrase 'in-flight' indicates that the phrase is intended to narrow the claim scope, not to be mere surplusage." *Id.* at 18. According to Patent Owner, claim 17 requires an in-flight reaction in a gas stream. *Id.*

Patent Owner further argues the '147 patent specification describes alternate methods for reacting bromine with activated carbon including "(1) pre-treatment of activated carbon sorbent with bromine promoter in a separate treatment vessel (Ex. 1001 at 14:40-64); and (2) 'in-flight' treatment of activated carbon sorbent with bromine promoter within the gas transport system at a coal-fired power plant (Ex. 1001 at 12:45-57)." *Id.* at 15. Patent Owner argues that Figure 3 illustrates "in-flight" treatment where bromine and carbon are provided into a transport gas connected to the combustion chamber flue gas line and thus react "in-flight." *Id.* at 15–16.

Patent Owner further contends that U.S. Provisional Application No. 60/605,640 ("the '640 provisional") supports its construction of "in-flight" and describes "in-flight" treatment in Figure 2, reproduced below. Ex. 1020, 16.

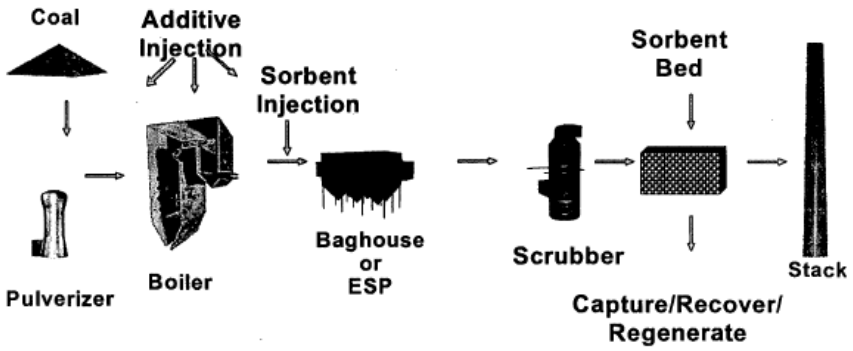



FIG. 2

Figure 2 is a block diagram of a sorbent injection process in a coal fueled facility. *Id.* at 15. Patent Owner argues that "[t]he provisional contrasts the disclosed in-flight treatment [described in Figure 2] with the pre-treatment process described in Nelson: '[**t]he Nelson method** lacks many of the features described in this application that impart exceptional activity to the sorbent in a convenient way, for example, . . . **the use of in-flight bromine treatment**.'" [7] Prelim. Resp. 17 (citing Ex. 1020, 12–13).[8]

Patent Owner additionally asserts that the prosecution history of the '114 patent provides support for its construction of "in-flight." *Id.* (citing Ex. 2028, 1696). Patent Owner explains that the '114 patent applicant successfully overcame a rejection over Nelson by contrasting its "in-flight"

[7] The provisional application cites the published application of Nelson, i.e., US 2004/0003716 A1, published January 8, 2004.
[8] Certain exhibits (*see e.g.*, Ex. 1019, 1020, and 2024) contain multiple documents within a single exhibit. For consistency, we cite to the exhibit page number as opposed to the individual document page number.

treatment with that of Nelson's pre-treatment method by stating that "Nelson did not recommend or teach adding chemicals to the flue gas or in-flight mixing of Br2 and HBr with sorbents. Quite the contrary, he recommended that the bromine be contacted with the sorbent outside the presence of boiler gases . . . ." *Id.* (citing Ex. 2028, 1814); *see also id.* at 17–18 (citing Ex. 2028, 1927–1928 (the Examiner explaining that "in-flight promotion . . . is more effective for mercury removal," "the Nelson reference seems to teach away from inflight promotion," and "one having ordinary skill in the art would not have looked to in-flight promotion" methods).

Petitioner replies that "[t]he plain language is not limited to a 'power plant,' and could include other '[m]ercury removal applications' such as 'waste incineration.'" Pet. Reply 10 (citing Ex. 1001, 1:50–55). Petitioner also contends that the claim language is not "limited to onsite in a transport system, as opposed to promoting sorbent offsite by suspending it on 'glass wool' or in a 'fluidized bed' reactor.'" *Id.* (citing Ex. 1001, 9:61–64, 15:63–16:50; Pet. 53). However, Petitioner asserts that "Grounds 1–4 apply even under Patent Owner's erroneous construction." *Id*.

After considering the parties' initial arguments and additional arguments on claim construction, we determine that a modified version of Patent Owner's proposed construction of "in-flight" is consistent with the claim language, the specification, and prosecution history of the '147 patent. We agree with Petitioner, however, that the claims are not limited to a "power plant" and may include other applications taught by the '147 patent. Pet. Reply 10; Ex. 1001, 1:50–55. Patent Owner fails to direct our attention any disclosure in the '147 patent or understanding in the art that would limit "in-flight" to use in a "power plant." *See generally* Sur-reply 9–10.

Accordingly, we determine that the term "in-flight" should be construed to mean "reacting bromine and activated carbon on-site in the gas transport system and within the transport line."

Claim terms generally should be given their ordinary and customary meaning, except "1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution." *Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). "To act as its own lexicographer, a patentee must 'clearly set forth a definition of the disputed claim term' other than its plain and ordinary meaning." *Id.* (quoting *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002)). Patent Owner asserts that "the inventors coined the term 'in-flight' to distinguish pre-treated sorbents." Prelim. Resp. 16. Though Petitioner asserts all claims should be given their plain and ordinary meaning, Petitioner does not explain what the ordinarily skilled artisan would understand the term "in-flight" to mean. Pet. 20; Pet. Reply 10 (arguing that Patent Owner is relying on an "exemplary process" as opposed to acting as his own lexicographer).

Based on our review of the record evidence, we are persuaded that '147 patentee acted as his own lexicographer. The '147 patent describes "in-flight" sorbent preparation as being accomplished by:

> contacting the vapors of any combination of halogens and optionally a second component, in-flight, with very fine carbon particles. The particles may be dispersed in a stream of transport air (or other gas), which also conveys the halogen/halide promoted carbon sorbent particles to the flue gas duct, or other contaminated gas stream, from which mercury is to then be removed. There is no particular temperature requirement for this contact. This technology is obviously very simple to implement,

> and results in a great cost savings to facilities using this technology for mercury capture.

Ex. 1001, 12:45–57 (emphasis added). The '147 patentee repeatedly explains that an "in-flight" promoted sorbent is prepared "by reacting an activated carbon and a promoter *within a pneumatic transport line* from which the reaction product is injected to the mercury-containing flue gas stream." Ex. 1001, 4:19–23 (emphasis added); *see also id.* at 4:30–35 (same), 4:55–59 (same); 12:62–65 ("With this technique, the halogen/halide is introduced to the carbon-air (or other gas) mixture in a transport line (or other part of the sorbent storage and injection system)"). Further, the '147 patent contrasts other preparation methods with its preferred "in-flight" method and states that

> [t]he halogen/halide may preferably be combined via line **121** directly into transport line **115,** within which it contacts and reacts with the base activated carbon prior to injection point **116.** This option is one form of what is referred to herein as "in-flight" preparation of a promoted carbon sorbent in accordance with the invention.

*Id.* at 9:51–56. The '147 patent further explains that "'[i]n flight preparation of the halogen/halide promoted sorbent *on location* produces certain advantages," including, *inter alia*, the elimination of equipment and operation costs at the treatment facility, the method uses existing hardware, maintaining sorbent freshness, eliminating transport and handling concerns, and "allow[ing for] rapid *on-site* tailoring of additive-sorbent ratios. *Id.* at 12:59–13:19 (identifying the benefits "in-flight" methods performed at the "end-use site" "over current conventional concepts for treating sorbents off-site.").

Accordingly, we determine the term "in-flight" should be construed to mean "reacting bromine and activated carbon on-site in the gas transport system and within the transport line." We note that this construction excludes the introduction of pre-treated sorbents in the transport line.

*D. Discretion to Deny Institution*

*1. 35 U.S.C. § 325(d)*

Patent Owner argues that we should exercise our discretion to deny all of the asserted grounds under 35 U.S.C. § 325(d) because they present substantially the same prior art and arguments the Office previously considered during prosecution. *See* Prelim. Resp. 4–9.

Section 325(d) provides that in determining whether to institute an *inter partes* review, "the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office." The Board uses a two-part framework in determining whether to exercise its discretion under § 325(d), specifically:

> (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of the first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.

*Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential).

In applying the two-part framework, we consider several non-exclusive factors, including: (a) the similarities and material differences between the asserted art and the prior art involved during examination; (b) the cumulative nature of the asserted art and the prior art evaluated during

examination; (c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection; (d) the extent of the overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art; (e) whether Petitioner has pointed out sufficiently how the Examiner erred in its evaluation of the asserted prior art; and (f) the extent to which additional evidence and facts presented in the Petition warrant reconsideration of the prior art or arguments. *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph). *Becton, Dickinson* factors (a), (b), and (d) relate to part (1) of the *Advanced Bionics* framework and factors (c), (e), and (f) relate to part (2). Therefore, if after review of factors (a), (b), and (d), we determine that the same or substantially the same art or arguments previously were presented to the Office, then we consider factors (c), (e), and (f) to determine whether petitioner demonstrates that the Office erred in a manner material to the patentability of the challenged claims. *Advanced Bionics*, Paper 6 at 10.

*a) Advanced Bionics Framework Part (1)*

For part (1) of the *Advanced Bionics* framework (and factors (a), (b), and (d) of *Becton, Dickinson*), Patent Owner argues that the Examiner considered Nelson in "initially reject[ing]" but ultimately allowing a claim similar to claim 17 during the prosecution of the '114 patent. Prelim. Resp. 4 (citing Ex. 2028, 1645). Patent Owner contends that the Examiner's arguments in the '114 patent are "nearly identical to Petitioner['s] current proposal of combining Nelson with Lissianski-Patent." *Id.* at 5. And, that "the same examiner that examined the '147 [patent] claims also determined

that similar claims were distinguishable over Nelson, and Nelson combined with a reference similar to Lissianski-Patent." *Id.* at 8.

Nelson was before the Office during the prosecution of the '114 patent but *not the prosecution of the '147 patent*; the '147 patent issued six years prior to the filing of the '114 patent. Moreover, as Petitioner explains, the '114 patent claims and the '147 "patent claims differ significantly." Pet. Reply 1 ("The '114 Patent claims were amended to recite bromine containing promoter 'added to the coal upstream of the combustion chamber' whereas claims 18–19 of the '147 Patent require the promoter to be added downstream of the combustion chamber (e.g., in mercury-containing gas.").

Further, it does not appear that the same or substantially the same arguments predicated on Nelson were before the Office. Specifically, the Examiner during the '114 patent prosecution determined that the combination of Felsvang, describing each limitation of then pending claim 2 except for the use of bromine, and Nelson, disclosing a bromine promoter, would not have been obvious because objective evidence of nonobviousness established that bromine was more effective than chlorine. Ex. 2028, 1927–1928. The Examiner further determined that Nelson did not suggest an in-flight promotion with bromine. *Id.* In contrast, Petitioner here contends that Lissianski provides the combination of bromine introduced into a gas stream and an in-flight reaction—unlike Felsvang—and relies on Nelson to describe injection of a sorbent material including graphene sheets having carbene species edge sites. Pet. 69–77.

