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BOARD AND PARTIES ONLY

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAKER HUGHES, a GE COMPANY, LLC
(f/k/a BAKER HUGHES INCORPORATED),¹
Petitioner,

v.

LIQUIDPOWER SPECIALTY PRODUCTS INC.
(f/k/a/ LUBRIZOL SPECIALTY PRODUCTS, INC.),
Patent Owner.

Case IPR2016-01901
Patent 8,450,249 B2

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and
MICHELLE N. ANKENBRAND, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION

Holding Claims 1–5 Unpatentable
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

Dismissing Patent Owner’s Motion to Exclude
37 C.F.R. § 42.64(c)

Denying Without Prejudice Petitioner’s and Patent Owner’s Motions to Seal
37 C.F.R. § 42.54

¹ Petitioner represents that its name has changed from Baker Hughes Incorporated to Baker Hughes, a GE Company, LLC. Paper 20, 2. Accordingly, we modify the case caption to reflect that change.

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I. INTRODUCTION

Baker Hughes, a GE Company, LLC (f/k/a Baker Hughes Incorporated) (“Petitioner”) requested an *inter partes* review of claims 1–5 of U.S. Patent No. 8,450,249 B2 (“the ’249 patent,” Ex. 1003). Paper 2 (“Pet.”). LiquidPower Specialty Products Inc. (f/k/a/ Lubrizol Specialty Products, Inc.) (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). We instituted an *inter partes* review of claims 1–5 on certain grounds of unpatentability alleged in the Petition. Paper 10 (“Dec.”).

After institution of trial, Patent Owner filed a Patent Owner Response. Paper 19 (“PO Resp.” (public version)). Petitioner filed a Reply. Paper 31 (“Reply” (public version)). Patent Owner, with Board authorization, filed a Sur-Reply. Paper 40 (“Sur-Reply” (public version)). An oral hearing was held on December 4, 2017. A transcript of the hearing is included in the record. Paper 63 (“Tr.” (public version)).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has established by a preponderance of the evidence that claims 1–5 of the ’249 patent are unpatentable.

A. *Related Proceedings*

Petitioner identifies the following pending litigation involving the ’249 patent: *Lubrizol Specialty Products, Inc. v. Baker Hughes Inc.*, No. 4:15-cv-02915 (S.D. Tex.). Pet. 2; Paper 20, 3. Petitioner also identifies U.S. Patent Application No. 13/209,119, filed on August 12, 2011, as pending, and represents that the ’119 application claims benefit to, and is a continuation in part of, U.S. Patent Application No. 11/615,539 (now U.S.

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Patent No. 8,022,118, “the ’118 patent”) to which the ’249 patent claims priority. Pet. 3.

Petitioner identifies two additional instituted *inter partes* review proceedings involving Petitioner’s challenges to patents related to the ’249 patent: IPR2016-01903 (challenging U.S. Patent No. 8,426,498 B2), and IPR2016-01905 (challenging U.S. Patent No. 8,450,250 B2). *See* Pet. 2; Paper 8, 3. Petitioner also filed an earlier Petition requesting an *inter partes* review of the ’118 patent. *Baker Hughes Inc. v. Lubrizol Specialty Prods., Inc.*, Case IPR2016-00734 (“734 IPR”), Paper 2. We issued a final written decision in the 734 IPR on October 1, 2017. 734 IPR, Paper 79; Paper 85 (public version).

B. The ’249 Patent

The ’249 patent, titled “Drag Reduction of Asphaltenic Crude Oils,” issued on May 28, 2013. Ex. 1003, at [54], [45]. The ’249 patent relates to a “method of introducing a drag reducing polymer into a pipeline such that the friction loss associated with the turbulent flow though [sic] the pipeline is reduced by suppressing the growth of turbulent eddies,” in which the “drag reducing polymer is introduced into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon.” *Id.* at [57].

According to the specification, “[w]hen fluids are transported by a pipeline, there is typically a drop in fluid pressure due to the friction between the wall of the pipeline and the fluid.” *Id.* at 1:20–22. The pressure drop increases with increasing flow rate, resulting in energy losses and inefficiencies that increase equipment and operation costs. *Id.* at 1:24–32.

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The problems associated with pressure drop are most acute when fluids are transported over long distances. *Id.* at 1:29–31.

Before the '249 patent, it was known to use drag reducing polymers in the fluid flowing through a pipeline to alleviate the problems resulting from pressure drop. *Id.* at 1:33–35. A drag reducing polymer “is a composition capable of substantially reducing friction loss associated with the turbulent flow of a fluid through a pipeline,” and such a composition works by “suppress[ing] the growth of turbulent eddies, which results in higher flow rate at a constant pumping pressure.” *Id.* at 1:37–42. Drag reduction generally “depends in part upon the molecular weight of the polymer additive and its ability to dissolve in the hydrocarbon under turbulent flow.” *Id.* at 1:44–46.

According to the specification, because conventional drag reducing polymers do not perform well in crude oils having a low API gravity² and/or a high asphaltene content, there exists a need for “improved drag reducing agents capable of reducing the pressure drop associated with the turbulent flow of low API gravity and/or high-asphaltene crude oils through pipelines.” *Id.* at 1:49–54. The subject matter of the disclosed invention, therefore, “relates generally to high molecular weight drag reducers for use in crude oils.” *Id.* at 1:15–16. More specifically, the '249 patent discloses a method for reducing the pressure drop associated with flowing a liquid hydrocarbon through a conduit, such as a pipeline. *Id.* at 2:48–50. The method comprises introducing a drag reducing polymer into a liquid

² The specification defines API gravity as “the specific gravity scale developed by the American Petroleum Institute for measuring the relative density of various petroleum liquids.” *Id.* at 3:50–54.

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hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to produce a treated liquid hydrocarbon wherein the viscosity is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer. *Id.* at 18:62–19:5.

The '249 patent provides several examples of suitable heavy crude oils and blended heavy crude oils. *Id.* at 4:25–34, Table 1.

The specification further explains that, “[i]n order for the drag reducing polymer to function as a drag reducer, the polymer should dissolve or be substantially solvated in the liquid hydrocarbon.” *Id.* at 11:16–18.

The liquid hydrocarbon and the drag reducing polymer, therefore, have solubility parameters that can be determined according to known methods. *Id.* at 4:9–21 (setting forth known methods for determining the solubility parameter of the liquid hydrocarbon), 11:26–64 (setting forth known methods for determining the solubility parameter of the drag reducing polymer).

C. *Illustrative Claim*

Claims 1, 4, and 5 are independent claims of the '249 patent. Claim 1 is illustrative of the challenged claims and recites:

1. A method comprising:
introducing a drag reducing polymer, into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies, into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid

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hydrocarbon prior to treatment with the drag reducing polymer;

wherein the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw and

wherein a plurality of the repeating units comprise a heteroatom.

Ex. 1003, 18:62–19:10.

D. Instituted Grounds of Unpatentability

We instituted an *inter partes* review of claims 1–5 of the '249 patent on two grounds. Dec. 27.

Reference(s)	Statutory Basis	Claim Challenged
Holtmyer Publication, ³ Holtmyer Patent, ⁴ and Carnahan ⁵	§ 103(a)	1–5
Inaoka ⁶ and Carnahan	§ 103(a)	1–5

Petitioner relies on the declarations of Thomas H. Epps, III, Ph.D. (Ex. 1041; Ex. 1115 (public version)). Patent Owner relies on the declaration of Brian Dunn, Ph.D. (Ex. 2141 (public version)).

³ Marlin D. Holtmyer & Jiten Chatterji, *Study of Oil Soluble Polymers as Drag Reducers*, 20 POLYMER ENG'G & SCI. 7, 473–77 (1980) (“Holtmyer Publication”) (Ex. 1005).

⁴ U.S. Patent No. 3,758,406, issued September 11, 1973 (“Holtmyer Patent”) (Ex. 1006).

⁵ Norman F. Carnahan, *Precipitation of Asphaltenes in Heavy Oil and Tar Sands*, in 40B DEV. IN PETROLEUM SCI., ASPHALTENES AND ASPHALTS, 2 319–33 (Teh Fu Yen & George V. Chilingarian eds., 2000) (“Carnahan”) (Ex. 1008).

⁶ European Pat. App. No. EP 0,882,739 A2, published December 9, 1998 (“Inaoka”) (Ex. 1007).

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II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable constructions in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under the broadest reasonable construction standard, claim terms are presumed to have their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Only those terms which are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner submits that we need not construe any claim term for purposes of this decision. Pet. 14. Patent Owner does not appear to propose any claim constructions in its Response. We determine that no claim terms require construction.

B. Level of Ordinary Skill in the Art

Petitioner proposes a detailed definition of one of ordinary skill in the art. Pet. 11–13 (citing Ex. 1041 ¶¶ 18–20, 22, 42). Patent Owner does not, in its Response, appear to dispute this definition. In light of the evidence before us, we adopt Petitioner’s definition of one of ordinary skill in the art.

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We also find that Petitioner’s proposed level of skill in the art is reflected by the references themselves. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“the absence of specific findings on the level of skill in the art does not give rise to reversible error ‘where the prior art itself reflects an appropriate level and a need for testimony is not shown.’”); *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (finding that the Board of Patent Appeals and Interferences did not err in concluding that the level of ordinary skill in the art was best determined by the references of record).

C. Overview of the Asserted References

1. Holtmyer Publication

The Holtmyer Publication, titled “Study of Oil Soluble Polymers as Drag Reducers,” was published in 1980. Ex. 1005, 473. The Holtmyer Publication is directed to an investigation “undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines.” *Id.* at Abstract. A decrease in friction loss “would allow lower energy consumption or alternatively an increased flow rate under the original pumping conditions,” making a decrease in friction loss “desirable” and “economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells.” *Id.* at 473. Among the polymers for drag reduction synthesized and described by the Holtmyer Publication is poly(isodecyl

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methacrylate) (“iDMA”), which was tested for drag reduction in kerosene, QC-1156, Cardium, and Ellenberger. *Id.* at 476, Table 9.

2. *Holtmyer Patent*

The Holtmyer Patent, titled “Methods and Compositions for Reducing Frictional Pressure Loss in the Flow of Hydrocarbon Liquids,” issued in 1973. Ex. 1006. The Holtmyer Patent relates to “methods and compositions for reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit.” *Id.* at 1:15–18. Regarding frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids, the Holtmyer Patent provides that “considerable energy generally in the form of pumping horsepower must be expended” in order to compensate for such pressure loss and, thus, “reduction of the frictional pressure loss in the flow of such hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” *Id.* at 1:56–65. The Holtmyer Patent provides examples of “suitable monomers which may be utilized to form the polymer additives of the present invention.” *Id.* at 3:3–20. When using the polymer additive “with a well-treating fluid containing sand or other solid agent suspended therein,” the Holtmyer Patent states that “it is preferable to use a somewhat larger amount of the polymer additive.” *Id.* at 4:63–67.

3. *Inaoka*

Inaoka, titled “High Molecular Weight Polymer and Producing Method the Same and Drag Reducer,” relates to a method of producing a high molecular weight polymer in which “dissolved oxygen existing in a solvent in a radical polymerization reaction is removed, and to a high

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molecular weight polymer obtained by the same, and to a drag reducer.”
Ex. 1007, 2:5–7. Inaoka describes, generally, the problems with transporting “an organic liquid such as crude oil” through a pipeline, caused by “the fact that transporting pressure on the liquid is lost by the friction generated between the liquid and the conduit.” *Id.* at 3:9–11. To suppress such pressure loss, Inaoka states that “a drag reducer has been used conventionally,” and the drag reducer includes a high molecular weight polymer. *Id.* at 3:14–15. Regarding production of such polymers, Inaoka states that “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent] is known.” *Id.* at 3:27. Regarding specific polymer additives, Inaoka states that “2-ethylhexylacrylate (2EHA (carbon number of 8)) and 2-ethylhexylmethacrylate (2EHMA (carbon number of 8)) are particularly preferable.” *Id.* at 4:48–50.

4. *Carnahan*

Carnahan, titled “Precipitation of Asphaltenes in Heavy Oil and Tar Sands,” is a chapter of a textbook titled “Asphaltenes and Asphalts, 2.”
Ex. 1008. Carnahan discloses solubility parameters of asphaltenes and of petroleum fluids, particularly, that the expected value of the solubility of heavy petroleum fluids is about 8–10 hildebrands (wherein 10 hildebrands is equivalent to 20.5 MPa^{1/2}). *Id.* at 325. Carnahan also discloses that the solubility parameter of certain asphaltenes is about 20.5 MPa^{1/2}. *Id.* at 324.

D. *Analysis*

A patent 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 to a person of ordinary skill in the art at the time the invention was made. *KSR*

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Int'l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007). Obviousness is resolved based on 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, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must demonstrate obviousness by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d); *see also 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”)). A party that petitions the Board for a determination of obviousness must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 408 F.3d 1348, 1361 (Fed. Cir. 2007)). We analyze both parties’ arguments, below, in accordance with the above-stated principles.

1. Petitioner’s Ground 1—Asserted Obviousness Based on the Holtmyer Publication, the Holtmyer Patent, and Carnahan

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of the Holtmyer Publication,

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the Holtmyer Patent, and Carnahan, to a method comprising all of the elements recited in claims 1–5. Pet. 20–33, 46–51.