Thus, Part (1) of the *Advanced Bionics* framework is not met as to the Petitioner's combination including Lissianski and Nelson as the prior art

combination considered by the Examiner during the '114 patent prosecution was different and applied in a different manner. Moreover, neither Downs-Halogenation nor Olson-Paper are alleged to have been before the Office. *See generally* Pet. 10–12; Prelim. Resp. 4–8.

It appears, however, that an earlier publication of Nelson (Ex. 1013, "Nelson-Publication") was before the Office during the prosecution of the '147 patent. Pet. 11. Therefore, we review Part (2) of the framework with respect to the Nelson Publication.

*b) Advanced Bionics Framework Part (2)*

For part (2) of the *Advanced Bionics* framework (and factors (c), (e), (f) of *Becton, Dickinson*), Petitioner argues that, following the Examiner's rejection based on Nelson-Publication, "applicants amended the sole independent claim to require: 'activated carbon contains graphene sheets having carbene species edge sites which react with the bromine containing promoter to form a carbocation paired with a bromide anion in the promoted-brominated sorbent for oxidation of the mercury.'" Pet. 11 (citing Ex. 1019, 322, 466–72). Petitioner contends that Olson-Paper, which was not before the Examiner and is used in combination with Nelson-Publication in each ground in the Petition, "discloses the specific sorbent in all primary references (activated carbon). Olson-Paper even discloses that the ***specific brand*** of sorbent in Nelson—Norit Darco FGD—contains '<u>carbene structures</u> … <u>at the edges of the carbon graphene layers</u>.'" *Id.* at 12. Petitioner also contends, "the Examiner should not have allowed the claims because 'a newly-discovered property of the prior art cannot support a patent' merely because 'the patentee explicitly claims that property.'" *Id.*

at 11 (citing *Abbott Labs. v. Baxter Pharm. Prod., Inc.*, 471 F.3d 1363, 1368 (Fed. Cir. 2006)).

Patent Owner argues that "Petitioners fail to identify any error in the examiner's conduct described above," and therefore have failed to demonstrate that institution is warranted with respect to Nelson or Nelson in combination with Lissianski. Prelim. Resp. at 8–9.

We find that Petitioner has sufficiently shown that the Examiner erred in a manner material to the patentability of the claims by failing to recognize that the sorbent used in Nelson-Publication contains the claimed graphene sheets having carbine species at the edge sites. Ex. 1079, 979; *see also* Ex. 1013 ¶¶ 76, 80, 83, 91, Fig 12. The Examiner's finding that Nelson-Publication failed to teach "activated carbon contain[ing] graphe[n]e sheets having carbine species edge sites" was a basis for the Examiner's reason for allowance. Ex. 1019, 471 (Notice of Allowability); *see Advanced Bionics*, Paper 6, 8 n.9 ("An example of a material error may be misapprehending or overlooking specific teachings of the relevant prior art where those teachings impact patentability of the challenged claims.").

For these reasons, and considering the *Advanced Bionics* framework as applied to the various references before us, we decline to exercise our discretion under § 325(d) to deny institution.

Although we have preliminarily analyzed Nelson, and determined (below) that challenged Ground 1 based on Nelson and Olson—without Lissianski—does not provide a basis for obviousness against the challenged claims, this preliminary determination does not conflict with our Part (2) determination that the Examiner erred in not considering Nelson-Publication in a manner potentially material to the patentability of the challenged claims.

*2. 35 U.S.C. § 314(a)*

Under § 314(a), we have discretion to deny institution of an *inter partes* review. *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016); *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1356 (2018); *Harmonic Inc.*, 815 F.3d at 1367 ("[T]he PTO is permitted, but never compelled, to institute an IPR proceeding."); *see also* 37 C.F.R. § 42.4(a) ("The Board institutes the trial on behalf of the Director."). In deciding whether to institute an *inter partes* review, we consider the guidance provided in the Consolidated Trial Practice Guide, which states

> Based on the Board's prior experience, one petition should be sufficient to challenge the claims of a patent in most situations. Two or more petitions filed against the same patent at or about the same time . . . may place a substantial and unnecessary burden on the Board and the patent owner and could raise fairness, timing, and efficiency concerns.

Patent Trial and Appeal Board Consolidated Trial Practice Guide ("Consolidated TPG") 64 (Nov. 2019), https://www.uspto.gov/sites/default/files/documents/ tpgnov.pdf, 59.

Here, Petitioner filed two petitions on the same day, one challenging claims 17–20 and the other challenging claims 18 and 19 of the '147 patent. In this Petition, Petitioner presents four obviousness grounds, two based on Nelson as the main reference and two based on Downs-Halogenation as the main reference. Pet. 10. In IPR2020-00928, Petitioner presents two obviousness challenges, the first based on Lissianski-Presentation and

Olson-646 and the second based on Sjostrom[9] and Olson-646.[10] IPR2020-00928, Paper 3, 10.

Petitioner "request[s] that the Board institute on both petitions" but explains that two petitions are warranted because the two petitions assert different priority dates and assert different references, citing the Consolidated Trial Practice Guide's statement that "more than one petition may be necessary . . . when there is a dispute about priority date requiring arguments under multiple prior art references." Paper 3 (Petitioner's Explanation Regarding the Necessity of Multiple Petitions, "Explanation") (citing Consolidated TPG 59). According to Petitioner,

> Petitioners expect Patent Owner to argue that all the claims of the '147 Patent can trace priority back to a provisional application filed August 30, 2004, while Petitioners dispute this. Petitioners assert that two of the claims—Claims 18 and 19—have no support in the Provisional or intervening applications, and thus the earliest priority date for these two claims is the filing date of what became the '147 Patent, April 9, 2009.

*Id.* at 1. The Explanation ranks this Petition above the Petition in IPR2020-00928. *Id*. at 2.

Petitioner further argues that the issues presented to the Board by the two Petitions are limited, because the Petition in this proceeding uses two primary references and two secondary references, whereas the Petition in IPR2020-00928 uses two primary references and only one secondary reference. *Id.* at 3. Petitioner also argues that they joined efforts to provide

[9] S. Sjostrom, *Full Scale Evaluations of Mercury Control Technologies with PRB Coals*, Electric Utilities Environmental Conference (January 2005) (Exhibit 1010, "Sjostrom").
[10] Olson et al., US 2006/0048646 A1, published March 9, 2006 (Exhibit 1014, "Olson-646").

efficiency instead of each party individually filing separate petitions. *Id.* at 4–5.

We find Petitioner's arguments are persuasive. The existence of different priority date arguments and different prior art references in the two petitions invokes the Consolidated Trial Practice Guide statement that "more than one petition may be necessary . . . when there is a dispute about priority date requiring arguments under multiple prior art references." Consolidated TPG 59. Notwithstanding Petitioner's and Patent Owner's post-Petition arguments regarding the similarity of the priority date arguments, the fact remains that the Petitions themselves present different priority date arguments and rely on different prior art references. The Petitions are the documents to which the Patent Owner will be responding in the *inter partes* review proceeding. Moreover, Petitioner ranks this Petition first and, for the reasons discussed below, *inter partes* review will be instituted in this proceeding. We also institute *inter partes* review in IPR2020-00928 for the reasons discussed in that proceeding.

*3. 35 U.S.C. § 312(a)(2)*

Patent Owner argues that "35 U.S.C. § 312(a)(2) provides that a petition may only be considered if 'the petition identifies all real parties in interest.'" Prelim. Resp. 9. Patent Owner contends that Petitioner lists "dozens of 'potential real parties in interest,' without explanation as to their relationship to petitioners," that this "is not an identification of *all real parties in interest*," and that, if instituted, this proceeding would be under a cloud of uncertainty because the ambiguity in Petitioner's list "will likely lead to confusion and disputes as to which parties are real parties in interest and which are bound by the estoppel provisions of 35 U.S.C. § 315." *Id.*

at 9–10. For instance, Patent Owner asserts that Petitioner identifies various vendors and suppliers as "potential real parties in interest" but states that "[n]one of these companies or any unnamed entity is funding, controlling, or directing, or otherwise has an opportunity to control or direct this Petition or proceeding" and this implies that these entities are not actually real parties in interest. *Id*. at 10. In addition, Patent Owner argues that some entities are identified both as "potential real parties in interest" and "real parties in interest," which creates ambiguity and conflict in the listing of entities. *Id*. at 10–11. For these reasons, Patent Owner contends that "Petitioners have not met their burden of identifying all real parties in interest" and "the Board should deny institution for failure to comply with § 312(a)(2)." *Id.* at 11.

We are not aware of, and Patent Owner does not direct us, to any rule, statute, or case law that prohibits Petitioner from identifying multiple real parties-in-interest or multiple potential real parties-in-interest. Petitioner's identification of about a dozen real parties-in-interest does not appear problematic or overly burdensome. Pet. 1–2. Petitioner's identification of numerous potential real parties-in-interest, albeit unusual, also does not appear problematic. *Id.* at 2–6. To the extent Petitioner has identified an entity as both a real party-in-interest and as a potential real party-in-interest, we interpret that to mean that party is identified as a real party-in-interest. Petitioner's reasons for identifying numerous potential real parties-in-interest reasons appear plausible: Petitioner identifies these parties "out of an abundance of caution" because "they are vendors and suppliers" in the related litigation but have not "agreed to be listed as a real party-in-interest" in this Petition. Pet. 1–6. This provides the Board and Patent Owner notice that other potential entities may be indirectly involved, but also provides

reasons for not committing those parties to the real party-in-interest category. Ordinarily, problems regarding identification of real parties-in-interest arise when a petitioner fails to identify a real party-in-interest. *See, e.g., Ventex Co., Ltd. v. Columbia Sportswear N. Am., Inc.*, IPR2017-00651, Paper 152 (PTAB Jan. 24, 2019) (precedential) (terminating proceeding where Petition failed to name time-barred RPI and privy). Here, the alleged problem is over-identification of potential real parties-in-interest. Without express violation of a known rule, statute, or case law, this does not appear to be a problem warranting a denial on institution of *inter partes* review.

E. *Availability of Prior Art*

Petitioner contends that Nelson, Downs-Halogenation, and Lissianski, each qualify as prior art under 35 U.S.C. §§ 102(b) and (e) (pre-AIA), and Olson-Paper qualifies as prior art under §§ 102(a) and (b), because each reference predates the filing date of the '640 provisional, i.e., August 30, 2004. Pet. 9.[11]

Patent Owner contends that "Petitioners have failed to qualify these references as prior art because the inventors conceived the claimed invention prior to May 6, 2003 and diligently reduced to practice before March 22, 2004." Prelim. Resp. 20. Patent Owner presents evidence in the form of declaration testimony from the named inventors and a "research ideas" file to support its argument that the inventors "conceived of using bromine as the pre-combustion additive" by August 2002. *Id.* at 23–25, 26 (citing

[11] Petitioner also contends "[e]ach reference is also prior art under §102 (b) (pre-AIA) with respect to claims 18–19 [because e]ach was patented and/or described in a printed publication or otherwise available to the public, including more than one year before the effective filing date of claims 18–19 of the '147 Patent (April 2009)." Pet. 9.

Ex. 2024[12] (Pavlish Decl.) 4–8, 13–30; Ex. 2007; Ex. 2008; Ex. 2010). Patent Owner presents further evidence in the form of "meeting presentations, testing logbooks, and post-testing reports" to support its argument that the inventors reduced the invention to practice "through pilot scale testing conducted in September 2003, December 2003, and February 2004." *Id.* at 23, 32 (citing Ex. 2024; Exs. 2011–2014; Ex. 1016). Patent Owner argues that the relevant period for establishing diligence "is from May 5, 2003 to September 2003" and that "[t]his is an entirely reasonable amount of time for the inventors to have designed, developed, and performed the necessary testing to optimize their new approach to mercury capture." *Id.* at 39–40.

Petitioner disputes Patent Owner's assertion of an earlier actual reduction to practice. Pet. Reply. 2–10. Petitioner argues that "Patent Owner fails to demonstrate conception or provide 'independent evidence corroborating the inventor's testimony.'" *Id.* at 3. Petitioner criticizes Patent Owner's evidence as "a hodgepodge of 'research ideas' from anonymous authors that Dr. Pavlish 'had compiled' from the CATM research center" that "leave[] it to the Board to decipher conception evidence from Exhibit 2024, which does not identify ***any*** authors, much less the named inventors." *Id.* at 3–4. Petitioner asserts that "[n]owhere does the [Patent Owner Preliminary Response] include a claim chart, or any other

[12] Exhibit 2024 comprises three separate declarations—the declaration testimony of John Pavlish ("the Pavlish Decl."), Edwin S. Olson ("the Olson Decl."), and Michael J. Holmes ("the Holmes Decl."). *See* Ex. 2024, 1, 32, 34. The Olson and Holmes declarations "confirm" the accuracy of the testimony provided in the Pavlish declaration. *Id.* at 33, 35. Exhibit 24 additionally includes a claim chart detailing Patent Owner's evidence of reduction to practice. *Id.* at 36.

evidence, showing conception of ***each*** element of claims 1 and 17–20 of the '147 patent" nor has Patent Owner explained how the remaining evidence, including the Department of Energy ("DOE") reports "disclose every feature of the subject matter sought to be patented." *Id.* at 4–5 (citing *Unified Patents, LLC v. Lighthouse Consulting Grp. LLC*, IPR2020-00194, 2020 WL 3065760, at *12 (P.T.A.B. June 9, 2020); *Burroughs Wellcome Co. v. Barr Labs*, 40 F.3d 1223, 1228 (Fed. Cir. 1994) (requiring "every feature of [the] claimed invention"). Petitioner argues that Patent Owner has "fail[ed] to chart numerous claim limitations" including the "carbene species edge sites" or "a bromine-containing promoter that is 'gas, vapor, or non-aqueous.'" *Id.* at 7. Petitioner presents detailed arguments against Patent Owner's conception evidence (*id.* at 3–5), reduction to practice evidence (*id.* at 5–8), and diligence evidence (*id.* at 9–10). Petitioner argues that trial should be instituted so it may depose Patent Owner's declarants and "explore the deficiencies in Patent Owner's evidence." *Id.* at 3.

Patent Owner replies that Petitioner misunderstands the "rule of reason" for a conception date. Sur-reply 2. Patent Owner also replies that Petitioner failed to show that the inventors' asserted reduction to practice date lacks credibility. *Id.* at 4–6. Patent Owner contends that Petitioner has not shown that any non-obvious limitations are missing from the evidence establishing reduction to practice. *Id.* at 7. Finally, Patent Owner argues that Petitioner failed to show that the inventors lacked diligence. *Id.* at 8–9.

To remove a patent as a prior art reference, the record must establish either (1) a conception and reduction to practice before the filing date of the patent or (2) a conception before the filing date of the patent combined with

diligence and reduction to practice after that date. *See Taurus IP, LLC v. DaimlerChrysler Corp.*, 726 F.3d 1306, 1323 (Fed. Cir. 2013).

"Conception exists when a definite and permanent idea of an operative invention, including every feature of the subject matter sought to be patented, is known." *Sewall v. Walters*, 21 F.3d 411, 415 (Fed. Cir. 1994). Furthermore, the "conception analysis necessarily turns on the inventor's ability to describe his invention with particularity. Until he can do so, he cannot prove possession of the complete mental picture of the invention." *Burroughs*, 40 F.3d at 1228. Objective evidence that corroborates an inventor's testimony regarding the conception of the invention is required "because of the danger in post-hoc rationales by an inventor claiming priority." *Invitrogen Corp. v. Clontech Labs., Inc.*, 429 F.3d 1052, 1065 (Fed. Cir. 2005). The sufficiency of corroboration is determined according to a "rule of reason." *Price v. Symsek*, 988 F.2d 1187, 1195 (Fed. Cir. 1993). Under the rule of reason, "all pertinent evidence is examined in order to determine whether the inventor's story is credible." *Fleming .v Escort Inc.*, 774 F.3d 1371, 1377 (Fed. Cir. 2014) (quoting *Sandt Tech., Ltd. v. Resco Metal & Plastics Corp.*, 264 F.3d 1344, 1350 (Fed. Cir. 2001)).

To establish an actual reduction to practice, as opposed to the constructive reduction to practice that occurs when a patent application is filed, a party must establish that: (1) the inventor constructed an embodiment or performed a process that satisfies every element of the claim at issue; and (2) the inventor determined that the invention would work for its intended purpose. *E.I. du Pont De Nemours & Co. v. Unifrax I LLC*, 921 F.3d 1060, 1075 (Fed. Cir. 2019). The same requirement for evidence that corroborates

inventor testimony on conception under the rule of reason also applies to the reduction to practice determination. *Id.* at 1076. To demonstrate diligence, a patent owner "must show there was *reasonably continuous* diligence" throughout the critical period. *Perfect Surgical Techniques, Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1009 (Fed. Cir. 2016).

Petitioner bears the burden of persuasion that the challenged claims are unpatentable, which includes the burden of establishing that any reference upon which it relies constitutes prior art under 35 U.S.C. § 102. *See* 35 U.S.C. § 316(e); *Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1576 (Fed. Cir. 1996) (holding that the challenger "bore the burden of persuasion . . . on all issues relating to the status of [the asserted reference] as prior art"). However, because Petitioner initially offered up the prior art references into evidence, which on their face qualify as prior art, Patent Owner bears the subsequent procedural burden of producing evidence antedating the prior art references. *See Dynamic Drinkware*, 800 F.3d at 1378–80; *Magnum Oil*, 829 F.3d at 1375. Although the burden of production can be a shifting burden, we note that the burden of persuasion is on Petitioner to ultimately prove "unpatentability by a preponderance of the evidence," and that this burden never shifts to Patent Owner. *Dynamic Drinkware*, 800 F.3d at 1378.

Petitioner has come forward with evidence to support its assertion that the prior art references are in fact prior art to the '147 patent. *See* Explanation 2–3. Patent Owner has come forward with evidence and argument that the proffered prior art references are not prior art, due to the asserted prior conception, reduction to practice, and diligence on the part of the inventors. *See* Prelim. Resp. 19–40; Sur-reply 2–9. However, on this

record and at this preliminary stage, we are not persuaded that the evidence and arguments before us are sufficient to show the asserted conception date, reduction to practice date(s), or diligence. Most importantly, Patent Owner does not explain in sufficient detail how the proffered testimony and documents disclose *every feature* of the subject matter challenged. It is also unclear, without further explanation, what the documents purporting to show conception and reduction to practice actually demonstrate, and how they are related specifically to the limitations of the challenged claims.

Accordingly, based on the preliminary record, we determine that, for purposes of this Decision, Nelson, Olson-Paper[13], Lissianski, and Downs-Halogenation constitute prior art under 35 U.S.C. § 102, and, as such, it is proper to rely on them in the grounds presented under 35 U.S.C. § 103. The parties may further address this issue in post-institution briefing.

*F. Priority Date for the '147 Patent*

Petitioner explains that "[t]he current petition assumes *arguendo* that the Challenged Claims of the '147 Patent have priority to August 30, 2004." Pet. 7. Petitioner explains that the instant petition differs from the second petition, i.e., IPR 2020-00928, in that the second petition asserts a different priority date of April 2009 for claims 18 and 19 of the '147 patent. *Id.* at 7–9. Therefore, each reference in the instant petition is prior art under 35 U.S.C. § 102(e) and "is also prior art under § 102(b) (pre-AIA) with respect to claims 18–19. Each was patented and/or described in a printed publication or otherwise available to the public, including more than one

[13] Patent Owner does not appear to assert that Olson-Paper fails to qualify as prior art. *See generally* Prelim. Resp. 19–39; *see also* Pet. Reply 2 (noting that "Patent Owner does not dispute the prior-art status of Olson-Paper").

year before the effective filing date of claims 18–19 of the '147 Patent (April 2009)." *Id.* at 9.

Patent Owner asserts that "Petitioners attempt to justify filing multiple petitions against this patent by arguing that they will only challenge the priority date of the '147 claims in IPR2020-00928. However, Petitioners made the same representation in related proceedings (IPR2020-00834) and have reversed course." Prelim. Resp. 43–44. Therefore, Patent Owner "copies" its arguments from IPR2020-00928 and presents them here. Specifically, Patent Owner alleges that claims 18 and 19 of the '147 patent are entitled to the earliest priority date, that is, the priority date of the '640 provisional application, August 30, 2004. *Id.* at 49–50.

Petitioner, in reply, likewise copies its arguments from IPR2020-00928 and asserts that claims 18 and 19 are not entitled to the priority date of the '640 provisional application because priority has been broken, the incorporated material has not been specified, and that "'essential material' cannot be incorporated [by reference] from a provisional application." Pet. Reply. 11–12. Petitioner also contends that even if the '640 provisional application can be considered, its written description fails to provide the requisite support for claims 18 and 19. *Id.* at 12–14. Similarly, Petitioner urges that intervening applications, i.e., the '163 and '595 applications fail to teach injecting the sorbent material separate from the bromine promoter and injecting the bromine promoter into a mercury containing gas stream. *Id.* at 14–15.

Patent Owner asserts that Petitioner's position is based on a continued misinterpretation of the '640 provisional application and in particular example 9. Sur-reply 11. Patent Owner further maintains that claims 18 and

19 are supported by the intervening '163 and '595 applications. *Id.* at 13–15.