Petitioner argues that the “Holtmyer Publication discloses most of the limitations of claim 1.” *Id.* at 21. In the section of the Petition summarizing the Holtmyer Publication, Petitioner characterizes the Holtmyer Publication as describing an investigation “to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines” and as describing “the problem of frictional pressure losses associated with the turbulent flow of a fluid through a conduit.” *Id.* at 14–15 (citing Ex. 1005, 473, Abstract). Petitioner further notes that the Holtmyer Publication describes the drag reducing properties of “a series of homo- and copolymers of alkyl styrenes, acrylates, and methacrylates in hydrocarbon solvents.” *Id.* at 15 (citing Ex. 1005, 473, 474, Table 1). Specifically, Petitioner focuses on the Holtmyer Publication’s preparation and testing of iDMA, which test results are presented in Table 9 of the Holtmyer Publication. *Id.* at 15–16 (citing Ex. 1005, Table 9). The test results demonstrate iDMA’s drag reduction in kerosene, in two types of crude oil (Cardium and Ellenberger), and in QC-1156 (primarily an aromatic hydrocarbon with an API gravity of 22.5°). *Id.* at 16 (citing Ex. 1005, Table 9).

Petitioner relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have known that a plurality of the repeating units of the iDMA polymer comprise oxygen heteroatoms.” *Id.* at 21–22 (citing Ex. 1041 ¶ 57). Petitioner further relies on Dr. Epps’s testimony that a person of ordinary skill in the art would have understood that introduction of the iDMA polymer into a liquid hydrocarbon would reduce “friction loss

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associated with the turbulent flow through the pipeline . . . by suppressing the growth of turbulent eddies” as recited in claim 1. *Id.* at 22 (citing Ex. 1041 ¶ 71). Regarding the claim 1 requirement that “the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer,” Petitioner relies on Dr. Epps’s testimony that adding the iDMA drag reducing polymer of the Holtmyer Publication to a liquid hydrocarbon would achieve this effect. *Id.* at 23 (citing Ex. 1041 ¶¶ 76–77). Finally, Petitioner relies on Dr. Epps’s testimony that the Holtmyer Publication would have directed a person of ordinary skill in the art to add iDMA to a liquid hydrocarbon, such as that defined by the claims of the ’249 patent, “at a concentration within the ‘about 0.1 ppmw to about 500 ppmw’ range recited by claim 1,” specifically, at a concentration of about 300 ppm. *Id.* at 23–24 (citing Ex. 1041 ¶¶ 72–75; Ex. 1005, Table 6).

Petitioner posits that the “only limitation of claim 1 that the Holtmyer Publication does not disclose explicitly is the introduction of the iDMA drag reducing polymer into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent,” (*id.* at 24) but argues that (i) crude oils having the claimed properties were well known, as acknowledged in the ’249 patent itself and other contemporaneous publications (*id.* at 25 (citing Ex. 1003, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been prompted by the known economic benefits associated with drag reduction to introduce the iDMA polymer into a crude oil having the claimed properties (*id.* at 25–27 (citing Ex. 1005, 473; Ex. 1041 ¶¶ 90–92)); and (iii) one of ordinary skill would have had a reasonable expectation that

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the iDMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 27–33 (citing Ex. 1041 ¶¶ 94–111)).

Regarding asphaltene, Petitioner argues the Holtmyer Patent addresses the effect of asphaltene content on the ability of the iDMA polymer to achieve drag reduction, relying on Dr. Epps’s testimony that “the optimum quantity of polymer to be introduced to a hydrocarbon liquid may vary depending on the type of liquid hydrocarbon involved” and that “when a solid agent is suspended in the liquid hydrocarbon, it is preferable to use a somewhat larger amount of the polymer additive,” such as between about 160 ppm and 1600 ppm. *Id.* at 27–28 (citing Ex. 1041 ¶ 97 (citing Ex. 1006, 4:51–59, 4:63–75)). Regarding solubility, Petitioner argues that solubility parameters “were (and are) commonly consulted in order to predict solubility of one compound in another.” *Id.* at 29 (citing Ex. 1041 ¶ 100). Petitioner relies on Carnahan (Ex. 1008, 325) and Dr. Epps’s calculations of the solubility parameters of heavy, asphaltenic crude oils (“within the range between about $16.4 \text{ MPa}^{1/2}$ and $20.5 \text{ MPa}^{1/2}$,” Ex. 1041 ¶ 107) and the iDMA polymer (“about $17.84 \text{ MPa}^{1/2}$,” Ex. 1041 ¶¶ 101–03) to argue that because the solubility parameter of the iDMA polymer falls squarely within the range disclosed by Carnahan, a person of ordinary skill in the art “would have had a reasonable expectation that the iDMA drag reducing polymer would be effective at achieving drag reduction in a liquid hydrocarbon having an API gravity less than about 26° and an asphaltene content of at least 3 weight percent undergoing turbulent flow through a pipeline.” Pet. 33 (citing Ex. 1041 ¶ 111).

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2. *Petitioner's Ground 2—Asserted Obviousness Based on Inaoka and Carnahan*

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of Inaoka and Carnahan to a method comprising all of the elements recited in claims 1–5. Pet. 33–44, 46–51.

Petitioner argues that “Inaoka discloses most of the limitations of claim 1.” *Id.* at 34. In the section of the Petition summarizing Inaoka, Petitioner characterizes Inaoka as describing a high molecular weight polymer having a straight-chain structure with less branching, being soluble in an organic solvent, and “suitably adopted as a drag reducer.” *Id.* at 17 (quoting Ex. 1007, Abstract). Petitioner further characterizes Inaoka as describing the problem of frictional pressure losses associated with the turbulent flow of fluid through a conduit and the conventional use of drag reducers to address the problem of pressure loss. *Id.* at 17–18 (quoting Ex. 1007, 3:9–13, 3:14–21). Petitioner notes that Inaoka refers to drag reducing polymers that may be produced by “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent].” *Id.* at 18 (quoting Ex. 1007, 3:27). Inaoka’s drag reducing polymer “can be suitably adopted in transporting of an organic liquid such as crude oil through a conduit, such as a pipeline.” *Id.* at 19 (quoting Ex. 1007, 17:1–5). Inaoka’s two “particularly preferable” drag reducing polymers are 2-ethylhexylacrylate (“2EHA”) and 2-ethylhexylmethacrylate (“2EHMA”); the latter, according to Dr. Epps, is the same as Polymer A of the ’249 patent. *Id.* at 19–20 (citing Ex. 1007, 4:48–50; Ex. 1041 ¶ 155).

Petitioner relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have known that a plurality of the repeating units of the

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2EHMA polymer comprise oxygen heteroatoms.” *Id.* at 34–35 (citing Ex. 1041 ¶ 156). Petitioner further relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have understood that introducing the 2EHMA polymer into crude oil flowing through a pipeline would reduce drag by suppressing the growth of turbulent eddies” as recited in claim 1. *Id.* at 35–36 (citing Ex. 1041 ¶ 167). Regarding the claim 1 requirement that “the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer,” Petitioner relies on Dr. Epps’s testimony that adding the 2EHMA drag reducing polymer of Inaoka to a liquid hydrocarbon would achieve this effect. *Id.* at 36 (citing Ex. 1041 ¶¶ 169–171). Finally, Petitioner relies on Dr. Epps’s testimony that Inaoka would have directed a person of ordinary skill in the art to add 2EHMA to a liquid hydrocarbon “at a concentration within the ‘about 0.1 ppmw to about 500 ppmw’ range recited by claim 1,” preferably in a range of 0.1 ppm to 100 ppm.” *Id.* at 37 (citing Ex. 1041 ¶ 168; Ex. 1007, 8:18–20).

Petitioner argues that although “Inaoka does not disclose introducing the 2EHMA drag reducing polymer into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26°, it would have been obvious to a person of ordinary skill in the art to do so.” *Id.* at 37. Petitioner argues that (i) crude oils having the claimed properties were well known, as acknowledged in the ’249 patent itself (*id.* at 38 (citing Ex. 1003, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been prompted by the known economic benefits associated with drag reduction to introduce the 2EHMA polymer into a crude oil having the claimed properties (*id.* at 38–39 (citing Ex. 1041 ¶¶ 174–76));

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and (iii) one of ordinary skill would have had a reasonable expectation that the 2EHMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 39–43 (citing Ex. 1041 ¶¶ 178–191)).

Regarding solubility, Petitioner argues that solubility parameters “were (and are) commonly consulted in order to predict solubility of one compound in another.” *Id.* at 41 (citing Ex. 1041 ¶ 180). Petitioner relies on Carnahan (Ex. 1008, 325) and Dr. Epps’s calculations of the solubility parameters of heavy, asphaltenic crude oils (“within the range between about 16.4 MPa^{1/2} and 20.5 MPa^{1/2},” Ex. 1041 ¶ 187) and the 2EHMA polymer (“about 18.04 MPa^{1/2},” Ex. 1041 ¶¶ 181–183) to argue that, because the solubility parameter of the 2EHMA polymer falls squarely within the range disclosed by Carnahan, a person of ordinary skill in the art would have had a reasonable expectation that the 2EHMA drag reducing polymer of Inaoka “would be effective at achieving drag reduction in a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° undergoing turbulent flow through a pipeline.” Pet. 44 (citing Ex. 1041 ¶ 191).

3. *Additional Claims*

Petitioner presents arguments directed to both grounds regarding the additional limitations of claims 2–5. Pet. 46–51. Petitioner argues that a person of ordinary skill in the art “would have understood that the iDMA homopolymer of Holtmyer and the 2EHMA polymer of Inaoka each has well above 25,000 repeating units,” a limitation found in claims 2 and 5. Pet. 46, 50 (relying on Ex. 1041 ¶¶ 64–67, 162–165). Petitioner also argues that a person of ordinary skill in the art would have understood “that the iDMA homopolymer of Holtmyer has a[n] average molecular weight of at

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least 1×10^6 g/mol,” and “that the polymers disclosed by Inaoka as being preferred for drag reduction have molecular weights well above ‘at least 1×10^6 g/mol’,” a limitation found in claims 3 and 5. *Id.* at 47–48, 50 (relying on Ex. 1041 ¶¶ 61–63, 157–161). Regarding the claim 4 limitation that the type of heteroatom be selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a phosphorus atom, Petitioner argues that the iDMA polymer disclosed by Holtmyer and the 2EHMA homopolymer disclosed by Inaoka contain oxygen heteroatoms, as previously argued in connection with claim 1. Pet. 49 (relying on Ex. 1041 ¶¶ 57, 156). Patent Owner does not appear to separately dispute Petitioner’s arguments regarding these additional limitations.

Having reviewed both of Petitioner’s grounds, and the evidence in support thereof, we find that the evidence of record supports Petitioner’s arguments, and we adopt those arguments as to these grounds. Next, we consider Patent Owner’s arguments and evidence in the manner in which they were presented.

4. Patent Owner’s Arguments

a. Heavy, Asphaltenic Liquid Hydrocarbon

Patent Owner argues that neither the Holtmyer Publication nor Inaoka discloses, teaches, or suggests the claimed heavy, asphaltenic liquid hydrocarbon. PO Resp. 5–7. Rather, Patent Owner argues, the Holtmyer Publication discloses only processed solvents and light crudes, and Inaoka treats only kerosene and xylene. *Id.* at 5–6.

Petitioner replies that the claimed “liquid hydrocarbon” was well-known, and moreover, “that Holtmyer and Inaoka do not explicitly disclose the claimed liquid hydrocarbon is irrelevant because Petitioner hasn’t

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asserted that the claimed liquid hydrocarbon was disclosed by either reference.” Reply 10, 12. Rather, Petitioner argues, “each of Holtmyer and Inaoka discloses the use of DRAs *in crude oil generally*,” (citing Pet. 24–25, 37–38) and one of ordinary skill in the art would not have understood “the term ‘crude oil’ in Holtmyer and Inaoka to *exclude* heavy crude oil.” *Id.* at 10.

We are persuaded by Petitioner’s arguments on this point. As a preliminary matter, because only obviousness grounds are at issue in this case, an argument that a particular reference does not individually disclose the exact limitation within its four corners is inapposite. Additionally, although the Holtmyer Publication and Inaoka do not specifically discuss the particular liquid hydrocarbon of the claims, “crude oil” is discussed generally. Ex. 1005, 473; Ex. 1007, 3, 4, 8. In the prosecution history of the parent application, of which the ’249 patent is a continuation, applicant represented: “Broadly speaking, the genus of crude oil can be broken down to three different broad species of heavy, medium and light crude oil.” Ex. 1022 (Response to Final Office Action), 8. The specification of the ’249 patent provides that the “present invention relates generally to high molecular weight drag reducers for use in crude oils,” indicating that heavy, asphaltenic crude oils, as identified in the claims, are not excluded from the category of crude oils. Ex. 1003, 1:15–16. The title of the ’249 patent is “Drag Reduction of Asphaltenic Crude Oils,” which identifies “asphaltenic” as a characteristic of certain crude oils. *Id.* at [54]. Heavy crude oil is defined as containing asphaltenes. Ex. 1062, 3; *see also* Ex. 2028 (indicating that both light crude and heavy crude contain asphaltenes). In the prosecution history, applicant further represented that the “specific

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characteristics of applicant’s liquid hydrocarbon are defined by one of ordinary skill in the art as ‘heavy crude oil’ or ‘heavy crude.’” Tr. 30:17–31:5; Ex. 1022, 8. Given this matrix of evidence, we are not apprised of any persuasive reason, notwithstanding Patent Owner’s arguments to the contrary, that the general category of “crude oil” referred to in the Holtmyer Publication and Inaoka would exclude the claimed liquid hydrocarbon.

b. Patent Owner’s Argument that Grounds 1 and 2 Fail Because There Would Have Been No Basis To Modify The Holtmyer Publication Or Inaoka To Add The Claimed Heavy, Asphaltenic “Liquid Hydrocarbon”

Patent Owner argues that there would have been no basis to modify the Holtmyer Publication or Inaoka to add the claimed heavy, asphaltenic “liquid hydrocarbon.” PO Resp. 7–19.

i. Economic Benefits

First, Patent Owner argues that Petitioner’s “well-known economic benefits” rationale is flawed. *Id.* at 7–12, 16–18. In this regard, Patent Owner criticizes Dr. Epps’s testimony regarding the benefits of drag reduction based on the Holtmyer references⁷ as being “conclusory” and “problematic.” *Id.* at 9–12. Patent Owner also criticizes Dr. Epps’s testimony regarding the Holtmyer Patent and its references to suspended solid materials, which Patent Owner asserts only refer to proppants, not asphaltenes. *Id.* at 12–14.