This Petition does not raise the same priority date issues presented in IPR2020-00928, because the prior art here predates the presumed priority date based on the '640 provisional application filing date of August 30, 2004. Explanation 2; Pet. 9. But, Patent Owner in this case raises priority arguments by referring to the arguments raised in the IPR2020-00928 and IPR2020-00832 Petitions and invites us to consider the arguments raised and evidence presented in IPR2020-00928. Prelim. Resp. 43–60. In the IPR2020-00928 Institution Decision, we analyze this priority date issue in depth based on the parties' arguments and evidence and determine that, at this stage of the proceedings, the priority date for claims 18 and 19 is no earlier than April 6, 2009, i.e., the filing date for the '147 patent. We are aware of the potential problems that could arise if we ignore or fail to address a priority date issue in this case, when the same potentially dispositive issue has been raised and analyzed in IPR2020-00928 concerning the same patent and the same priority date evidence. Petitioner elected to take two different priority date approaches in the Petitions in IPR2020-00926 and IPR2020-00928, for the purposes of qualifying each petition for separate institution. Explanation, 1–2. This drafting choice results in two Petitions that ostensibly present different sets of evidence, but that may end up turning on the same priority date issue raised in IPR2020-00928. The conception, reduction to practice, and diligence issues raised here, however, distinguish this case sufficiently that our reasoning for granting institution in both petitions, as further explained below, is unchanged.

*G. Alleged Obviousness over Nelson and Olson-Paper (claims 17 and 20)*

Petitioner contends claims 17 and 20 are rendered obvious over the combination of Nelson and Olson-Paper. Pet. 20–57. Petitioner also relies on the testimony of Dr. Niksa to support its arguments. *Id.*

*1. Nelson (Ex. 1012)*

Nelson relates to preparing a mercury sorbent "by treating a carbonaceous substrate with an effective amount of a bromine-containing gas for a sufficient time to increase the ability of the carbonaceous substrate to adsorb mercury and mercury-containing compounds." Ex. 1012, 4:58–63. Nelson discloses "that the simple act of exposing a carbonaceous material, preferably powdered activated carbon (PAC), to gaseous bromine, $Br_2$(g), or to gaseous hydrogen bromide, HBr(g), significantly increases the carbonaceous material's ability to remove mercury species when injected into high-temperature coal-fired flue-gas compositions." *Id.* at 6:10–15. Nelson discloses that

> [t]he carbon material and the bromine gas need simply be contacted with each other for the advantageous mercury-reactive surface compounds to quickly form. . . . Using a gas-phase carbon reactant considerably simplifies the production of the sorbent and leads to the low costs which are a requirement for a sorbent to be used as a once-through duct injectant. . . . It is also preferable that the mixing of bromine gas and carbon be done at an elevated temperature. This keeps the bromine gas in the gaseous form, but also minimizes the amount of any bromine physically-adsorbed into the pores of the carbon.

*Id.* at 6:42–64.

Nelson's manufacturing process for a mercury sorbent is depicted below in Figure 1.

**Figure 1.**

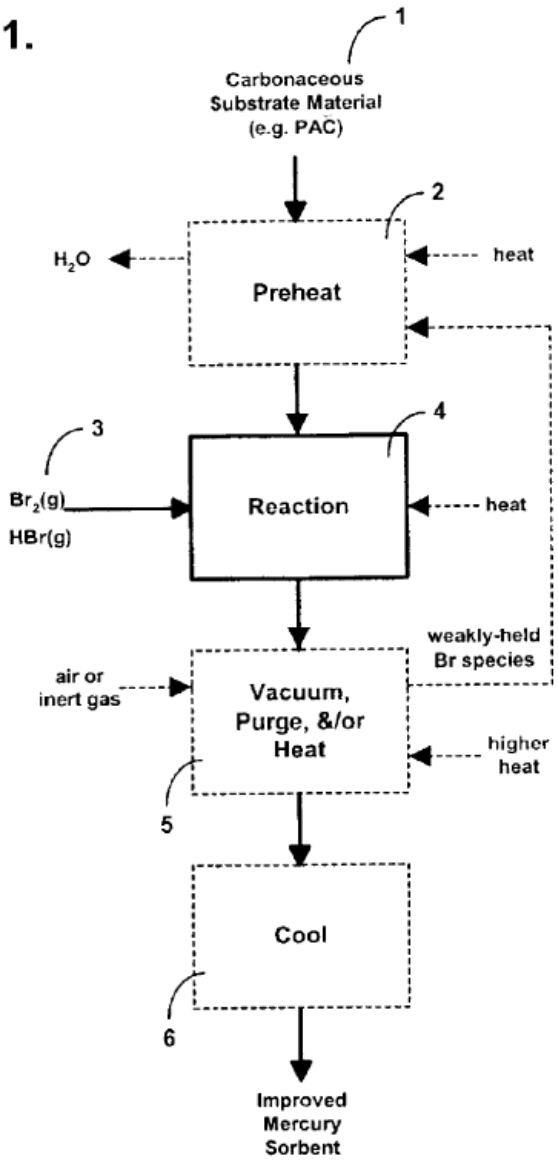



Figure 1 is "block diagram of the process for manufacturing the improved mercury sorbent compositions." *Id.* at 5:29–30. Figure 1 depicts "activated carbon entering the treatment process at 1." *Id.* at 7:29–31. The activated carbon is preheated at 2 and enters a reaction chamber where gaseous bromine 3 is introduced at 4. *Id.* at 7:37–8:14. Nelson discloses that "the size of the carbonaceous particles during bromination . . . can be fine enough [to] be mixed with and carried by the mercury-containing flue-gas stream, or

it can be large and granular, to be comminuted after bromination, but prior to being injected into the mercury-containing gas stream." *Id.* at 7:16–23. Nelson describes preferred powdered activated carbons ("PACs") as including Norit's Darco FGD®. *Id.* at 11:10–20.

Nelson discloses that "[i]n some applications it may be beneficial to utilize a diluting carrier gas to better distribute the $Br_2$(g) or HBr(g) among the carbonaceous substrate particles." *Id.* at 7:64–66. According to Nelson,

> [t]he key step in the sorbent manufacturing process is exposing the dried carbonaceous materials to the bromine containing gas, 4. . . . [P]referably this is done with the carbonaceous materials at a temperature at or above about 150° C., or above the temperature of the mercury-containing flue-gas stream into which the sorbents will be injected.

*Id.* at 8:8–21. Nelson also discloses that

> [w]hile over 30 wt % of $Br_2$(g) can be adsorbed into some powdered activated carbons, for example, significant increases in mercury reactivity will be observed with only about 1 wt % $Br_2$(g) in the PAC. Greater degrees of bromination do correlate with greater maximum mercury capacities for a particular carbonaceous substrate. . . . If a PAC substrate is used, brominating to 1 wt % provides a highly-capable mercury sorbent, although a 5 wt % material performs better and may be preferable.

*Id.* at 8:35–56.

Figure 2 depicts injecting the mercury sorbent into hot combustion flue gas as reproduced below. *Id.* at 9:30–35.

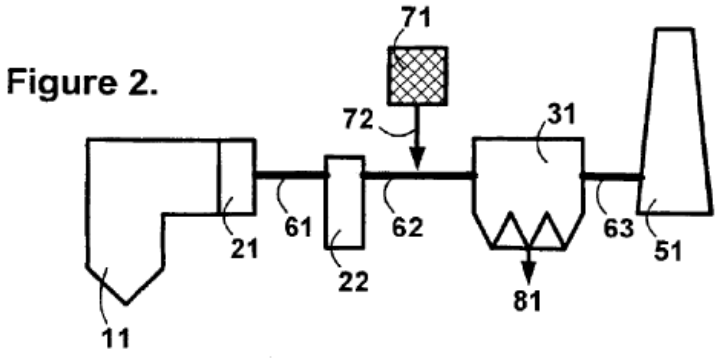



Figure 2 is a schematic diagram of an exhaust gas system "describing example methods for using the improved sorbent compositions to remove and isolate mercury species from hot combustion flue gases." *Id.* at 5:30–34. Nelson discloses that "the mercury sorbent of this invention, stored in a container such as a bin 71, is fed to and through an injection line 72 to the ductwork 62 and injected through a multitude of lances to be widely dispersed in the hot combustion flue gas." *Id.* at 9:31–35.

*2. Olson-Paper (Ex. 1079)*

Olson-Paper relates chemisorption mechanisms in mercury emission control technologies. Ex. 1079, 19. Olson-Paper discloses mechanisms of mercury-flue gas-sorbent interactions from activated carbon sorbents, including Norit FGD. *Id.* at 21. Olson-Paper depicts a mechanistic model for $Hg^0$ oxidation and binding in Figure 2, reproduced below.

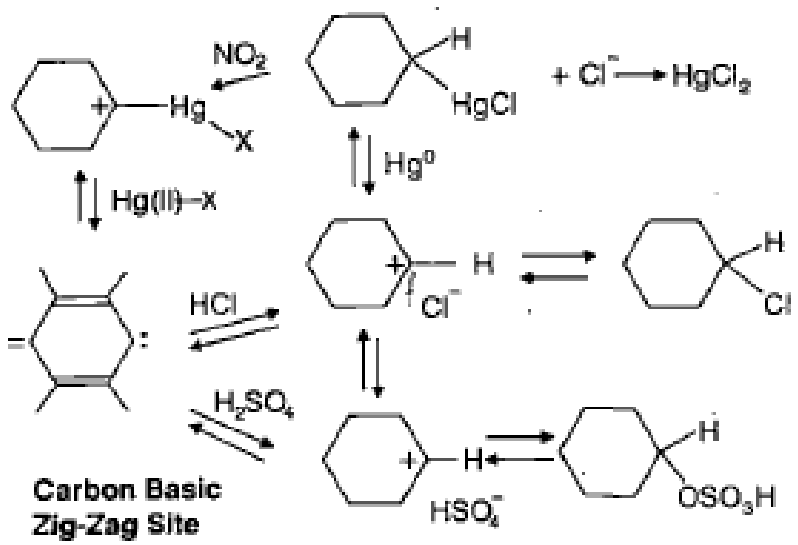



Figure 2 depicts a reaction site model for activated carbon. *Id.* at 22. The model "uses the concept of zig-zag carbene structures recently proposed for electronic states at the edges of the carbon graphene layers. In the edge carbene model of Hg capture, the zig-zag carbon atom positioned between aromatic rings is hypothesized to be a Lewis base site." *Id.*

*3. Analysis of claim 17*

Although claim 1 is disclaimed, claim 17 depends from and includes the limitations of claim 1. Ex. 1001, 24:34–41. Accordingly, we review Petitioner's contentions as to claim 1, followed by the additional limitations of claim 17.

Petitioner contends that Nelson discloses a method for separating mercury from a mercury containing gas by promoting an activated carbon particulate sorbent material by chemically reacting activated carbon with gaseous or liquid bromine to form a promoted brominated sorbent. *See* Pet. 30–34 (citing Ex. 1012, 2:36–37, 4:58–63, 5:63–6:37, 7:4–36, 7:45–51). Petitioner explains that Nelson describes the particulate sorbent as Norit

Darco FGD® powdered-activated carbon. *Id.* at 31 (citing Ex. 1012, 11:11–20; Ex. 1003 ¶¶ 297–300).

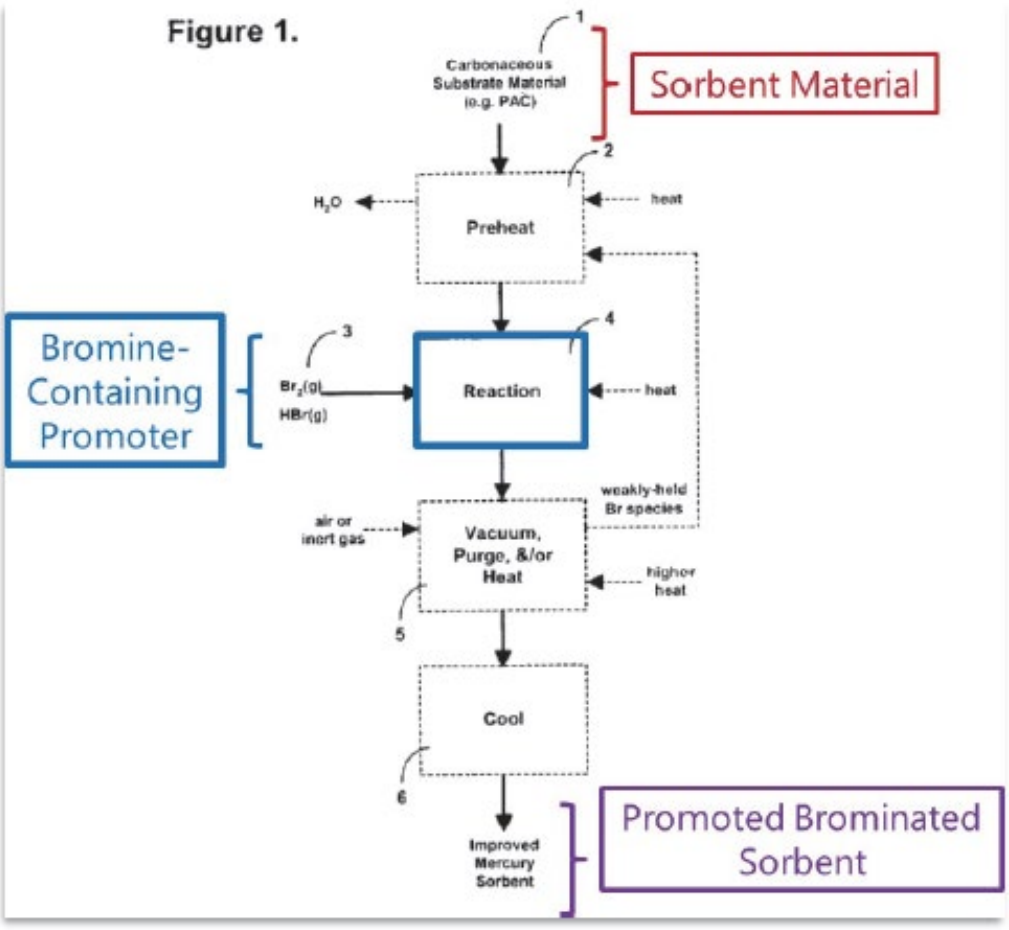
Petitioner contends that Olson-Paper discloses the limitation "wherein the activated carbon contains graphene sheets having carbene species edge sites which react with the bromine containing promoter to form a carbocation paired with a bromide anion in the promoted brominated sorbent for oxidation of the mercury." *Id.* at 34. Specifically, Petitioner contends that Olson-Paper "describes that activated carbon—particularly the Norit Darco FGD® of Nelson—contains graphene sheets having "a zig-zag *carbene site* on the *carbon edge*." *Id.* (citing Ex. 1079, 979, 982). Petitioner further contends that Olson-Paper discloses that "[t]he basic carbene cannot react directly with [elemental mercury] $Hg^0$, but reacts with HCl *to form stable carbenium ion intermediates*, which are then active for binding $Hg^0$, accepting electrons from the atom (Figure 2). Thus *HCl or other acids promote the oxidation step*." *Id.* at 36 (quoting Ex. 1079, 982). Petitioner contends that although Olson-Paper "identifies hydrochloric acid (HCl) and chloride anions ($Cl^-$), a POSITA would have applied the same mechanism for a bromine-containing promoter (e.g., HBr)," as taught by Nelson. *Id.* at 37–38.

Petitioner contends that both Nelson and Olson-Paper disclose chemically reacting elemental mercury with the promoted brominated sorbent to form a mercury/sorbent composition, i.e., claim 1, step (b). *Id.* at 39–40 (citing Ex. 1012, 6:26–34, Figure 12; Ex. 1079, 982; Ex. 1003 ¶¶ 321–323).

Petitioner contends that Nelson "discloses separating mercury/sorbent particulates from the mercury containing gas 'along with the fly ash,' using a

'particulate collector' such as an 'electrostatic precipitator (ESP) or fabric filter,'" i.e., claim 1, step (c). *Id.* at 41–42 (citing Ex. 1012, 6:1–4, 6:30–41, 9:17–10:67; Ex. 1003 ¶¶ 324–328).

With respect to claim 17, Petitioner contends Nelson discloses: (1) "injecting the particulate sorbent material at a sorbent material injection rate and injecting separately the bromine containing promoter into a gas stream," and (2) "whereby in-flight reaction produces the promoted brominated sorbent." *Id.* at 52–53. Petitioner submits annotated Figure 1 of Nelson to support its argument, as reproduced below.




Petitioner's annotated version of Nelson's Figure 1 illustrates "the sorbent (red) and bromine-containing promoter (blue) are injected separately into a

gas stream, in which in-flight reaction (blue) produces promoted-brominated sorbent (purple)." *Id.* at 52. Petitioner contends that a person of ordinary skill in the art "would have understood that for sorbent and promoter to be injected, they must necessarily have been injected at an injection rate," as further illustrated in Nelson's Figure 14. *Id.* Petitioner contends that Nelson's "[b]romine-containing promoter and sorbent react inflight in a gas-phase, such as in a 'fluidized-bed unit' or a 'transport reactor.'" *Id.* at 53 (citing Ex. 1012, 8:57–67; Ex. 1003 ¶¶ 359–364). Finally, Petitioner contends that "nothing in claim 17 (or claim 1) of the '147 patent limits the in-flight reaction to one that occurs at the combustion site." *Id.* (citing Ex. 1003 ¶¶ 357–358).

Petitioner contends that Nelson discloses that "the promoter is reacted in the gas phase or as a vapor" because Nelson describes reacting gaseous $Br_2$(g) and HBr(g) with sorbent in a gas phase. *Id.* at 32–33, 53 (citing Ex. 1012, 2:36–37, 6:26–34, 7:45–51; Ex. 1003 ¶¶ 301–303, 308–309, 365).

Finally, Petitioner contends that Nelson discloses the limitation that "the promoter is added at from about 1 to about 30 grams per 100 grams of the sorbent material," whether the claim is interpreted as a ratio of promoter added to the sorbent or promoter added to the gas stream. *Id.* at 54–55. Specifically, Petitioner contends that "Nelson expressly describes adding promoter *to the sorbent* from about 1–30 grams of sorbent." *Id.* at 54 (citing Ex. 1012, 8:35–42, 11:10–20, 12:9–20, 13:23–26, 14:55–63, 15:35–46; Ex. 1003 ¶ 367). Petitioner contends that although Nelson does not expressly disclose the ratio of promoter added to gas stream, "it would have been obvious, given the highly reactive nature of HBr and $Br_2$ towards activated carbon, that the gas-phase ratio would have been similar to the

ratio on the sorbent in Nelson." *Id.* at 55 (citing Ex. 1012, 8:9–35; Ex. 1003 ¶¶ 368–369).

Petitioner contends that a person of ordinary skill in the art would have combined Nelson and Olson-Paper "to describe the surface chemistry of the sorbent, [Norit's Darco FGD], in Nelson." *Id.* at 28 (citing Ex. 1003 ¶¶ 290–291). Petitioner contends that a person of ordinary skill in the art would have understood the applicability of Olson's chloride-containing chemical reactions with activated-carbon sorbent to Nelson's bromide-containing chemical reactions with the same sorbent. *Id.* (citing Ex. 1003 ¶¶ 292–294).

Patent Owner, at this time, does not challenge most of Petitioner's allegations regarding the teachings of Nelson and Olson. *See generally* Prelim. Resp. Instead, Patent Owner focuses its argument on Petitioner's purported failure to show an "in-flight reaction [that] produces the promoted brominated sorbent," as claimed. *Id.* at 40–41. At this stage of the proceeding, Petitioner's arguments and evidence are sufficient to suggest each limitation of claim 17 of the '471 patent, except that which Patent Owner disputes. Below we address whether Nelson teaches the requisite "in-flight reaction."

Patent Owner contends that claim 17, correctly interpreted, requires injecting "bromine into a gas stream moving through a power plant's gas transport system, as opposed to gas located in a stationary treatment vessel." *Id.* at 18. Patent Owner disputes Petitioner's argument that "claims 17 and 20 may be met by pre-treating sorbent off-site, as opposed to treating sorbent 'in-flight' within the gas transport system of the power plant." *Id.* at 40.

On this record, Petitioner fails to establish that Nelson suggests an "in-flight" reaction as claimed. As properly construed, and discussed above (*see supra* Section II.C.), claim 17 requires preparing the bromine promoted sorbent by an "in-flight" reaction, that is, "reacting bromine and activated carbon on-site in the gas transport system and within the transport line." Petitioner directs our attention to annotated Figure 1 of Nelson which, according to Petitioner, shows "the sorbent (red) and bromine-containing promoter (blue) . . . injected separately into a gas stream, in which in-flight reaction (blue) produces promoted-brominated sorbent (purple)." Pet 52. Petitioner contends that Nelson describes reacting the bromine promoter and sorbent "in-flight" using a fluidized-bed like the '147 patent. And, Petitioner asserts that "nothing in claim 17 (or claim 1) of the '147 patent limits the in-flight reaction to one that occurs at the combustion site." *Id*. at 53. Each of Petitioner's arguments fails to consider claim 17 in light of the '147 patent specification and reads portions of the specification in isolation. For example, while true that claim 17 requires "injecting separately the bromine containing promoter into a *gas stream*," the inquiry does not end there as Petitioner suggests. Ex. 1001, 24:34–38 (emphasis added). The claim continues "whereby [an] *in-flight* reaction produces the promoted brominated sorbent." *Id.* (emphasis added). An "in-flight" reaction, according to the specification, is not simply injecting the bromine promoter into a gas stream but rather reacting the promoter and activated carbon *on-site in the gas transport system* and *within the transport line*. Figure 1 of Nelson, referenced by Petitioner, depicts injecting both the sorbent material and the bromine containing promoter separately and carrying out the bromination of the activated carbon sorbent in a reactor

vessel. Ex. 1012, 8:9–9:16. The bromine-promoted sorbent is collected in storage bin 71 and fed into mercury containing gas through injection line 72. *Id.* at 9:21–10:67, Figs. 2–6. Therefore, the sorbent in Nelson is premixed and not subject to an "in-flight" reaction within the gas transport system. Petitioner's reliance on the fluidized-bed embodiment of the '147 patent does not persuade us otherwise as that embodiment is described in contrast to "in-flight" methods and details preparing the promoted carbon sorbent in a reservoir separate from the transport line. Ex. 1001, 9:51–64.