Regarding Patent Owner’s “economic motivation” argument, Petitioner replies that the parties agree that reducing drag was known to reduce the cost of transporting crude oil via pipelines. Reply 11 (citing

⁷ We refer to the Holtmyer Publication and Holtmyer Patent collectively as the “Holtmyer references,” where appropriate.

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Ex. 1029; Ex. 1030; Ex. 2096; Ex. 1072, 9:15–10:1, 88:17–89:4). Petitioner argues that Dr. Epps supports his testimony with quotes from the Holtmyer Publication and the Holtmyer Patent that indicate the disclosures of the two references do not relate solely to hydraulic fracturing. *Id.* at 12.

We find that the Holtmyer Publication and the Holtmyer Patent—both of which are concerned with more effectively and economically moving oil through pipelines by introducing a drag reducing agent (“DRA”)—would have provided a person of ordinary skill in the art with a reason to reduce drag in crude oil flowing through a pipeline. The Holtmyer Publication is directed to a “study of oil soluble polymers as drag reducers,” which was “undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines.” Ex. 1005, 473; *see* Pet. 25–27; Ex. 1041 ¶¶ 90–92. The Holtmyer Patent, cited in Inaoka for its method of producing certain polymers, is directed to “reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit” and provides that “reduction of the frictional pressure loss in the flow of [] hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” Ex. 1006, 1:16–18, 1:56–65; Ex. 1007, 3:27; *see* Pet. 38–39; Ex. 1041 ¶¶ 174–176. Also, despite Patent Owner’s argument that being “economically profitable” in general is insufficient to demonstrate obviousness (PO Resp. 19), we find that the Holtmyer references are sufficiently directed to the specific economic benefits of drag reducing oil flowing through pipelines by using drag reducing agents, rather than directed generally to an unspecified market need. *Cf. Celsis In Vitro*,

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Inc. v. CellzDirect, Inc., 664 F.3d 922, 928 (Fed. Cir. 2012) (explaining, in the context of affirming a preliminary injunction grant, that “vague references to ‘market need’” are not probative of obviousness).

We note, also, that in connection with its presentation of objective evidence, Patent Owner itself argues that there was “a tremendous economic incentive” to solve the long-felt, unmet need that existed before Patent Owner’s invention. PO Resp. 45 (“billions of barrels of heavy crude oil have been produced and imported into the U.S. for decades, which created a tremendous economic incentive to solve the long-felt, unmet need that existed many years before LSPI’s invention.”); *see also id.* at 43 (“operators needed and demanded better, safer, and more economic solutions for improving the pipeline transport of heavy crude oils.”).

Regarding Patent Owner’s argument that the Holtmyer references concern fracking, rather than transporting heavy crude oil, we observe that the Holtmyer references use hydraulic fracturing as an example, rather than as an exclusive focus. *See, e.g.*, Ex. 1005, 473 (stating generally that “it is economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells.”); Ex. 1006, 1:56–65 (describing the benefits of drag reducing agents generally). Relatedly, regarding Patent Owner’s argument that the “solid agent” the Holtmyer Patent discloses is “unrelated to asphaltenes” (PO Resp. 12–13), we credit Petitioner’s assertion that Dr. Epps never argued that the “solid agent” disclosed or referred to asphaltenes. Reply 12–13. Rather, Petitioner argues, Dr. Epps’s statement was intended to convey that a person of ordinary skill in the art would have understood that suspended solids in a liquid hydrocarbon “may necessitate a

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higher concentration of DRA” and would have been informative as to the potential effects of asphaltene on drag reduction, because asphaltene is a solid colloidally suspended in crude oil. *Id.* at 13 (citing Ex. 1041 ¶¶ 95–98). After reviewing the arguments and testimony, we find this adequately supported by the record.

ii. Obvious to Try

Patent Owner argues that it would not have been “obvious to try” the drag reducing polymers in the specific claimed species of liquid hydrocarbon based on the allegedly well-known economic benefits, because Petitioner has not shown that one of ordinary skill of the art “would have chosen the particular species of liquid hydrocarbon in the claims.” PO Resp. 14. Because crude oils are complex, because the art was unpredictable, and because there are at least 450 different crudes in the world, Patent Owner argues that there were not a finite number of identified, predictable solutions. *Id.* at 14–16.

Petitioner replies that it would have been obvious to try a DRA in a crude oil in which it was expected to be effective. Reply 13. The Supreme Court set forth the standard for when a combination may be “obvious to try”: “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.” *KSR*, 550 U.S. at 421. The Court continued: “If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* Petitioner contends that it “has shown that one would have had an economic motivation to introduce a DRA

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into any pipeline-transported crude oil in which it would have been expected to be effective.” Reply 13.

Having considered the trial record as a whole, we find Petitioner’s position is supported by the preponderance of the evidence. We have found that market pressure or economic motivation existed. *See supra* Section II.D.4.b.i.; *see, e.g.*, Ex. 1005, 473; Ex. 1006, 1:56–65; Ex. 1041 ¶¶ 90–92, 174–176. Regarding the finite number of identified, predictable solutions, drag reducing agents were well-known and were often an effective solution to the problems of flow in oil pipelines, but the effective use of drag reducing agents in heavy crude oil was difficult. Ex. 1003, 1:49–51 (“Conventional polymeric drag reducers, however, typically do not perform well in crude oils having a low API gravity and/or a high asphaltene content.”). We credit Dr. Epps’s testimony that a person of ordinary skill in the art would have had a reasonable expectation of success that the iDMA drag reducing agent of the Holtmyer Publication and the 2EHMA drag reducing agent of Inaoka would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26°. Ex. 1041 ¶¶ 93, 177. As Dr. Epps explains, success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps calculated for the iDMA and 2EHMA drag reducing agents. *Id.* ¶¶ 30, 94–111, 178–192; *see also id.* ¶ 29 (the “more soluble a drag reducing polymer is in the fluid, the greater the drag reducing effect of the polymer”). Accordingly, in view of the knowledge of one of ordinary skill in the art, we

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find that introducing the DRAs identified in the Holtmyer Publication and Inaoka into any pipeline-transported crude oil in which they would have been expected to be effective based on the parameters Petitioner identifies would have been obvious to try with a reasonable expectation of success.

Regarding Patent Owner's criticism of Petitioner's reliance on Buckley⁸ and Ferguson⁹ to assert that heavy, asphaltenic crudes were well known in 2005 and earlier (PO Resp. 8–9), we acknowledge that those references were not named as primary references, but agree with Petitioner that Dr. Epps relied on them in providing his testimony regarding, among other things, common knowledge in the art about heavy, asphaltenic crude oils and solubility parameters. Tr. 8:16–21.

iii. Conventional Wisdom

Patent Owner argues that the “conventional wisdom” of one of ordinary skill in the art was that “drag reduction of heavy crudes was generally not believed to be a viable option.” PO Resp. 16–18 (citing Ex. 2028 (“Traditional DRA doesn't work in heavy crude.”); Ex. 2106 (“Heavy crude oil is frequently a challenge for traditional drag reducing agents.”); Ex. 2056, 5 (“[C]urrent DRA technology does not work effectively with heavy oil.”). Patent Owner emphasized at oral hearing that “conventional wisdom was that it was impossible” for current DRA technology to work effectively with heavy oil. Tr. 24:2–4, 25:17–18

⁸ Buckley, J.S., et al., *Asphaltene Precipitation and Solvent Properties of Crude Oils*, 16 PETROLEUM SCI. & TECH. 3–4, 251–285 (1998) (Ex. 1017).

⁹ Ferguson, K.R., et al., *Microbial Pilot Test for the Control of Paraffin and Asphaltenes at Prudhoe Bay*, Society of Petroleum Engineers, Inc. 36630, 557–564 (1996) (Ex. 1018).

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(“where the claimed liquid hydrocarbon was, this impossible zone where the prior art has said it won’t work here.”).

Petitioner replies that Patent Owner’s arguments “stem from a false premise that reducing drag in heavy, asphaltenic oils was thought unachievable.” Reply 2. Petitioner argued in the Petition that Patent Owner acknowledged, in its own promotional material and in arguments presented to the Office, that use of a drag reducing agent in heavy crude oil was viable. Pet. 9 n.1 (citing Exs. 1020, 1028, 1029, 1030, 1040). Petitioner also discusses this evidence in its Reply, which we consider properly responsive to Patent Owner’s argument, indicating that reducing drag in heavy, asphaltenic crude oils was not an unexpected result since at least the 1980s. Reply 2–3 (citing Ex. 1040, 25 (examining achievement of drag reduction in heavy crude oil); Ex. 1028–1030 (indicating that Patent Owner’s own traditional DRAs were marketed for reducing drag in heavy crude oils); Ex. 1074–1076 (examining drag reduction of heavy crude oils in the 1980s–1990s); Ex. 1078–1079, 1081–1082 (discussing 7–27% drag reduction of three heavy crude oils having API gravities of 23.7°, 25° and 21.8°, and asphaltene contents of 10–11 wt.%, 8–13 wt.% and 9 wt.%, respectively, by Patent Owner’s drag reducing products)).

Petitioner further replies that Patent Owner’s “conventional wisdom” argument relates only to “traditional” polyalphaolefin DRAs and not to the acrylate/methacrylate DRAs of the prior art. Reply 4. Thus, Petitioner argues, even if “traditional” polyalphaolefins were ineffective in heavy crude oil—and Petitioner asserts they were not—Patent Owner’s expert says nothing about the conventional wisdom regarding acrylate/methacrylate polymers, such as those disclosed by Holtmyer and Inaoka. *Id.* at 4–5

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(citing Ex. 2050 ¶¶ 102–103; Ex. 1072, 52:23–53:8, 55:17–23).

Additionally, Petitioner argues, the “perceived shortcomings of polyalphaolefin DRAs in heavy crude oil would have motivated a POSA to try other types of DRAs, such as the acrylate/methacrylate DRAs of Holtmyer and Inaoka.” *Id.* at 6. At oral hearing, Petitioner criticized Patent Owner’s “impossibility” argument as not “supported by its own evidence,” which characterized traditional drag reducing agents as not working well in heavy crude oil and not efficient as drag reducing additives in heavy crude oil, but “they still reduce drag and that’s exactly what’s shown in Patent Owner’s marketing materials.” Tr. 44:14–45:1.

In this regard, we agree with Petitioner. Although Patent Owner was pressed at oral hearing to identify a point at which the characteristics of heavy crude oil rendered drag reduction impossible, it was unable to do so. Tr. 33:18–34:16. Petitioner’s evidence indicates that drag reduction with traditional DRAs was not particularly efficient, but extant. Accordingly, Patent Owner’s addition of a drag reducing agent to a heavy crude oil was not as unexpected or novel as Patent Owner argues. Moreover, Patent Owner, despite filing a Sur-Reply, did not address Petitioner’s argument distinguishing traditional polyalphaolefins from acrylate/methacrylate polymers. Accordingly, we find that “conventional wisdom” was not that drag reduction of heavy asphaltenic crude oils was impossible, but simply that it wasn’t being done as well as it could have been as of the critical date.

iv. Hindsight

Finally, Patent Owner argues that Petitioner’s argument to add the claimed heavy, asphaltenic liquid hydrocarbon is based on hindsight. PO Resp. 18–19. Petitioner replies that “one would have had an economic

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motivation to introduce a DRA into any pipeline-transported crude oil in which it would have been expected to be effective,” and that no hindsight would be required. Reply 13. We do not find Petitioner’s obviousness analysis to be based on hindsight reconstruction. Petitioner articulates a reason having rational underpinnings for making a proposed combination of the prior art teachings of the Holtmyer Publication, the Holtmyer Patent, and Carnahan, as well as Inaoka and Carnahan, namely, that crude oils having the claimed properties were well known, and that one of ordinary skill would have been prompted by known economic benefits and would have had a reasonable expectation that the identified polymers would be effective. Pet. 24–33, 37–44. We find that Petitioner’s articulated reasoning is effective to support its contentions of obviousness. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”).

c. Drag Reduction Limitation

Patent Owner argues that none of the prior art references teach or suggest the drag reduction limitation. PO Resp. 20–27. First, Patent Owner argues that drag reduction is a substantive limitation of the claims. *Id.* at 20–24. Next, Patent Owner argues that none of the cited prior art references teach or suggest “drag reduction of the claimed, heavy asphaltenic ‘liquid hydrocarbon.’” *Id.* at 25. Finally, Patent Owner argues that Petitioner’s combinations fail under *KSR* because Patent Owner’s

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claimed invention yielded more than a predictable result. *Id.* at 27 (citing PO Resp. Section II(B)(2)(d), concerning “conventional wisdom”).

Petitioner does not appear to materially dispute that drag reduction is a substantive limitation of the claims. Reply 11. Given Patent Owner’s arguments and given the lack of a dispute between the parties, we consider the limitation as substantive. Petitioner replies that, notwithstanding whether the drag reduction limitation is a claim limitation, evidence shows that it would have been obvious for a person of ordinary skill in the art “to have introduced the DRAs of Inaoka and/or Holtmyer into the claimed liquid hydrocarbon to reduce drag (i.e., have the intended effect) in that hydrocarbon.” *Id.* For the reasons articulated in the Petition, we are persuaded by Petitioner’s argument. With respect to Ground 1, Dr. Epps testifies that the reduction in frictional pressure loss demonstrated by Table 9 of the Holtmyer Publication is brought about by the ability of the iDMA drag reducing agent to suppress the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See* Pet. 22 (citing Ex. 1041 ¶ 71). Similarly, for Ground 2, Dr. Epps testifies that a person of ordinary skill in the art would have understood that the drag reducing agents of Inaoka achieve a reduction in frictional pressure losses associated with turbulent flow by suppressing the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See id.* at 35–36 (citing Ex. 1041 ¶ 167). Accordingly, Petitioner has shown sufficiently that the references disclose introducing a drag reducing polymer into a pipeline, such

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that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies.

Regarding Patent Owner's second point that none of the cited prior art references teach or suggest drag reduction of the claimed heavy, asphaltenic liquid hydrocarbon, we note that all grounds in this case are based on obviousness and, thus, it is not imperative that any one of the cited prior art references teach drag reduction of the claimed liquid hydrocarbon within its four corners. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Our discussions regarding the suggestions of the references and the obviousness of the claimed combinations are interspersed throughout this opinion and directed to this point.

Regarding Patent Owner's third point, Petitioner replies that there is no evidence of "unpredictability," in that Dr. Dunn's testimony relies on a single discredited document, and that the cited examples in the '249 patent do not provide enough information to assess whether the results were predictable. Reply 17–18. We are not persuaded that the drag-reducing result of using DRAs in the claimed hydrocarbon is "unpredictable." Although some unpredictability may exist as to whether a particular DRA will work in a particular hydrocarbon (Ex. 2050 ¶ 148), the art sets forth general guidelines to assist one of ordinary skill in the art in this determination. Ex. 1041 ¶¶ 99–111, 178–192. We agree with Petitioner that the weight of the evidence presented in this case indicates that there are "correlations between solubility parameters and drag reduction" that one of ordinary skill in the art would have used to determine whether a particular DRA would be effective in a particular liquid hydrocarbon, which is contrary to Dr. Dunn's assertions of unpredictability and contrary to

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Dr. Dunn’s reliance on Exhibit 2137 (“Transport Phenomena: A Unified Approach”). Reply 17 (citing Ex. 2050 ¶ 148; Ex. 1088–1091 (articles examining the effects of solubility parameters on drag reduction)). We also agree that the examples cited in the ’249 patent do not support Patent Owner’s assertions of unpredictability, as they do not disclose the solubility parameters that would allow for such a conclusion. *Id.* at 17–18.

Accordingly, because we determine that the claimed invention yields no more than a predictable result, Petitioner’s asserted prior art combinations do not fail.

d. Reasonable Expectation of Success

Patent Owner argues that there would have been no reasonable expectation of success to make Petitioner’s combinations. PO Resp. 27–37. First, Patent Owner argues that there was no reason to combine Carnahan with the Holtmyer references or Inaoka, because Carnahan is a disparate reference directed to a different endeavor than the Holtmyer references and Inaoka (*id.* at 28), and because the Petition presents no evidence that one of ordinary skill in the art would have used solubility parameters to match drag reducing agents to crude oils (*id.* at 29). Second, Patent Owner argues that there would have been no reasonable expectation of success in combining the prior art references. *Id.* at 30. More particularly, Patent Owner argues that Dr. Epps’s conflicting opinions on the solubility parameter range fail to show a reasonable expectation of success (*id.*), and a solubility parameter match does not indicate a reasonable expectation of success (*id.* at 32). Finally, Patent Owner argues that conventional wisdom disproves motivation to combine with any reasonable expectation of success. *Id.* at 35. Regarding this last argument, we have addressed variations of the

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“conventional wisdom” argument above, and incorporate those findings herein.

Regarding Patent Owner’s first argument, Petitioner replies that “there is no sound reason why” a person of ordinary skill in the art would disregard the disclosure of Carnahan, a published scientific work that reports a solubility parameter range for heavy crude oils based on experimental data. Reply 15–16. Patent Owner’s argument in this regard appears to be that Carnahan is non-analogous art. To rely upon a reference as a basis for unpatentability, the reference must either (1) be in the field of the inventor’s endeavor or (2) be reasonably pertinent to the particular problem with which the inventor was concerned. *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992). In determining whether a reference is reasonably pertinent to the problem, “it is necessary to consider ‘the reality of the circumstances’ . . . in other words, common sense.” *Id.* (quoting *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979)). That is, “[r]eferences are selected as being reasonably pertinent to the problem based on the judgment of a person having ordinary skill in the art.” *In re Kahn*, 441 F.3d 977, 987 (Fed. Cir. 2006) (citing *Oetiker*, 977 F.2d at 1447).

Here, we find that Carnahan is at least reasonably pertinent to one of the problems confronting the inventors of the ’249 patent. It was known prior to the ’249 patent that solubility of the drag reducing polymer in the liquid hydrocarbon was necessary to achieve drag reduction, and an important requirement in preparing a more effective drag reducing polymer. Ex. 1041 ¶ 29; Ex. 1014, 800–802; Ex. 1015, 1550; *see* Ex. 1003, 1:45–46. Thus, the inventors of the ’249 patent would have been concerned about whether the drag reducing polymer was soluble in the liquid hydrocarbon

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being treated by the polymer. Carnahan, which discloses solubility parameter ranges that one of ordinary skill in the art would have applied to hydrocarbons, is reasonably pertinent to that problem. *See* Reply 15–16.

Regarding Patent Owner’s second argument, Petitioner replies that Dr. Epps’s opinions about solubility parameters based on different references highlight “the remarkably similar solubility parameter ranges obtained using *different methods* described in *different references*.”

Reply 15. We agree. The parties also seem to agree that different methods are available to determine solubility parameters, and solubility parameters obtained by different methods may vary. Ex. 1092 ¶ 20; Ex. 1072, 116:22–117:5; Ex. 1105, 39:5–16. The differences here are insignificant enough that they do not undermine our ultimate findings based on Dr. Epps’s solubility parameter calculations.

Petitioner further replies that it is “irrelevant that solubility alone does not provide an expectation of success.” Reply 16. Petitioner reiterates that its argument is not based on solubility alone, but on Dr. Epps’s assertions that “(1) a DRA must have a straight-chain structure, high molecular weight, and solubility in the target fluid; (2) Holtmyer and Inaoka disclose polymers having the structure and molecular weight necessary to reduce drag; and (3) using solubility parameters, one would [have] predict[ed] that those polymers would be soluble in heavy, asphaltenic crude oil.” *Id.* (citing Ex. 1041 ¶¶ 30, 111, 192). We agree that Petitioner’s case is more multifaceted than just solubility alone. As discussed above in connection with our discussion of a reason to combine the teachings of the asserted references, we credit Dr. Epps’s testimony not only regarding the reasonable expectation of success that the iDMA and 2EHMA drag reducing polymers

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would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26° (Ex. 1041 ¶¶ 93, 177), but also that such success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps calculated (*id.* at ¶¶ 30, 94–111, 178–192). *See supra* Section II.D.4.b. Taken together, the evidence presented by Petitioner underscores that one of ordinary skill in the art would have had a reasonable expectation of success in achieving the claimed method according to Petitioner’s asserted prior art combination.

Petitioner also argues that the “well-known correlation between solubility and drag reduction” enabled Patent Owner “to identify known DRAs for use in heavy oil.” Reply 6. To counter Patent Owner’s argument that using solubility parameters was inventive, Petitioner relies on Dr. Epps’s testimony that a person of ordinary skill in the art would have known that solubility parameters could be used to predict the effectiveness of a drag reducing polymer in a particular fluid, such as a crude oil, and to several articles describing the relationship between solubility parameters and drag reduction. *Id.* at 6–7; Ex. 1092 ¶¶ 4–9; Ex. 1088, 538 (“drag reduction is greatest when the solubility parameters of solvent and polymer are equal”); Ex. 1089. According to Petitioner, Patent Owner “did no more than apply known solubility parameter relationships to identify known drag reducing polymers that one would expect to be effective in known crude oils. That is the epitome of obviousness.” Reply 7. In this regard, we agree with Petitioner. Introducing a drag reducing agent into a liquid hydrocarbon

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was well-known; the additional limitations Patent Owner added do not overcome this shortcoming. We credit Dr. Epps's testimony that one of ordinary skill in the art would have considered a number of factors, including solubility parameters informing whether a particular drag reducing agent would dissolve in a particular liquid hydrocarbon, to determine the optimum drag reducing agent for a particular crude oil.

e. Objective Evidence

Patent Owner argues that objective evidence supports the nonobviousness of the challenged claims. PO Resp. 37–69.¹⁰ Generally, Patent Owner argues that the evidence of record demonstrates that the industry “had a long-felt need, actively tried and failed to find a DRA solution, was stunned by the surprising and unexpected results achieved by the 249 Patent, praised it, and then blatantly copied it.” *Id.* at 37; *see id.* at 42–45 (long-felt need), 46–47 (failure of others), 47–48 (skepticism of experts and unexpected results), 49–50 (praise), 50–52 (commercial success), 52–68 (copying), 68–69 (acquiescence).

Notwithstanding what the teachings of the prior art would have suggested to one of ordinary skill in the art at the time of the invention, the totality of the evidence submitted, including objective evidence of nonobviousness, may lead to a conclusion that the claimed invention would not have been obvious to one of ordinary skill. *In re Piasecki*, 745 F.2d 1468, 1471–1472 (Fed. Cir. 1984). “For objective evidence of secondary considerations to be accorded substantial weight,” however, “its proponent

¹⁰ In this section, we cite to the confidential versions of Patent Owner's Response and Dr. Dunn's declaration, and the arguments and testimony contained therein.

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must establish a nexus between the evidence and the merits of the *claimed invention*.” *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (quoting *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010)). “[N]exus” is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). We apply “a presumption of nexus for objective considerations when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘is the invention disclosed and claimed in the patent.’” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016) (citations omitted). Patent Owner bears the burden of showing that the product or method “is the invention disclosed and claimed in the patent.” *See Demaco*, 851 F.2d at 1392 (discussing patent owner’s burden in the context of commercial success).

Patent Owner’s argument regarding nexus as to any of its identified secondary considerations is that it is entitled to a presumption of nexus because its evidence is tied to specific products that embody the claims of the ’249 patent. PO Resp. 38; Tr. (confidential) 6:10 (“You don’t get a more direct case of nexus.”). In that regard, Patent Owner contends that its Extreme Power, EP-1000, and EP-2000 products contain the drag reducing polymer [REDACTED]

[REDACTED] PO Resp. 38–39. Patent Owner directs us to Test 2 of the ’249 patent as evidence that [REDACTED] a component of the [REDACTED] products, reduces drag in AHS crude, a heavy, asphaltenic crude oil. [REDACTED]

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[REDACTED] Patent Owner also contends that Petitioner's and third party Flowchem LLC's ("Flowchem") commercial products embody the claims of the '249 patent. For example, Patent Owner points to Petitioner's FLO ULTIMA product as [REDACTED]

[REDACTED] Likewise, Patent Owner states that Flowchem's commercial heavy crude oil DRA [REDACTED]

[REDACTED]

Id. at 63. Patent Owner's Sur-Reply asserts that Petitioner ignores Patent Owner's detailed showing of nexus (Sur-Reply 1), and that Petitioner's argument that the objective evidence is "not commensurate with the scope of the claims" fails (*id.* at 2).

We do not find that Patent Owner is entitled to a presumption of nexus. As noted above, a presumption of nexus requires that the product "'is the invention disclosed and claimed in the patent.'" *WBIP*, 829 F.3d at 1329 (citations omitted). That is, a nexus is presumed when the commercial product "both 'embodies the claimed features' and is 'coextensive' with the claims at issue." *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1319 (Fed. Cir. 2015).

Here, the Extreme Power products, as well as Petitioner's and Flowchem's products, are not coextensive with the challenged claims. All the products Patent Owner identifies are polymers. The challenged claims of the '249 patent, however, are not directed to a polymer composition.¹¹

¹¹ Patent Owner appears to treat the challenged claims as though they are directed to a specific polymer, when they are not. For example, Patent

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Rather, the challenged claims recite a method of introducing a polymer into a hydrocarbon flowing in a pipeline. *See* Ex. 1003, 18:61–20:27. Thus, the evidence of record does not indicate that Petitioner, Patent Owner, or Flowchem produces a commercial product that is coextensive with the method recited in the challenged claims. As a result, we determine that Patent Owner is not entitled to a presumption of nexus for any of its proffered secondary considerations. Because Patent Owner does not direct us to additional evidence to establish nexus, Patent Owner does not establish on this record a nexus between its proffered secondary considerations evidence and the claimed invention.

5. *Conclusions as to Obviousness*

Having considered the parties’ arguments and evidence, we evaluate all of the evidence together to make a final determination of obviousness. *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1075 (Fed. Cir. 2012) (stating that a fact finder must consider all evidence relating to obviousness before finding patent claims

Owner contends that Petitioner created its FLO ULTIMA product “with the

PO Resp. 60; *see id.* at 62 (arguing that Flowchem “used LSPI’s Patent Specification as a blueprint” to move “to a substantially different DRA product,

But the challenged claims encompass a method of introducing into a pipeline any drag reducing polymer, wherein a plurality of the repeating units comprise a heteroatom, with additional limitations relating thereto. The additional limitations (having a heteroatom selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a phosphorus atom; having at least about 25,000 repeating units; having an average molecular weight of at least 1×10^6 g/mol) do not transform the claims to a method of introducing a drag reducing polymer into claims directed to a specific polymer.