Accordingly, we determine that Petitioner fails to demonstrate sufficiently that the combination of Nelson and Olson-Paper teaches or suggests an "in-flight" reaction. Because each challenged claim requires an "in-flight" reaction, we determine that Petitioner fails to show a reasonable likelihood of prevailing on its assertion that claims 17–20 of the '147 patent would have been obvious over Nelson and Olson-Paper.

*H. Alleged Obvious over Nelson, Olson-Paper, and Lissianski*

Petitioner contends claims 17–20 are rendered obvious over the combination of Nelson, Olson-Paper, and Lissianski. Pet. 59–81. Petitioner also relies on the testimony of Dr. Niksa to support its arguments. *Id.*

*1. Lissianski (Ex. 1036)*

Lissianski relates to a method for removing mercury emissions from coal combustion flue gas by injecting $NH_4Br$ into the flue gas; oxidizing elemental mercury with a halogen from the injected additive; absorbing the oxidized mercury with an adsorbent in the flue gas; and collecting the adsorbent in a combustion waste treatment system. Ex. 1036, 2:3–13. Lissianski discloses that "[t]he hot flue gas causes the additive to thermally decompose to form HCl, HBr or HI which results in more significant

mercury oxidation. The increase in mercury oxidation allows for improved efficiency of mercury removal by activated carbon (AC) injection." *Id.* at 3:45–49. Lissianski discloses that "[t]he halogen additive can be co-injected with air, recycled flue gas, nitrogen or another carrier gas to increase the penetration of the additive aqueous solution across the flue gas path and to improve mixing of the additive aqueous solution and flue gas." *Id.* at 4:20–23.

Lissianski illustrates the method for removing mercury emissions in a coal plant with a halogen containing additive in Figure 3, reproduced below.

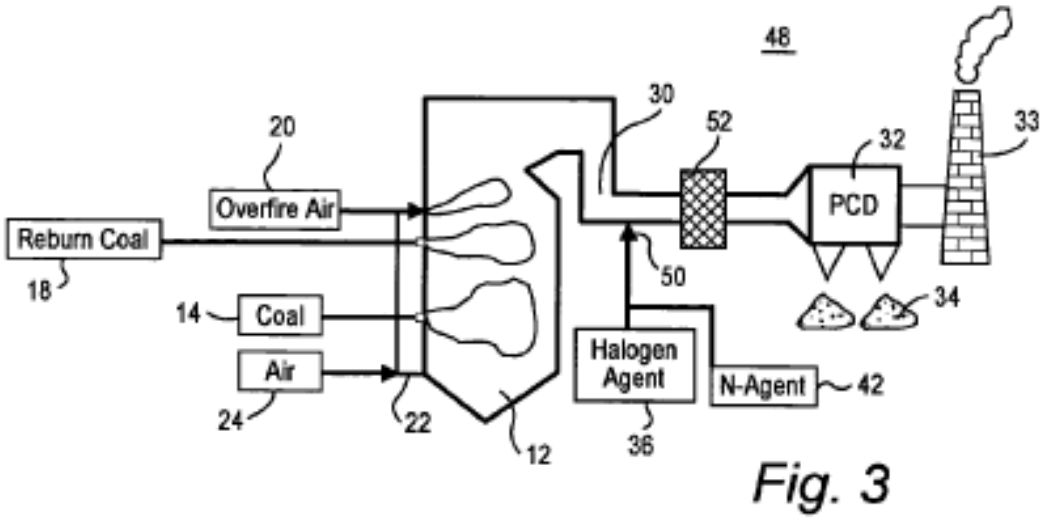



Fig. 3

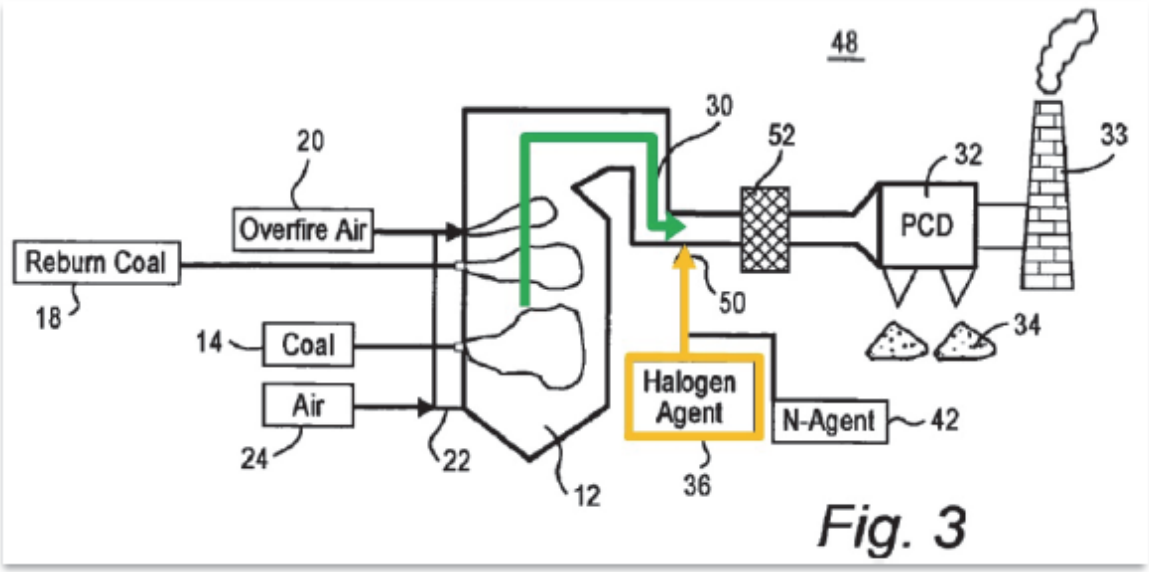
Figure 3 "is a schematic diagram of coal fired power plant . . . where the additive injector is in a conductive pass of the plant and the conductive pass also includes a Selective Catalytic Reduction ('SCR') unit." *Id.* at 2:61–64. Figure 3 illustrates halogen containing additive 36 injected via nozzles 50 into conductive pass 30 of the boiler and upstream of SCR unit 52 and particulate control device ("PCD") 32. *Id.* at 4:1–5, 4:43–59.

Lissianski discloses that "[m]odeling predicts that injection of chlorine or bromine in the amount of 3 ppm results in mercury oxidation at

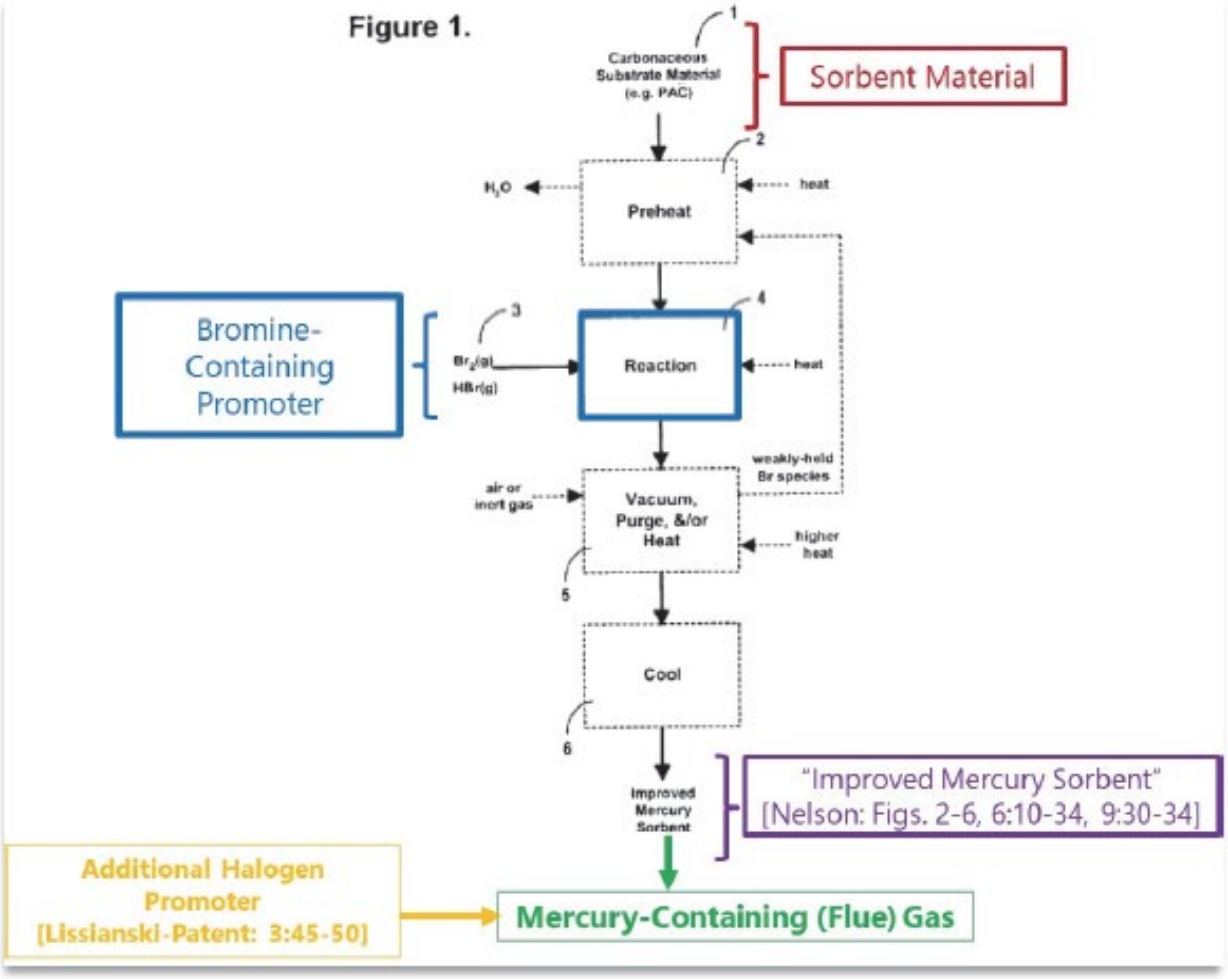
higher temperatures. Modeling also predicts that bromine is a more effective oxidizing agent than is chlorine." *Id.* at 6:53–65, Figure 9.

*2. Analysis of Claim 17*

Petitioner contends that Nelson and Olson-Paper disclose the steps and limitations of claim 1, from which claim 17 depends as outlined above (*supra* Section II.F.3). *See* Pet. 59. Petitioner argues that Lissianski "discloses supplying $NH_4Br$ directly into mercury-containing gas, which thermally decomposes to form HBr and provides the mercury-containing gas (green) with a gas-phase 'Br' concentration of 0.3 or 3 ppm," as illustrated in annotated Figure 3 below. *Id.* at 73 (citing Ex. 1035, 6:63–7:6; Ex. 1003 ¶¶ 408–409).




Petitioner contends a person of ordinary skill in the art would have combined Lissianski's promoter with Nelson's sorbent as illustrated in modified Nelson Figure 1 below. *Id.* at 73–74 (citing Ex. 1003 ¶ 410).