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invalid). After considering the parties' arguments and evidence, we are persuaded that Petitioner has made a sufficient showing that a person having ordinary skill in the art would have combined the teachings in the manner proposed by Petitioner. We conclude that Petitioner has satisfied its burden of demonstrating, by a preponderance of the evidence, that the subject matter of claims 1–5 of the '249 patent would have been obvious over the combined teachings of the Holtmyer Publication, Holtmyer Patent, and Carnahan, and that the subject matter of claims 1–5 of the '249 patent would have been obvious over the combined teachings of Inaoka and Carnahan.

III. MOTION TO EXCLUDE

Patent Owner moves to exclude (1) Exhibits 1062, 1073–82, 1088–91, 1102, and 1092 ¶¶ 4–9, and pages 1–7, 10–11, 13–14, and 17 of Petitioner's Reply as involving "new theories, arguments, and evidence that exceed the scope of the Petition and are thus irrelevant to the instituted grounds under F.R.E. [Federal Rules of Evidence] 401–403;" (2) Exhibits 1074–78, 1083–87, 1094, 1096–1100, and pages 3, 20, and 21 of Petitioner's Reply, which involve Patent Owner's "internal communications and documents that were not public or prior art and thus are irrelevant to the instituted grounds under F.R.E. 401–403;" and (3) Exhibit 1092 ¶¶ 2–3 and ¶¶ 85–91, and the related arguments on pages 9, 10, and 30 of Petitioner's Reply as "unsupported and unreliable" under *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993) and F.R.E. 702. Paper 46 (redacted), 1; Paper 59 (redacted).

Petitioner filed a Response (Paper 54 (redacted)). With respect to the first category of exhibits, or portions thereof, and portions of Petitioner's Reply that Patent Owner seeks to exclude, Petitioner argues that Exhibits 1062, 1073–82, and 1102 respond to Patent Owner's arguments regarding

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“surprising and unexpected results;” Exhibits 1088–91 and 1092 ¶¶ 4–9 do not raise new theories, but are “completely consistent with arguments made in the Petition;” pages 1–7, 10–11, 13–14, and 17 of Petitioner’s Reply are attorney argument that should not be the subject of a Motion to Exclude; and Patent Owner fails to identify any new arguments raised for the first time in the Reply. Paper 54, 1–5. Having reviewed these exhibits and papers, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence exceed the scope of a proper reply; rather, they are properly responsive and may be considered as part of our evaluation of the record.

With respect to the second category of exhibits and Reply pages that Patent Owner seeks to exclude, Petitioner argues that Patent Owner “relies almost exclusively on internal, confidential documents as support for its assertion of unexpected results,” and that the documents dated after the priority date of the subject patent refer to prior art, and, therefore, are relevant. Paper 54, 6–7. Again, having reviewed these exhibits and the Reply pages, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence are irrelevant. Patent Owner’s arguments appear directed to the weight to be given to the documents and argument sought to be excluded, rather than to their admissibility.

As to the third category of exhibits and Reply pages Patent Owner seeks to exclude, Petitioner argues that Patent Owner failed to object to paragraphs 2 and 3 of Exhibit 1092 in a timely manner, and Patent Owner does not respond. Paper 54, 8; Paper 59, 4. Patent Owner must object timely to the evidence it seeks to exclude. 37 C.F.R. § 42.64(b)(1).

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Petitioner further argues that Dr. Epps's expertise qualifies him to provide the testimony given in Exhibit 1092. Paper 54, 9. We decline to exclude any of this testimonial evidence or any portions of the Reply and, instead, give the evidence more or less persuasive value depending on the degree to which the testimony is supported by reasoning, fact, and Dr. Epps's expertise.

Accordingly, the Motion to Exclude is *dismissed*.

IV. MOTIONS TO SEAL

Patent Owner and Petitioner each filed unopposed Motions to Seal portions of certain papers and exhibits. Paper 17; Paper 25; Paper 26; Paper 35; Paper 44; Paper 48; Paper 55; Paper 56; Paper 58. The Board previously entered a protective order to govern the confidential information produced and filed in this proceeding. Paper 16, 2–4 (granting Patent Owner's motion for entry of a protective order and placing Patent Owner's modified protective order (Paper 13, Addendum A) into effect).

In its first Motion to Seal, Patent Owner seeks to seal portions of the Patent Owner Response and "certain exhibits to the Patent Owner Response that contain confidential information" belonging to Patent Owner, Petitioner, and/or Flowchem, including portions of Dr. Dunn's declaration (Ex. 2050). Paper 17, 1. Other than Dr. Dunn's declaration, Patent Owner does not identify any of the exhibits it seeks to seal. *Id.* In its second Motion to Seal, Patent Owner seeks to seal a sentence, and its accompanying citation, in its Opposition to Petitioner's Motion for Additional Discovery. Paper 26, 1. In its third Motion to Seal, Patent Owner moves to seal a portion of its Motion to Exclude and a portion of its Sur-Reply. Paper 44, 1. In its fourth Motion to Seal, Patent Owner moves to seal portions of its Motion for Observations

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on Cross-Examination. Paper 48, 1. In its fifth Motion to Seal, Patent Owner moves to seal Exhibit 2154 (Dr. Epps's deposition transcript). Paper 56, 1. In its sixth Motion to Seal, Patent Owner moves to seal its Reply to Patent Owner's Motion to Exclude. Paper 58, 1.

In its first Motion to Seal, Petitioner seeks to seal Exhibit 1070, which it filed in redacted and unredacted versions. Paper 25, 1. In its second Motion to Seal, Petitioner seeks to seal Exhibits 1074, 1075, 1076, 1077, 1078, 1083, 1084, 1085, 1086, 1087, 1094, 1096, 1097, 1098, 1099, 1100, and 1108, portions of Exhibit 1072 (Dr. Dunn's cross-examination transcript), portions of Exhibit 1092 (Dr. Epps's reply declaration), portions of its Reply, and its updated exhibit list. Paper 35, 1. In its third Motion to Seal, Petitioner moves to seal portions of its Response to Patent Owner's Motion for Observations on Cross-Examination and its Opposition to Patent Owner's Motion to Exclude. Paper 55, 1.

“There is a strong public policy for making all information filed in a quasi-judicial administrative proceeding open to the public, especially in an *inter partes* review which determines the patentability of claims in an issued patent and therefore affects the rights of the public.” *Garmin Int'l v. Cuozzo Speed Techs., LLC*, IPR2012-00001, slip op. at 1-2 (PTAB Mar. 14, 2013) (Paper 34). For this reason, except as otherwise ordered, the record of an *inter partes* review trial shall be made available to the public. *See* 35 U.S.C. § 316(a)(1); 37 C.F.R. § 42.14. The standard for granting a motion to seal is good cause. 37 C.F.R. § 42.54. That standard includes showing that the information addressed in the motion to seal is truly confidential, and that such confidentiality outweighs the strong public interest in having the record open to the public. *See Garmin*, slip op. at 2-3.

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After having considered the submissions, we deny the Motions to Seal without prejudice. We are not persuaded that the parties establish good cause to seal all of the information identified in their respective motions. For example, both Petitioner and Patent Owner assert that certain information should be sealed because it previously was designated “confidential information,” “highly confidential information,” “protective order material,” or “outside attorneys eyes only” material. *See, e.g.*, Paper 17, 1; Paper 25, 1; Paper 35, 1. As noted above, except for Dr. Dunn’s declaration, Patent Owner’s first Motion to Seal does not identify any of the exhibits it seeks to seal.

We deny the motions without prejudice, and order the parties to work together to jointly file a motion to seal, setting forth: (1) each paper or exhibit that the parties seek to seal, in part or in full; (2) a showing why the information in each paper or exhibit (or the portions thereof) that the parties seek to seal is truly confidential; and (3) a clear identification, by paper or exhibit number, of the redacted and unredacted versions of each paper or exhibit that the parties seek to seal. To the extent that the parties have not yet filed redacted versions of each paper and exhibit they seek to seal, the parties shall file such redacted versions.

We further note that this decision will be entered as a non-public version covering protective order material because it references and cites several documents subject to the parties’ Motions to Seal. The parties may, as part of the joint motion to seal, request that the Board seal portions of this decision and/or the two oral hearing transcripts (Paper 63, Paper 64). The parties shall provide a joint proposed redacted version of this decision and/or the oral hearing transcript exhibits with the joint motion to seal. We caution

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the parties that there is a strong public interest in an unsealed Final Written Decision, and any justification to seal the decision must meet the good cause standard. Furthermore, any proposed redactions to the decision and the oral hearing transcript should be narrowly tailored.

The parties are authorized to file the joint motion to seal within ten (10) business days of the date of this decision. The parties shall meet and confer in good faith as necessary to comply with our orders in this decision. 37 C.F.R. § 42.11.

V. CONCLUSION

For the foregoing reasons, we determine that Petitioner establishes, by a preponderance of the evidence, that claims 1–5 of the '249 patent are unpatentable under 35 U.S.C. § 103 as obvious over the combination of the Holtmyer Publication, the Holtmyer Patent, and Carnahan, and unpatentable under 35 U.S.C. § 103 as obvious over the combination of Inaoka and Carnahan.

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner establishes, by a preponderance of the evidence, that claims 1–5 of the '249 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed* as moot;

FURTHER ORDERED that Patent Owner's and Petitioner's Motions to Seal are *denied* without prejudice;

FURTHER ORDERED that within ten (10) business days of this decision, the parties shall file a joint motion to seal in accordance with the instructions set forth above; and

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FURTHER ORDERED that this is a Final Written Decision;
therefore, parties to the proceeding seeking judicial review of the decision
must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Paper No. 68
Entered: March 28, 2018

BOARD AND PARTIES ONLY

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAKER HUGHES, a GE COMPANY, LLC
(f/k/a BAKER HUGHES INCORPORATED),¹
Petitioner,

v.

LIQUIDPOWER SPECIALTY PRODUCTS INC.
(f/k/a/ LUBRIZOL SPECIALTY PRODUCTS, INC.),
Patent Owner.

Case IPR2016-01903
Patent 8,426,498 B2

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and
MICHELLE N. ANKENBRAND, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION

Holding Claim 3 Unpatentable
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

Dismissing Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

Denying Without Prejudice Petitioner's and Patent Owner's Motions to Seal
37 C.F.R. § 42.54

¹ Petitioner represents that its name has changed from Baker Hughes Incorporated to Baker Hughes, a GE Company, LLC. Paper 21, 2. Accordingly, we modify the case caption to reflect that change.

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I. INTRODUCTION

Baker Hughes, a GE Company, LLC (f/k/a Baker Hughes Incorporated) (“Petitioner”) requested an *inter partes* review of claims 1–5 of U.S. Patent No. 8,426,498 B2 (“the ’498 patent,” Ex. 1002). Paper 2 (“Pet.”). LiquidPower Specialty Products Inc. (f/k/a/ Lubrizol Specialty Products, Inc.) (“Patent Owner”) filed a Preliminary Response. Paper 10 (“Prelim. Resp.”). We instituted an *inter partes* review of claims 1–5 on certain grounds of unpatentability alleged in the Petition. Paper 11 (“Dec.”).

After institution of trial, Patent Owner filed a Patent Owner Response. Paper 20 (“PO Resp.” (public version)). Petitioner filed a Reply. Paper 32 (“Reply” (public version)). Patent Owner, with Board authorization, filed a Sur-Reply. Paper 41 (public version). On November 16, 2017, Patent Owner filed a Disclaimer in Patent under 37 C.F.R. § 1.321(a), disclaiming claims 1, 2, 4, and 5 of the ’498 patent. Ex. 2156. An oral hearing was held on December 4, 2017. A transcript of the hearing is included in the record. Paper 66 (“Tr.” (public version)).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has established by a preponderance of the evidence that claim 3 of the ’498 patent is unpatentable.

A. *Related Proceedings*

Petitioner identifies the following pending litigation involving the ’498 patent: *Lubrizol Specialty Products, Inc. v. Baker Hughes Inc.*, No. 4:15-cv-02915 (S.D. Tex.). Pet. 2; Paper 21, 3. Petitioner also identifies U.S. Patent Application No. 13/209,119, filed on August 12, 2011,

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as pending, and represents that the '119 application claims benefit to, and is a continuation in part of, U.S. Patent Application No. 11/615,539 (now U.S. Patent No. 8,022,118, "the '118 patent") to which the '498 patent claims priority. Pet. 3.

Petitioner identifies two additional instituted *inter partes* review proceedings involving Petitioner's challenges to patents related to the '498 patent: IPR2016-01901 (challenging U.S. Patent No. 8,450,249 B2), and IPR2016-01905 (challenging U.S. Patent No. 8,450,250 B2). *See* Pet. 2; Paper 9, 3. Petitioner also filed an earlier Petition requesting an *inter partes* review of the '118 patent. *Baker Hughes Inc. v. Lubrizol Specialty Prods., Inc.*, Case IPR2016-00734 ("734 IPR"), Paper 2. We issued a final written decision in the 734 IPR on October 1, 2017. 734 IPR, Paper 79; Paper 85 (public version).

B. The '498 Patent

The '498 patent, titled "Drag Reduction of Asphaltenic Crude Oils," issued on April 23, 2013. Ex. 1002, at [54], [45]. The '498 patent relates to a "method of introducing a drag reducing polymer into a pipeline such that the friction loss associated with the turbulent flow though [sic] the pipeline is reduced by suppressing the growth of turbulent eddies," in which the "drag reducing polymer is introduced into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and/or an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon." *Id.* at [57].

According to the specification, "[w]hen fluids are transported by a pipeline, there is typically a drop in fluid pressure due to the friction between the wall of the pipeline and the fluid." *Id.* at 1:20–22. The pressure drop increases with increasing flow rate, resulting in energy losses and

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inefficiencies that increase equipment and operation costs. *Id.* at 1:24–32. The problems associated with pressure drop are most acute when fluids are transported over long distances. *Id.* at 1:29–31.

Before the '498 patent, it was known to use drag reducing polymers in the fluid flowing through a pipeline to alleviate the problems resulting from pressure drop. *Id.* at 1:33–35. A drag reducing polymer “is a composition capable of substantially reducing friction loss associated with the turbulent flow of a fluid through a pipeline,” and such a composition works by “suppress[ing] the growth of turbulent eddies, which results in higher flow rate at a constant pumping pressure.” *Id.* at 1:37–42. Drag reduction generally “depends in part upon the molecular weight of the polymer additive and its ability to dissolve in the hydrocarbon under turbulent flow.” *Id.* at 1:44–46.

According to the specification, because conventional drag reducing polymers do not perform well in crude oils having a low API gravity² and/or a high asphaltene content, there exists a need for “improved drag reducing polymers capable of reducing the pressure drop associated with the turbulent flow of low API gravity and/or high-asphaltene crude oils through pipelines.” *Id.* at 1:49–54. The subject matter of the disclosed invention, therefore, “relates generally to high molecular weight drag reducers for use in crude oils.” *Id.* at 1:15–16. More specifically, the '498 patent discloses a method for reducing the pressure drop associated with flowing a liquid hydrocarbon through a conduit, such as a pipeline. *Id.* at 2:48–50. The

² The specification defines API gravity as “the specific gravity scale developed by the American Petroleum Institute for measuring the relative density of various petroleum liquids.” *Id.* at 3:50–54.

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method comprises introducing a drag reducing polymer into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to produce a treated liquid hydrocarbon wherein the viscosity is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer. *Id.* at 19:17–20:4.

The '498 patent provides several examples of suitable heavy crude oils and blended heavy crude oils. *Id.* at 4:25–34, Table 1.

The specification further explains that, “[i]n order for the drag reducing polymer to function as a drag reducer, the polymer should dissolve or be substantially solvated in the liquid hydrocarbon.” *Id.* at 11:18–20.

The liquid hydrocarbon and the drag reducing polymer, therefore, have solubility parameters that can be determined according to known methods. *Id.* at 4:9–22 (setting forth known methods for determining the solubility parameter of the liquid hydrocarbon), 11:26–67 (setting forth known methods for determining the solubility parameter of the drag reducing polymer).

C. Illustrative Claim

Claim 3, the only claim remaining in this proceeding, is reproduced below:

3. A method comprising:
introducing a drag reducing polymer, into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies, into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than

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the viscosity of the liquid hydrocarbon prior to treatment
with the drag reducing polymer;

wherein a plurality of the repeating units comprise a heteroatom
and the heteroatom is selected from the group
consisting of an oxygen atom, a nitrogen atom, a sulfur
atom and/or a phosphorus atom.

Ex. 1002, 19:17–20:4.

D. Instituted Grounds of Unpatentability

We instituted an *inter partes* review of claims 1–5 of the '498 patent on three grounds. Dec. 29. Following the disclaimer of claims 1, 2, 4, and 5 of the '498 patent (Ex. 2156), only the following grounds remain in the proceeding:³

Reference(s)	Statutory Basis	Claim Challenged
Holtmyer Publication, ⁴ Holtmyer Patent, ⁵ and Carnahan ⁶	§ 103(a)	3
Inaoka ⁷ and Carnahan	§ 103(a)	3

³ We also instituted review of claims 1, 2, 4, and 5 of the '498 patent, on the ground of anticipation by the Holtmyer Publication under 35 U.S.C. § 102. Dec. 29. In view of the disclaimer, we no longer identify this ground in our instituted grounds of patentability. *See* Ex. 2156.

⁴ Marlin D. Holtmyer & Jiten Chatterji, *Study of Oil Soluble Polymers as Drag Reducers*, 20 POLYMER ENG'G & SCI. 473, 473–77 (1980) (“Holtmyer Publication”) (Ex. 1005).

⁵ U.S. Patent No. 3,758,406, issued September 11, 1973 (“Holtmyer Patent”) (Ex. 1006).

⁶ Norman F. Carnahan, *Precipitation of Asphaltenes in Heavy Oil and Tar Sands*, in 40B DEV. IN PETROLEUM SCI., ASPHALTENES AND ASPHALTS, 2 319–33 (Teh Fu Yen & George V. Chilingarian eds., 2000) (“Carnahan”) (Ex. 1008).

⁷ European Pat. App. No. EP 0,882,739 A2, published December 9, 1998 (“Inaoka”) (Ex. 1007).

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Petitioner relies on the declarations of Thomas H. Epps, III, Ph.D. (Ex. 1041; Ex. 1115 (public version)). Patent Owner relies on the declaration of Brian Dunn, Ph.D. (Ex. 2141 (public version)).

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable constructions in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under the broadest reasonable construction standard, claim terms are presumed to have their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Only those terms which are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner submits that we need not construe any claim term for purposes of this decision. Pet. 14. In our Decision on Institution, we construed the term “and/or,” which affected claims 1, 2, 4, and 5. Dec. 8–9. We also determined, based on the record at the time, that no other claim term required express construction. *Id.* at 9. In its Response, discussing our “and/or” construction, Patent Owner argues that the prosecution history

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requires that “the claims require both the API gravity and the asphaltene content limitations.” PO Resp. 5.

Because Patent Owner disclaimed all claims in which the term “and/or” appeared, we need not address this term any further. We determine that no other claim terms require construction.

B. Level of Ordinary Skill in the Art

Petitioner proposes a detailed definition of one of ordinary skill in the art. Pet. 12–14 (citing Ex. 1041 ¶¶ 18–20, 22, 42). Patent Owner does not, in its Response, appear to dispute this definition. In light of the evidence before us, we adopt Petitioner’s definition of one of ordinary skill in the art. We also find that Petitioner’s proposed level of skill in the art is reflected by the references themselves. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“the absence of specific findings on the level of skill in the art does not give rise to reversible error ‘where the prior art itself reflects an appropriate level and a need for testimony is not shown.’”); *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (finding that the Board of Patent Appeals and Interferences did not err in concluding that the level of ordinary skill in the art was best determined by the references of record).

C. Overview of the Asserted References

1. Holtmyer Publication

The Holtmyer Publication, titled “Study of Oil Soluble Polymers as Drag Reducers,” was published in 1980. Ex. 1005, 473. The Holtmyer Publication is directed to an investigation “undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines.” *Id.* at Abstract. A decrease in friction loss “would allow lower energy consumption or

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alternatively an increased flow rate under the original pumping conditions,” making a decrease in friction loss “desirable” and “economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells.” *Id.* at 473. Among the polymers for drag reduction synthesized and described by the Holtmyer Publication is poly(isodecyl methacrylate) (“iDMA”), which was tested for drag reduction in kerosene, QC-1156, Cardium, and Ellenberger. *Id.* at 476, Table 9.

2. *Holtmyer Patent*

The Holtmyer Patent, titled “Methods and Compositions for Reducing Frictional Pressure Loss in the Flow of Hydrocarbon Liquids,” issued in 1973. Ex. 1006. The Holtmyer Patent relates to “methods and compositions for reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit.” *Id.* at 1:15–18. Regarding frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids, the Holtmyer Patent provides that “considerable energy generally in the form of pumping horsepower must be expended” in order to compensate for such pressure loss and, thus, “reduction of the frictional pressure loss in the flow of such hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” *Id.* at 1:56–65. The Holtmyer Patent provides examples of “suitable monomers which may be utilized to form the polymer additives of the present invention.” *Id.* at 3:3–20. When using the polymer additive “with a well-treating fluid containing sand or other solid agent suspended

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therein,” the Holtmyer Patent states that “it is preferable to use a somewhat larger amount of the polymer additive.” *Id.* at 4:63–67.

3. *Inaoka*

Inaoka, titled “High Molecular Weight Polymer and Producing Method the Same and Drag Reducer,” relates to a method of producing a high molecular weight polymer in which “dissolved oxygen existing in a solvent in a radical polymerization reaction is removed, and to a high molecular weight polymer obtained by the same, and to a drag reducer.” Ex. 1007, 2:5–7. Inaoka describes, generally, the problems with transporting “an organic liquid such as crude oil” through a pipeline, caused by “the fact that transporting pressure on the liquid is lost by the friction generated between the liquid and the conduit.” *Id.* at 3:9–11. To suppress such pressure loss, Inaoka states that “a drag reducer has been used conventionally,” and the drag reducer includes a high molecular weight polymer. *Id.* at 3:14–15. Regarding production of such polymers, Inaoka states that “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent] is known.” *Id.* at 3:27. Regarding specific polymer additives, Inaoka states that “2-ethylhexylacrylate (2EHA (carbon number of 8)) and 2-ethylhexylmethacrylate (2EHMA (carbon number of 8)) are particularly preferable.” *Id.* at 4:48–50.

4. *Carnahan*

Carnahan, titled “Precipitation of Asphaltenes in Heavy Oil and Tar Sands,” is a chapter of a textbook titled “Asphaltenes and Asphalts, 2.” Ex. 1008. Carnahan discloses solubility parameters of asphaltenes and of petroleum fluids, particularly, that the expected value of the solubility of heavy petroleum fluids is about 8–10 hildebrands (wherein 10 hildebrands is

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equivalent to 20.5 MPa^{1/2}). *Id.* at 325. Carnahan also discloses that the solubility parameter of certain asphaltenes is about 20.5 MPa^{1/2}. *Id.* at 324.

D. Analysis

As a preliminary matter, many of Petitioner's and Patent Owner's arguments focus on claims that are no longer at issue in this proceeding (namely, claims 1, 2, 4, and 5), due to the disclaimer Patent Owner filed after the parties completed most of the substantive briefing in this case. Statutory disclaimer of claims is authorized under 35 U.S.C. § 253(a), which provides in part:

A patentee, whether of the whole or any sectional interest therein, may, on payment of the fee required by law, make disclaimer of any complete claim, stating therein the extent of his interest in such patent. Such disclaimer shall be in writing, and recorded in the Patent and Trademark Office; and it shall thereafter be considered as part of the original patent to the extent of the interest possessed by the disclaimant and by those claiming under him.

The Federal Circuit has held that claims disclaimed under § 253(a) should be treated as though they never existed. *See Vectra Fitness, Inc. v. TNWK Corp.*, 162 F.3d 1379, 1383 (Fed. Cir. 1998) ("This court has interpreted the term 'considered as part of the original patent' in section 253 to mean that the patent is treated as though the disclaimed claims never existed."); *Guinn v. Kopf*, 96 F.3d 1419, 1422 (Fed. Cir. 1996) ("A statutory disclaimer under 35 U.S.C. § 253 has the effect of canceling the claims from the patent and the patent is viewed as though the disclaimed claims had never existed in the patent."); *see also Genetics Inst., LLC v. Novartis Vaccines & Diagnostics, Inc.*, 655 F.3d 1291, 1299 (Fed. Cir. 2011) (holding that the Board's interference jurisdiction under 35 U.S.C. § 291 required

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“the existence of an interference, and a claim that ‘never existed’ [due to a statutory disclaimer] cannot form the basis for an interference”). Although many of Petitioner’s and Patent Owner’s arguments are directed to disclaimed claim 1, the argued limitations of claim 1 are largely the same as the limitations of claim 3. Pet. 46 (“Claim 3 differs from claim 1 in that it limits the type of heteroatom in the repeating units of the drag reducing polymer to oxygen, nitrogen, sulfur, or phosphorus.”). Accordingly, although we reference the parties’ arguments directed to “claim 1” or “claims 1–5,” we analyze the parties’ arguments in connection with claim 3 only.

1. Principles of Law

A patent 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 to a person of ordinary skill in the art at the time the invention was made. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). Obviousness is resolved based on 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, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must demonstrate obviousness by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d); *see*

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also 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”)). A party that petitions the Board for a determination of obviousness must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 408 F.3d 1348, 1361 (Fed. Cir. 2007)). We analyze both parties’ arguments, below, in accordance with the above-stated principles.

2. *Petitioner’s Ground 1—Asserted Obviousness Based on the Holtmyer Publication, the Holtmyer Patent, and Carnahan*

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of the Holtmyer Publication, the Holtmyer Patent, and Carnahan, to a method comprising all of the elements recited in claims 1–5. Pet. 20–33, 45–50.

Petitioner argues that the “Holtmyer Publication discloses most of the limitations of claim 1.” *Id.* at 21. In the section of the Petition summarizing the Holtmyer Publication, Petitioner characterizes the Holtmyer Publication as describing an investigation “to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines” and as describing “the problem of frictional pressure losses associated with the turbulent flow of a fluid through a conduit.” *Id.* at 14–15 (citing Ex. 1005, 473, Abstract). Petitioner further notes that the Holtmyer Publication describes the drag reducing properties of “a series of homo- and copolymers of alkyl styrenes, acrylates, and

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methacrylates in hydrocarbon solvents.” *Id.* at 15 (citing Ex. 1005, 473, 474, Table 1). Specifically, Petitioner focuses on the Holtmyer Publication’s preparation and testing of iDMA, which test results are presented in Table 9 of the Holtmyer Publication. *Id.* (citing Ex. 1005, Table 9). The test results demonstrate iDMA’s drag reduction in kerosene, in two types of crude oil (Cardium and Ellenberger), and in QC-1156 (primarily an aromatic hydrocarbon with an API gravity of 22.5°). *Id.* at 16 (citing Ex. 1005, Table 9).