Petitioner's modified Figure 1 shows Nelson's improved mercury sorbent (purple) and the additional halogen promoter of Lissianski (yellow) separately fed into a mercury-containing flue gas (green). Petitioner contends that "[a]n 'in-flight' reaction occurs in mercury-containing gas between the HBr(g) of [Lissianski] and the pre-brominated (partially promoted) sorbent of Nelson." *Id.* at 75. Petitioner contends that "most of the Br-species supplied by [Lissianski] would have been available to react with the pre-brominated sorbent of Nelson (purple), as opposed to being consumed in oxidizing mercury." *Id.* (citing Ex. 1036, 6:33–40, 6:62–67; Ex. 1003 ¶ 412).

Petitioner contends a person of ordinary skill in the art would have been motivated "to combine Nelson and [Olson-Paper] with [Lissianski] to: (i) supply the pre-brominated sorbent of Nelson into mercury-containing flue gas; and (ii) supply the halogen agent of [Lissianski], upstream of the sorbent, into the same mercury-containing flue gas." *Id.* at 61 (citing Ex. 103 ¶¶ 382–391). Petitioner contends that "[c]ombining the pre-brominated sorbent of Nelson (purple) in mercury-containing gas (green) with additional halogen (gold) of [Lissianski] beneficially provides multi-pollutant control, enhancing removal of both NOx and mercury." *Id.* at 65 (citing Ex. 1003, ¶¶ 387–392).

Patent Owner does not dispute Petitioner's allegations regarding the teachings of Nelson, Olson-Paper, and Lissianski. *See generally* Prelim. Resp. Instead, Patent Owner contends that a person of ordinary skill in the art would not have combined Lissianski with Nelson. Prelim. Resp. 41. At this stage of the proceeding, Petitioner's arguments and evidence are sufficient to show that each limitation of claim 17 of the '471 patent is taught or suggested by the combination of Nelson, Olson-Paper, and Lissianski. Below we consider whether Petitioner has demonstrated sufficiently that a person of ordinary skill in the art would have had a reason to combine the teachings of Lissianski and Nelson.

Patent Owner contends that neither of Petitioner's reasons to combine the references, *viz.*, (1) improving mercury capture and (2) NOx reduction, would have motivated a person of ordinary skill in the art. *Id.* First, Patent Owner argues that Nelson teaches bromine species are corrosive and thus a person of ordinary skill in the art would not have added in-flight bromine to a mercury capture process. *See id.* at 6–7 (citing Ex. 2028, 1827–28), 41.

Second, Patent Owner argues that "[i]f a POSITA using Nelson were motivated to further improve NOx reduction, that could be accomplished in the conventional way by injecting $NH_3$. Petitioners offer no reason other than hindsight for a POSITA to inject $NH_4Br$ instead." *Id.* at 43.

On this record, we are persuaded Petitioner adequately sets forth a reason to combine the teachings of Lissianski and Nelson. Patent Owner's argument that Nelson teaches bromine species are corrosive and therefore, a person skilled in the art would not have had reason to make the proffered combination is unpersuasive. Both Nelson and Lissianski teach using bromine species to improve mercury removal processes. Ex. 1012, 6:4–19; Ex. 1036, 2:1–13, 4:35–45. Though Nelson describes mercury as corrosive, Nelson suggests lining equipment with corrosion-resistant material. Ex. 1012, 52–56. "The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained should be weighed against one another." *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000).

We are similarly unpersuaded by Patent Owner's hindsight argument. It is improper to base a conclusion of obviousness upon facts gleaned only through hindsight. "The invention must be viewed not after the blueprint has been drawn by the inventor, but as it would have been perceived in the state of the art that existed at the time the invention was made." *Sensonics, Inc. v. Aerosonic Corp.*, 81 F.3d 1566, 1570 (Fed. Cir. 1996) (citing *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)). Therefore, "to establish a *prima facie* case of obviousness based on a

combination of elements disclosed in the prior art, the [Petitioner] must articulate the basis on which it concludes that it would have been obvious to make the claimed invention." *Id.* Impermissible hindsight is inferred when the specific understanding or principle within the knowledge of one of ordinary skill in the art that would motivate one (with no knowledge of the claimed invention) to make the proposed combination has not been explained. *In re Rouffet*, 149 F.3d 1350, 1358 (Fed. Cir. 1998).

In weighing the evidence before us, Petitioner has provided sufficient reasoning with rational underpinnings to explain why one of ordinary skill in the art would have modified the teachings of the applied references. *See KSR*, 550 U.S. at 418. The modification proposed by Petitioner is supported, in part, on its contention that the skilled artisan would have had reason to combine Lissianski and Nelson in order to reduce NOx. Pet. 61–66 (citing Ex. 1003 ¶¶ 382–401). According to Petitioner, Nelson and Lissianski each describe using a selective catalytic reduction ("SCR") unit to reduce NOx emissions and improve particulate removal. Ex. 1012, 10:34–37; Ex. 1036, 4:44–59; Ex. 1003 ¶ 393–395. According to Lissianski, "[t]he injected additive [i.e., $NH_4Cl$, $NH_4Br$, or $NH_4I$] also reduces NOx emissions in a selective catalytic reduction (SCR) and/or (SNCR) process." Ex. 1036, 3:42–52. Accordingly, we find no evidence of hindsight reconstruction.

After considering the parties' arguments and evidence of record, we determine Petitioner has established a reasonable likelihood of prevailing on its obviousness challenge of claim 17 based on the combined teachings of Nelson, Olson-Paper, and Lissianski. Patent Owner does not separately address the additional limitations of claims 18–20. We have reviewed the information Petitioner provides, including the relevant portions of the Niksa

Declaration and Petitioner's arguments and determine that that Petitioner has established a reasonable likelihood of prevailing on its challenge with respect to these claims.

*I. Alleged Obviousness over Downs, Olson-Paper, and Lissianski*

Petitioner contends claims 17–20 are rendered obvious over the combination of Downs-Halogenation, Olson-Paper, and Lissianski. Pet. 105–121. Petitioner also relies on the testimony of Dr. Niksa to support its arguments. *Id.*

*1. Downs-Halogenation (Ex. 1015)*

Downs-Halogenation relates to a dynamic halogenation process for treating powdered activated carbon sorbents for removing mercury from flue gases. Ex. 1015 ¶ 19; *see also*, Ex. 1016 ¶ 22. Specifically, Downs-Halogenation discloses using bromine-containing compounds to enhance the capture of elemental mercury by carbonaceous sorbents. Ex. 1015 ¶ 10; *see also*, Ex. 1016 ¶ 12.[14]

Figure 2 illustrates a method for treating conventional powdered activate carbon sorbents with a halogen as reproduced below.

[14] Because Petitioner relies on the filing date of the Downs-Halogenation provisional (i.e., Provisional application no. 60/555,281, filed March 22, 2004 (Ex. 1016, "Downs provisional")) for establishing a prior art date under 35 U.S.C. § 102(e), Petitioner provides parallel citations to both Downs-Halogenation and the Downs provisional for written-description support.

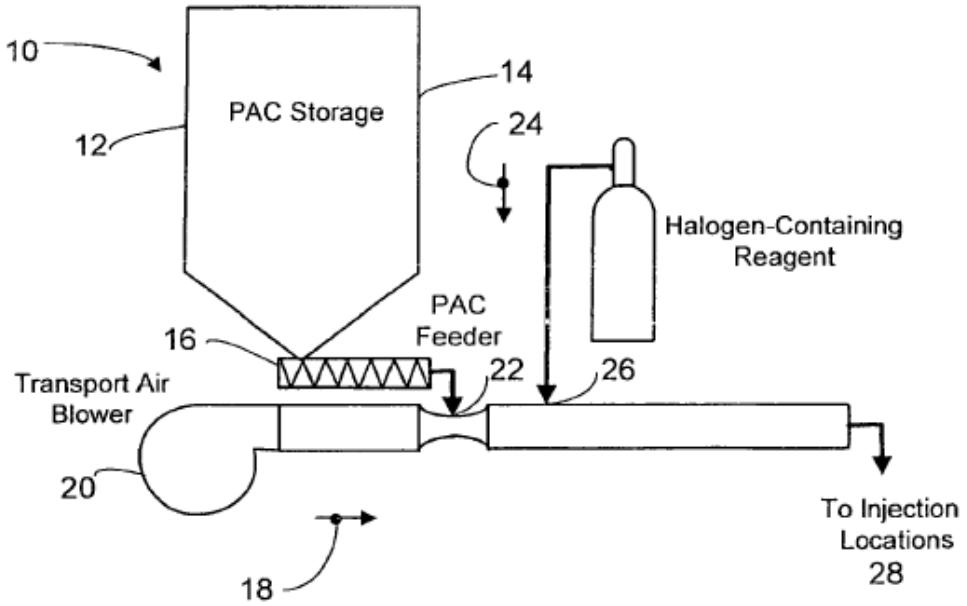



FIG. 2

Figure 2 is a schematic illustration of the Dynamic Halogenation process for treating sorbents for the removal of mercury from flue gases." Ex. 1015 ¶ 14. Figure 2 depicts sorbent storage tank 12 metered into sorbent transport air stream 18 and sorbent transport air blower 20 which supplies air for conveying sorbent 14 to injection locations 28. Ex. 1015 ¶ 19; *see also* Ex. 1016 ¶ 22. Downs-Halogenation discloses that gaseous halogen-containing reagent 24 is injected into the flowing transport air/sorbent stream. *Id*. Downs-Halogenation discloses that "[t]he adsorption of [] halogen-containing reagent 24 onto [] sorbent particles 14 occurs during the transport of this gas-solid mixture to [] point of injection 28" into the flue gas. Ex. 1015 ¶ 19; *see also* Ex. 1016 ¶¶ 22, 27.

Downs-Halogenation discloses that "halogen containing reagent 24, and a commercially-produced PAC were used as [] carbonaceous sorbent 14." Ex. 1015 ¶ 19; *see also* Ex. 1016 ¶ 26. Downs-Halogenation discloses that:

> 1) PAC injection, alone, at a similar injection rate provided no discernable mercury removal; 2) the use of hydrogen bromide was more effective than the use of hydrogen chloride; and 3) the rates of addition of both the hydrogen bromide and PAC were many times lower than the rates for other halogen addition processes and conventional PAC injection processes.

Ex. 1015 ¶ 23; *see also* Ex. 1016 ¶ 26.

*2. Analysis of Claim 17*

Although claim 1 is disclaimed, claim 17 depends from and includes the limitations of claim 1. Accordingly, we review Petitioner's contentions as to claim 1, followed by the limitations added by claim 17.

Petitioner contends that Downs-Halogenation discloses a method for separating mercury from a mercury containing gas by promoting activated carbon by chemically reacting powdered activated carbon with gaseous bromine (HBr or $Br_2$) to form a promoted brominated sorbent. *See* Pet. 87–90 (citing Ex. 1015 ¶¶ 4, 10, 19, 21. 23–24, 26–27; Ex. 1016 ¶¶ 4–5, 12, 22, 24, 26–27, 29–30; Ex. 1003 ¶¶ 443, 448–449).