Petitioner relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have known that a plurality of the repeating units of the iDMA polymer comprise oxygen heteroatoms.” *Id.* at 21–22 (citing Ex. 1041 ¶ 57). Petitioner further relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have understood that introduction of the iDMA polymer into [] liquid hydrocarbons” would reduce “friction loss associated with the turbulent flow through the pipeline . . . by suppressing the growth of turbulent eddies” as recited in claim 1. *Id.* at 22 (citing Ex. 1041 ¶ 71). Regarding the claim 1 requirement that “the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer,” Petitioner relies on Dr. Epps’s testimony that adding the iDMA drag reducing polymer of the Holtmyer Publication to a liquid hydrocarbon would achieve this effect. *Id.* at 23 (citing Ex. 1041 ¶¶ 76–77).

Petitioner posits that the “only limitation of claim 1 that the Holtmyer Publication does not disclose explicitly is the introduction of the iDMA drag reducing polymer into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent,” (*id.* at 24) but argues that (i) crude oils having the

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claimed properties were well known, as acknowledged in the '498 patent itself and other contemporaneous publications (*id.* at 24 (citing Ex. 1002, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been prompted by the known economic benefits associated with drag reduction to introduce the iDMA polymer into a crude oil having the claimed properties (*id.* at 25–26 (citing Ex. 1005, 473; Ex. 1041 ¶¶ 90–92)); and (iii) one of ordinary skill would have had a reasonable expectation that the iDMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 26–33 (citing Ex. 1041 ¶¶ 94–99, 100–11)). Regarding asphaltene, Petitioner argues the Holtmyer Patent addresses the effect of asphaltene content on the ability of the iDMA polymer to achieve drag reduction, relying on Dr. Epps's testimony that "the optimum quantity of polymer to be introduced to a hydrocarbon liquid may vary depending on the type of liquid hydrocarbon involved" and that "when a solid agent is suspended in the liquid hydrocarbon, it is preferable to use a somewhat larger amount of the polymer additive." *Id.* at 27–28 (citing Ex. 1040 ¶ 97 (citing Ex. 1006, 4:51–59, 4:63–75)). Regarding solubility, Petitioner argues that solubility parameters "were (and are) commonly consulted in order to predict solubility of one compound in another." *Id.* at 29 (citing Ex. 1041 ¶ 100). Petitioner relies on Carnahan (Ex. 1006, 325) and Dr. Epps's calculations of the solubility parameters of heavy, asphaltenic crude oils ("within the range between about 16.4 MPa^{1/2} and 20.5 MPa^{1/2}," Ex. 1041 ¶ 107) and the iDMA polymer ("about 17.84 MPa^{1/2}," Ex. 1041 ¶¶ 101–03) to argue that because the solubility parameter of the iDMA polymer falls squarely within the range disclosed by Carnahan, a person of ordinary skill in the art "would have had a reasonable expectation that the

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iDMA drag reducing polymer would be effective at achieving drag reduction in a liquid hydrocarbon having an API gravity less than about 26° and an asphaltene content of at least 3 weight percent undergoing turbulent flow through a pipeline.” Pet. 32.

3. Petitioner’s Ground 2—Asserted Obviousness Based on Inaoka and Carnahan

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of Inaoka and Carnahan to a method comprising all of the elements recited in claims 1–5. Pet. 33–43, 45–50.

Petitioner argues that “Inaoka discloses most of the limitations of claim 1.” *Id.* at 34. In the section of the Petition summarizing Inaoka, Petitioner characterizes Inaoka as describing a high molecular weight polymer having a straight-chain structure and being soluble in an organic solvent, and “suitably adopted as a drag reducer.” *Id.* at 17 (quoting Ex. 1007, Abstract). Petitioner further characterizes Inaoka as describing the problem of frictional pressure losses associated with the turbulent flow of fluid through a conduit, and the conventional use of drag reducers to address the problem of pressure loss. *Id.* at 17–18 (quoting Ex. 1007, 3:9–13, 14–21). Petitioner notes that Inaoka refers to drag reducing polymers that may be produced by “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent].” *Id.* at 18 (quoting Ex. 1007, 3:27). Inaoka’s drag reducing polymer “can be suitably adopted in transporting of an organic liquid such as crude oil through a conduit, such as a pipeline.” *Id.* at 19 (quoting Ex. 1007, 17:1–5). Inaoka’s two “particularly preferable” drag reducing polymers are 2-ethylhexylacrylate (“2EHA”) and 2-ethylhexylmethacrylate (“2EHMA”);

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the latter, according to Dr. Epps, is the same as Polymer A of the '498 patent. *Id.* at 20 (citing Ex. 1007, 4:48–50; Ex. 1041 ¶ 155).

Petitioner relies on Dr. Epps's testimony that "a person of ordinary skill in the art would have known that a plurality of the repeating units of the 2EHMA polymer comprise oxygen heteroatoms." *Id.* at 34 (citing Ex. 1041 ¶ 156). Petitioner further relies on Dr. Epps's testimony that "a person of ordinary skill in the art would have understood that introducing the 2EHMA polymer into crude oil flowing through a pipeline would reduce drag by suppressing the growth of turbulent eddies" as recited in claim 1. *Id.* at 35 (citing Ex. 1041 ¶ 167). Regarding the claim 1 requirement that "the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer," Petitioner relies on Dr. Epps's testimony that adding the 2EHMA drag reducing polymer of Inaoka to a liquid hydrocarbon would achieve this effect. *Id.* at 35–36 (citing Ex. 1041 ¶¶ 169–171).

Petitioner argues that although "Inaoka does not disclose introducing the 2EHMA drag reducing polymer into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26°, it would have been obvious to a person of ordinary skill in the art to do so." *Id.* at 36. Petitioner argues that (i) crude oils having the claimed properties were well known, as acknowledged in the '498 patent itself (*id.* at 37 (citing Ex. 1002, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been prompted by the known economic benefits associated with drag reduction to introduce the 2EHMA polymer into a crude oil having the claimed properties (*id.* at 37–38 (citing Ex. 1041 ¶¶ 174–76)); and (iii) one of ordinary skill would have had a reasonable expectation that

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the 2EHMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 38–43 (citing Ex. 1041 ¶¶ 178–92)).

Regarding solubility, Petitioner argues that solubility parameters “were (and are) commonly consulted in order to predict solubility of one compound in another.” *Id.* at 40 (citing Ex. 1041 ¶ 180). Petitioner relies on Carnahan (Ex. 1008, 325) and Dr. Epps’s calculations of the solubility parameters of heavy, asphaltenic crude oils (“within the range between about 16.4 MPa^{1/2} and 20.5 MPa^{1/2},” Ex. 1041 ¶ 187) and the 2EHMA polymer (“about 18.04 MPa^{1/2},” Ex. 1041 ¶¶ 181–83) to argue that, because the solubility parameter of the 2EHMA polymer falls squarely within the range disclosed by Carnahan, a person of ordinary skill in the art would have had “a reasonable expectation that the 2EHMA drag reducing polymer of Inaoka would be effective at achieving drag reduction in a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° undergoing turbulent flow through a pipeline.” Pet. 43.

Having reviewed both of Petitioner’s grounds, and the evidence in support thereof, we find that the evidence of record supports Petitioner’s arguments, and we adopt those arguments as to these grounds. Next, we consider Patent Owner’s arguments and evidence in the manner in which they were presented.

4. Patent Owner’s Arguments

a. Heavy, Asphaltenic Liquid Hydrocarbon

Patent Owner argues that neither the Holtmyer Publication nor Inaoka discloses, teaches, or suggests the claimed heavy, asphaltenic liquid hydrocarbon. PO Resp. 7–9. Rather, Patent Owner argues, the Holtmyer

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Publication discloses only processed solvents and light crudes, and Inaoka treats only kerosene and xylene. *Id.* at 8.

Petitioner replies that the claimed “liquid hydrocarbon” was well-known, and moreover, “that Holtmyer and Inaoka do not explicitly disclose the claimed liquid hydrocarbon is irrelevant because Petitioner hasn’t asserted that the claimed liquid hydrocarbon was disclosed by either reference.” Reply 10, 12. Rather, Petitioner argues, “each of Holtmyer and Inaoka discloses the use of DRAs *in crude oil generally*,” (citing Pet. 24, 36–37) and one of ordinary skill in the art would not have understood “the term ‘crude oil’ in Holtmyer and Inaoka to *exclude* heavy crude oil.” *Id.* at 10.

We are persuaded by Petitioner’s arguments on this point. As a preliminary matter, because only obviousness (and no anticipation) grounds remain at issue in this case, an argument that a particular reference does not individually disclose the exact limitation within its four corners is inapposite. Additionally, although the Holtmyer Publication and Inaoka do not specifically discuss the particular liquid hydrocarbon of the claims, “crude oil” is discussed generally. Ex. 1005, 473; Ex. 1007, 3, 4, 8. In the prosecution history of the parent application, of which the ’498 patent is a continuation, applicant represented: “Broadly speaking, the genus of crude oil can be broken down to three different broad species of heavy, medium, and light crude oil.” Ex. 1022 (Response to Final Office Action), 8. The specification of the ’498 patent provides that the “present invention relates generally to high molecular weight drag reducers for use in crude oils,” indicating that heavy, asphaltenic crude oils, as identified in the claim, are not excluded from the category of crude oils. Ex. 1002, 1:15–16. The title

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of the '498 patent is “Drag Reduction of Asphaltenic Crude Oils,” which identifies “asphaltenic” as a characteristic of certain crude oils. *Id.* at [54]. Heavy crude oil is defined as containing asphaltenes. Ex. 1062, 3; *see also* Ex. 2028 (indicating that both light crude and heavy crude contain asphaltenes). In the prosecution history, applicant further represented that the “specific characteristics of applicant’s liquid hydrocarbon are defined by one of ordinary skill in the art as ‘heavy crude oil’ or ‘heavy crude.’” Tr. 30:17–31:5; Ex. 1022, 8. Given this matrix of evidence, we are not apprised of any persuasive reason, notwithstanding Patent Owner’s arguments to the contrary, that the general category of “crude oil” would exclude the claimed liquid hydrocarbon.

b. Patent Owner’s Argument that Grounds 1 and 2 Fail Because There Would Have Been No Basis To Modify The Holtmyer Publication Or Inaoka To Add The Claimed Heavy, Asphaltenic “Liquid Hydrocarbon”

Patent Owner argues that there would have been no basis to modify the Holtmyer Publication or Inaoka to add the claimed heavy, asphaltenic “liquid hydrocarbon.” PO Resp. 9–22.

i. Economic Benefits

First, Patent Owner argues that Petitioner’s “well-known economic benefits” rationale is flawed. *Id.* at 9–10, 11–14, 16–18. In this regard, Patent Owner criticizes Dr. Epps’s testimony regarding the benefits of drag reduction based on the Holtmyer references⁸ as being “conclusory” and “problematic.” *Id.* at 11–12. Patent Owner also criticizes Dr. Epps’s testimony regarding the Holtmyer Patent and its references to suspended

⁸ We refer to the Holtmyer Publication and Holtmyer Patent collectively as the “Holtmyer references,” where appropriate.

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solid materials, which Patent Owner asserts only refer to proppants, not asphaltenes. *Id.* at 14–16.

Regarding Patent Owner’s “economic motivation” argument, Petitioner replies that the parties agree that reducing drag was known to reduce the cost of transporting crude oil via pipelines. Reply 11 (citing Ex. 1029; Ex. 1030; Ex. 2096; Ex. 1072, 9:15–10:1, 88:17–89:4). Petitioner argues that Dr. Epps supports his testimony with quotes from the Holtmyer Publication and the Holtmyer Patent that indicate the disclosures of the two references do not relate solely to hydraulic fracturing. *Id.* at 12.

We find that the Holtmyer Publication and the Holtmyer Patent—both of which are concerned with more effectively and economically moving oil through pipelines by introducing a drag reducing agent (“DRA”)—would have provided a person of ordinary skill in the art with a reason to reduce drag in a heavy, asphaltenic liquid hydrocarbon. The Holtmyer Publication is directed to a “study of oil soluble polymers as drag reducers,” which was “undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines.” Ex. 1005, 473; *see* Pet. 25–26; Ex. 1041 ¶¶ 90–92. The Holtmyer Patent, cited in Inaoka for its method of producing certain polymers, is directed to “reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit” and provides that “reduction of the frictional pressure loss in the flow of [] hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” Ex. 1006, 1:16–18, 1:56–65; Ex. 1007, 3:27; *see* Pet. 37–38; Ex. 1041 ¶¶ 174–176. Also, despite Patent Owner’s

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argument that being “economically profitable” in general is insufficient to demonstrate obviousness (PO Resp. 22), we find that the Holtmyer references are sufficiently directed to the specific economic benefits of drag reducing oil flowing through pipelines by using drag reducing agents, rather than directed generally to an unspecified market need. *Cf. Celsis In Vitro, Inc. v. CellzDirect, Inc.*, 664 F.3d 922, 928 (Fed. Cir. 2012) (explaining, in the context of affirming a preliminary injunction grant, that “vague references to ‘market need’” are not probative of obviousness).

We note, also, that in connection with its presentation of objective evidence, Patent Owner itself argues that there was “a tremendous economic incentive” to solve the long-felt, unmet need that existed before Patent Owner’s invention. PO Resp. 48 (“billions of barrels of heavy crude oil have been produced and imported into the U.S. for decades, which created a tremendous economic incentive to solve the long-felt, unmet need that existed many years before LSPI’s invention.”); *see also id.* at 45–46 (“operators needed and demanded better, safer, and more economic solutions for improving the pipeline transport of heavy crude oils.”).