Petitioner contends that Olson-Paper discloses the limitation that "wherein the activated carbon contains graphene sheets having carbene species edge sites which react with the bromine containing promoter to form a carbocation paired with a bromide anion in the promoted brominated sorbent for oxidation of the mercury." *Id.* at 90–93. Specifically, Petitioner contends that Olson-Paper discloses that powdered activated carbon contains graphene sheets having "a zig-zag *carbene site* on the *carbon edge*." *Id.* at 91 (citing Ex. 1079, 979, 982). Petitioner further contends that Olson-Paper discloses that the basic carbene "reacts with HCl *to form stable carbenium ion intermediates,* which are then active for binding $Hg^0$, accepting electrons from the atom (Figure 2)." *Id.* at 92 (quoting Ex. 1079, 982). Petitioner

contends that although Olson-Paper "identifies HCl and chloride anions ($Cl^-$), a POSITA would have applied the same mechanism for a bromine-containing promoter (e.g., HBr)," as taught by Downs-Halogenation. *Id.* at 93.

Petitioner contends that both Downs-Halogenation and Olson-Paper disclose the step of chemically reacting elemental mercury with the promoted brominated sorbent to form a mercury/sorbent composition, i.e., claim 1, step (b). *Id.* at 94 (citing Ex. 1015 ¶¶ 4, 6, 19–20; Ex. 1016 ¶¶ 5, 7, 22–26; Ex. 1079, 982; Ex. 1003 ¶¶ 462–463).

Petitioner contends Downs-Halogenation "discloses separating mercury/sorbent particulates from the mercury containing gas 'along with the fly ash,' using a 'particulate collector' such as an 'electrostatic precipitator (ESP) or fabric filter,'" i.e., claim 1, step (c). *Id.* at 95–96 (citing Ex. 1015 ¶¶ 3–4, 22, 29; Ex. 1016 ¶¶ 4–5, 25, 32; Ex. 1003 ¶¶ 465–467).

With respect to claim 17, Petitioner submits annotated Figure 2, illustrating the combined teachings of Downs-Halogenation and Lissianski. *Id.* at 110–113.

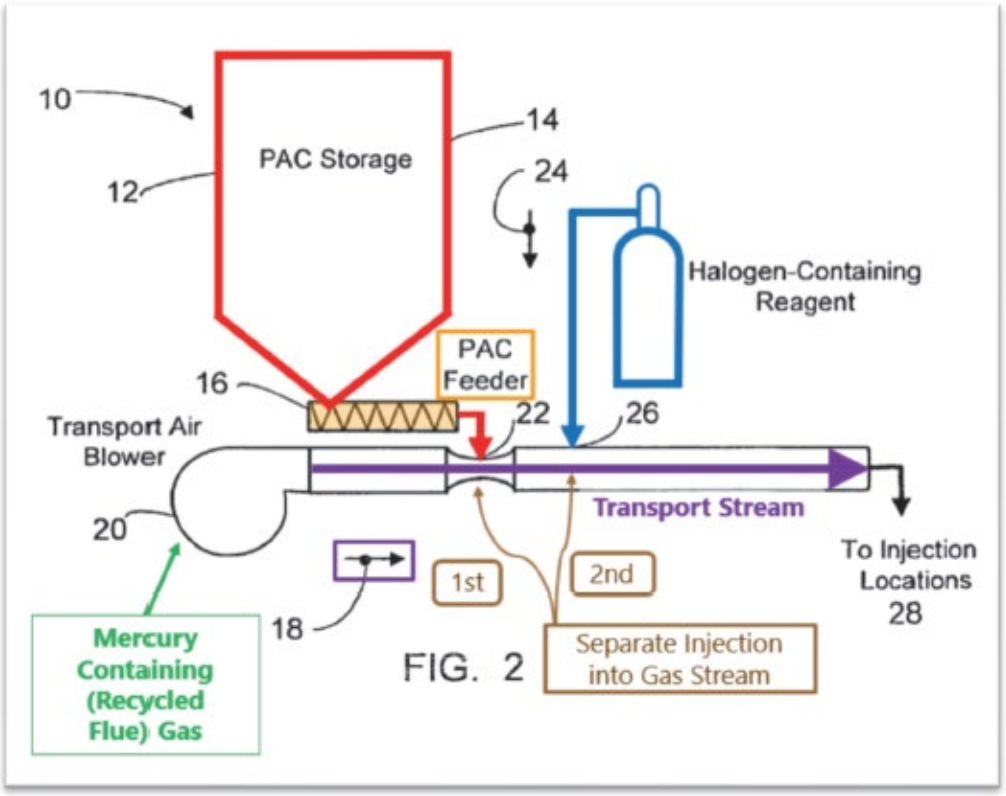



FIG. 2

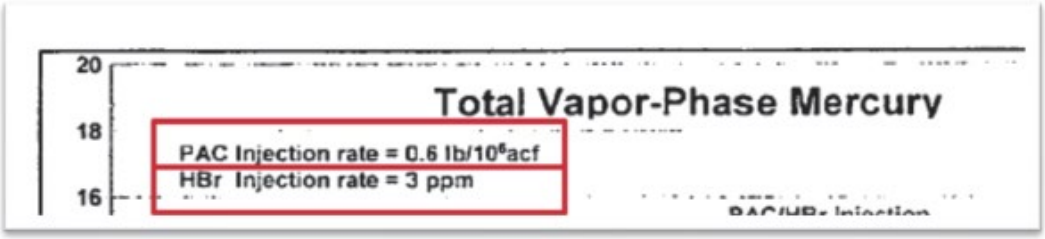
Petitioner contends Downs-Halogenation "describes separately injecting bromine-containing promoter (HBr, blue) and activated-carbon sorbent (red), with in-flight reaction occurring in a transport line (purple) to produce promoted-brominated sorbent." *Id.* at 105–106; *see also id.* at 111–112 (citing Ex. 1003 ¶¶ 504–506). Petitioner contends that a person of ordinary skill in the art would have been motivated to use Lissianski's "stream of recycled (mercury-containing) flue gas (below, green) as the medium in which activated-carbon sorbent and halogen-containing reagent undergo in-flight reaction in [Downs-Halogenation], and for carrying the promoted-brominated sorbent to injection location(s) 28 in the main flue gas duct." *Id.* at 107. Petitioner contends that "[t]he above in-flight reaction would occur regardless of whether the transport gas is air (as in [Downs-Halogenation]),

or the transport gas is a recycled flue gas (as in [Lissianski]). *Id.* at 112–113 (citing Ex. 1036, 4:20–23; Ex. 1003 ¶¶ 507–509).

As to the limitation of claim 17 that "the promoter is reacted in the gas phase or as a vapor," Petitioner contends that Downs-Halogenation "discloses gaseous HBr(g) and/or Br2(g) reacting with sorbent in the gas phase." *Id.* at 113 (citing Ex. 1003 ¶ 510).

Finally, Petitioner contends that the combination of Downs-Halogenation and Lissianski teaches adding the promoter "from about 1 to about 30 grams per 100 grams of the sorbent material." *Id.* at 113–116. As discussed above, Petitioner presents two potential interpretations the ratio of added promoter, either: (1) ratio of promoter added to the gas stream or (2) ratio of promoter added to the sorbent. *Id.* at 113.

Petitioner first addresses the ratio of added promoter to gas stream. *Id.* Petitioner contends Downs "describes a sorbent-injection rate of 0.6 lb/MMacf (pounds-per-million actual cubic feet of flue gas), and a bromine-promoter injection rate of 3 ppm (parts-per-million in flue gas)," as shown in annotated Figure 3, reproduced below. *Id.* (citing Ex. 1015, Figure 3; Ex. 1016, Figure 3; Ex. 1003 ¶¶ 88–90).




Downs-Halogenation Figure 3 lists PAC injection rate and HBr Injection rate based on total vapor-phase mercury. Ex. 1015 ¶ 15. Petitioner contends that Lissianski discloses concentrations of 3 ppm and 0.3 ppm bromine-promoter in flue gas provide "almost the same effect," and therefore

"expressly motivates" a lower promoter rate. *Id.* at 114–115 (citing Ex. 1036, 6:62–67; Ex. 1003 ¶ 512). Petitioner contends that "[t]he promoter rate of Lissianski-Patent (0.3 ppm) corresponds to 19.55 g/MMacf, and the sorbent rate of Downs-Halogenation (0.6 lb/MMacf) corresponds to 272 g/MMacf. Accordingly, there is a gas-phase ratio of 7.19 grams of bromine-containing promoter per 100 grams of sorbent, which is within the range of claim 17." *Id.* at 115 (citing Ex. 1003 ¶¶ 84, 88–90, 513–516).

Second, Petitioner addresses the ratio of added promoter to sorbent. *Id.* at 115–116. Petitioner contends "a gas-phase ratio of 7.19 grams bromine per 100 grams sorbent also leads to a disclosure that the 'promoter is added [to the sorbent] at from about 1 to about 30 grams per 100 grams of the sorbent material.'" *Id.* at 115 (citing Ex. 1003 ¶ 517). Petitioner further contends that "[i]t would have been well within the purview of a [person of ordinary skill in the art] to adjust promoter and sorbent-injection rates, as needed, to achieve desired mercury removal." *Id.* at 116 (citing Ex. 1003 ¶ 518).

Petitioner contends that a person of ordinary skill in the art "would have had a reasonable expectation of success in using recycled flue gas as the medium for in-flight reaction between sorbent and promoter and subsequent transport, because Downs-Halogenation teaches flexibility in gases used in the transport line (purple)." *Id.* at 108–109 (citing Ex. 1015 ¶ 19; Ex. 1016 ¶ 22; Ex. 1003 ¶ 498; Ex. 1036, 4:420–23). Furthermore, Petitioner contends that Downs-Halogenation, Lissianski, and Olson-Paper are all from the same field of endeavor and thus would have been combined by a person of ordinary skill in the art. *Id.* at 109 (citing Ex. 1003 ¶¶ 499–502).

Patent Owner, at this time does not challenge Petitioner's allegations regarding the teachings of Downs-Halogenation, combined with Olson-Paper and Lissianski. *See generally* Prelim. Resp. Instead, Patent Owner argues that Downs-Halogenation, as well as the other asserted references, is not prior art, based on its contention that the '147 patent is entitled to an earlier date of invention based on conception and reduction to practice as early as May 6, 2003. Prelim. Resp. 20. On this record, Petitioner's arguments and evidence are sufficient to show that each limitation of claim 17 of the '471 patent is taught or suggested by the combination of Downs-Halogenation, Olson-Paper, and Lissianski. Because we determined above (*supra* Section II.E.) that the '147 patent was not entitled to an earlier date of invention, we determine that Petitioner has established a reasonable likelihood of prevailing on its challenge to claim 17 as obvious over the combination of Downs and Olson-Paper. Patent Owner does not separately address the additional limitations of claims 18–20. We have reviewed the information Petitioner provides, including the relevant portions of the Niksa Declaration and Petitioner's arguments and determine that that Petitioner has established a reasonable likelihood of prevailing on its challenge with respect to these claims.

## III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one challenged claim of the '147 patent. Thus, we institute an *inter partes* review on all challenged claims and on all grounds presented.

## IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* review is instituted on each of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this decision.

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