Regarding Patent Owner’s argument that the Holtmyer references concern fracking, rather than transporting heavy crude oil, we observe that the Holtmyer references use hydraulic fracturing as an example, rather than as an exclusive focus. *See, e.g.*, Ex. 1005, 473 (stating generally that “it is economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells.”); Ex. 1006, 1:56–65 (describing the benefits of drag reducing agents generally). Relatedly, regarding Patent Owner’s argument that the “solid agent” the Holtmyer Patent discloses is

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“unrelated to asphaltenes” (PO Resp. 15), we credit Petitioner’s assertion that Dr. Epps never argued that the “solid agent” disclosed or referred to asphaltenes. Reply 12–13. Rather, Petitioner argues, Dr. Epps’s statement was intended to convey that a person of ordinary skill in the art would have understood that suspended solids in a liquid hydrocarbon “may necessitate a higher concentration of DRA” and would have been informative as to the potential effects of asphaltene on drag reduction, because asphaltene is a solid colloiddally suspended in crude oil. *Id.* at 13 (citing Ex. 1041 ¶¶ 95–98). After reviewing the arguments and testimony, we find this adequately supported by the record.

ii. Obvious to Try

Patent Owner argues that it would not have been “obvious to try” the drag reducing polymers in the specific claimed species of liquid hydrocarbon based on the allegedly well-known economic benefits, because Petitioner has not shown that one of ordinary skill of the art “would have chosen the particular species of liquid hydrocarbon in the claims.” PO Resp. 16–17. Because crude oils are complex, because the art was unpredictable, and because there are at least 450 different crudes in the world, Patent Owner argues that there were not a finite number of identified, predictable solutions. *Id.* at 17–18.

Petitioner replies that it would have been obvious to try a DRA in a crude oil in which it was expected to be effective. Reply 13. The Supreme Court set forth the standard for when a combination may be “obvious to try”: “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her

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technical grasp.” *KSR*, 550 U.S. at 421. The Court continued: “If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* Petitioner contends that it “has shown that one would have had an economic motivation to introduce a DRA into any pipeline-transported crude oil in which it would have been expected to be effective.” Reply 13.

Having considered the trial record as a whole, we find that Petitioner’s position is supported by the preponderance of the evidence. We have found that market pressure or economic motivation existed. *See supra* Section II.D.4.b.i.; *see, e.g.*, Ex. 1005, 473; Ex. 1006, 1:56–65; Ex. 1041 ¶¶ 90–92, 174–176. Regarding the finite number of identified, predictable solutions, drag reducing agents were well-known and were often an effective solution to the problems of flow in oil pipelines, but the effective use of drag reducing agents in heavy crude oil was difficult. Ex. 1002, 1:33–51 (“Conventional polymeric drag reducers, however, typically do not perform well in crude oils having a low API gravity and/or a high asphaltene content.”). We credit Dr. Epps’s testimony that a person of ordinary skill in the art would have had a reasonable expectation of success that the iDMA drag reducing agent of the Holtmyer Publication and the 2EHMA drag reducing agent of Inaoka would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26°. Ex. 1041 ¶¶ 93, 177. As Dr. Epps explains, success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps

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calculated for the iDMA and 2EHMA drag reducing agents. *Id.* ¶¶ 30, 94–111, 178–192; *see also id.* ¶ 73 (“solubility is necessary for drag reduction”). Accordingly, in view of the knowledge of one of ordinary skill in the art, we find that introducing the DRAs identified in the Holtmyer Publication and Inaoka into any pipeline-transported crude oil in which they would have been expected to be effective based on the parameters Petitioner identifies would have been obvious to try with a reasonable expectation of success.

Regarding Patent Owner’s criticism of Petitioner’s reliance on Buckley⁹ and Ferguson¹⁰ to assert that heavy, asphaltenic crudes were well known in 2005 and earlier (PO Resp. 10–11), we acknowledge that those references were not named as primary references, but agree with Petitioner that Dr. Epps relied upon them to support his testimony regarding, among other things, common knowledge in the art about heavy, asphaltenic crude oils and solubility parameters. Tr. 8:16–21.

iii. Conventional Wisdom

Patent Owner argues that the “conventional wisdom” of one of ordinary skill in the art was that “drag reduction of heavy crudes was generally not believed to be a viable option.” PO. Resp. 18–20 (citing Ex. 2028 (“Traditional DRA doesn’t work in heavy crude.”); Ex. 2106 (“Heavy crude oil is frequently a challenge for traditional drag reducing agents.”); Ex. 2056, 5 (“[C]urrent DRA technology does not work effectively with heavy oil.”). Patent Owner emphasized at oral hearing that

⁹ Buckley, J.S., et al., *Asphaltene Precipitation and Solvent Properties of Crude Oils*, 16 PETROLEUM SCI. & TECH. 3–4, 251–285 (1998) (Ex. 1017).

¹⁰ Ferguson, K.R., et al., *Microbial Pilot Test for the Control of Paraffin and Asphaltenes at Prudhoe Bay*, Society of Petroleum Engineers, Inc. 36630, 557–564 (1996) (Ex. 1018).

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“conventional wisdom was that it was impossible” for current DRA technology to work effectively with heavy oil. Tr. 24:2–4, 25:17–18 (“where the claimed liquid hydrocarbon was, this impossible zone where the prior art has said it won’t work here.”).

Petitioner replies that Patent Owner’s arguments “stem from a false premise that reducing drag in heavy, asphaltenic oils was thought unachievable.” Reply 2. Petitioner argued in the Petition that Patent Owner acknowledged, in its own promotional material and in arguments presented to the Office, that use of a DRA in heavy crude oil was viable. Pet. 9 n.1 (citing Exs. 1020, 1028, 1029, 1030, 1040). Petitioner also discusses this evidence in its Reply, which we consider properly responsive to Patent Owner’s argument, indicating that reducing drag in heavy, asphaltenic crude oils was not an unexpected result since at least the 1980s. Reply 2–3 (citing Ex. 1040, 25 (examining achievement of drag reduction in heavy crude oil); Ex. 1028–1030 (indicating that Patent Owner’s own traditional DRAs were marketed for reducing drag in heavy crude oils); Ex. 1074–1076 (examining drag reduction of heavy crude oils); Ex. 1078–1079, 1081–1082 (discussing 7–27% drag reduction of three heavy crude oils having API gravities of 23.7°, 25° and 21.8°, and asphaltene contents of 10–11 wt.%, 8–13 wt.% and 9 wt.%, respectively, by Patent Owner’s drag reducing products)).

Petitioner further replies that Patent Owner’s “conventional wisdom” argument relates only to “traditional” polyalphaolefin DRAs and not to the acrylate/methacrylate DRAs of the prior art. Reply 4–5. Thus, Petitioner argues, even if “traditional” polyalphaolefins were ineffective in heavy crude oil—and Petitioner asserts they were not—Patent Owner’s expert says

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nothing about the conventional wisdom regarding acrylate/methacrylate polymers, such as those Holtmyer and Inaoka disclose. *Id.* (citing Ex. 2050 ¶¶ 102–103; Ex. 1072, 52:23–53:8, 55:17–23). Additionally, Petitioner argues, the “perceived shortcomings of polyalphaolefin DRAs in heavy crude oil would have motivated a POSA to try other types of DRAs, such as the acrylate/methacrylate DRAs of Holtmyer and Inaoka.” *Id.* at 6. At oral hearing, Petitioner criticized Patent Owner’s “impossibility” argument as not “supported by its own evidence,” which characterized traditional DRAs as not working well in heavy crude oil and not efficient as drag reducing additives in heavy crude oil, but “they still reduce drag and that’s exactly what’s shown in Patent Owner’s marketing materials.” Tr. 44:14–45:1.

In this regard, we agree with Petitioner. Although Patent Owner was pressed at oral hearing to identify a point at which the characteristics of heavy crude oil rendered drag reduction impossible, it was unable to do so. Tr. 33:18–34:16. Petitioner’s evidence indicates that drag reduction with traditional DRAs was not particularly efficient, but extant. Accordingly, Patent Owner’s addition of a drag reducing agent to a heavy crude oil was not as unexpected or novel as Patent Owner argues. Moreover, Patent Owner, despite filing a Sur-Reply, did not address Petitioner’s argument distinguishing traditional polyalphaolefins from acrylate/methacrylate polymers. Accordingly, we find that “conventional wisdom” was not that drag reduction of heavy asphaltenic crude oils was impossible, but simply that it wasn’t being done as well as it could have been as of the critical date.

iv. Hindsight

Finally, Patent Owner argues that Petitioner’s argument to add the claimed heavy, asphaltenic liquid hydrocarbon is based on hindsight. PO

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Resp. 21–22. Petitioner replies that “one would have had an economic motivation to introduce a DRA into any pipeline-transported crude oil in which it would have been expected to be effective,” and that no hindsight would be required. Reply 13. We do not find Petitioner’s obviousness analysis to be based on hindsight reconstruction. Petitioner articulates a reason having rational underpinnings for making a proposed combination of the prior art teachings of the Holtmyer Publication, the Holtmyer Patent, and Carnahan, as well as Inaoka and Carnahan, namely, that crude oils having the claimed properties were well known, and that one of ordinary skill would have been prompted by known economic benefits and would have had a reasonable expectation that the identified DRAs would be effective. Pet. 24–33, 36–43. We find that Petitioner’s articulated reasoning is effective to support its contentions of obviousness. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”).

c. Drag Reduction Limitation

Patent Owner argues that none of the prior art references teach or suggest the drag reduction limitation. PO Resp. 22–30. First, Patent Owner argues that drag reduction is a substantive limitation of the claims. *Id.* at 22–27. Next, Patent Owner argues that none of the cited prior art references teach or suggest “drag reduction of the claimed, heavy asphaltenic ‘liquid hydrocarbon.’” *Id.* at 27. Finally, Patent Owner argues

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that Petitioner's combinations fail under *KSR* because Patent Owner's claimed invention yielded more than a predictable result. *Id.* at 29 (citing PO Resp. Section III(B)(2)(d), concerning "conventional wisdom").

Petitioner does not appear to materially dispute that drag reduction is a substantive limitation of the claims. Reply 11. Given Patent Owner's arguments and given the lack of a dispute between the parties, we consider the limitation as substantive. Petitioner replies that, notwithstanding whether the drag reduction limitation is a claim limitation, evidence shows that it would have been obvious for a person of ordinary skill in the art "to have introduced the DRAs of Inaoka and/or Holtmyer into the claimed liquid hydrocarbon to reduce drag (i.e., have the intended effect) in that hydrocarbon." *Id.* For the reasons articulated in the Petition, we are persuaded by Petitioner's argument. With respect to Ground 1, Dr. Epps testifies that the reduction in frictional pressure loss demonstrated in Table 9 of the Holtmyer Publication is brought about by the ability of the iDMA drag reducing agent to suppress the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See* Pet. 22 (citing Ex. 1041 ¶ 71). Similarly, for Ground 2, Dr. Epps testifies that a person of ordinary skill in the art would have understood that the drag reducing polymers of Inaoka achieve a reduction in frictional pressure losses associated with turbulent flow by suppressing the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See id.* at 35 (citing Ex. 1041 ¶ 167). Accordingly, Petitioner has shown sufficiently that the

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references disclose introducing a drag reducing polymer into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies.

Regarding Patent Owner's second point that none of the cited prior art references teach or suggest drag reduction of the claimed heavy, asphaltenic liquid hydrocarbon, we note that all remaining grounds in this case are based on obviousness, and thus, it is not imperative that any one of the cited prior art references teach drag reduction of the claimed liquid hydrocarbon within its four corners. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Our discussions regarding the suggestions of the references and the obviousness of the claimed combinations are interspersed throughout this opinion and directed to this point.

Regarding Patent Owner's third point, Petitioner replies that there is no evidence of "unpredictability," in that Dr. Dunn's testimony relies on a single discredited document, and that the cited examples in the '498 patent do not provide enough information to assess whether the results were predictable. Reply 17–18. We are not persuaded that the drag-reducing result of using DRAs in the claimed hydrocarbon is "unpredictable." Although some unpredictability may exist as to whether a particular DRA will work in a particular hydrocarbon (Ex. 2050 ¶ 148), the art sets forth general guidelines to assist one of ordinary skill in the art in this determination. Ex. 1041 ¶¶ 99–111, 178–192. We agree with Petitioner that the weight of the evidence presented in this case indicates that there are "correlations between solubility parameters and drag reduction" that one of ordinary skill in the art would have used to determine whether a particular DRA would be effective in a particular liquid hydrocarbon, which is

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contrary to Dr. Dunn's assertions of unpredictability and contrary to Dr. Dunn's reliance on Exhibit 2137 ("Transport Phenomena: A Unified Approach"). Reply 17 (citing Ex. 2050 ¶ 148; Ex. 1088–1091 (articles examining the effects of solubility parameters on drag reduction)). We also agree that the examples cited in the '498 patent do not support Patent Owner's assertions of unpredictability, as they do not disclose the solubility parameters that would allow for such a conclusion. *Id.* at 18. Accordingly, because we determine that claimed invention yields no more than a predictable result, Petitioner's asserted prior art combinations do not fail.

d. Reasonable Expectation of Success

Patent Owner argues that there would have been no reasonable expectation of success to make Petitioner's combinations. PO Resp. 30–39. First, Patent Owner argues that there was no reason to combine Carnahan with the Holtmyer references or Inaoka, because Carnahan is a disparate reference directed to a different endeavor than the Holtmyer references and Inaoka (*id.* at 30), and because the Petition presents no evidence that one of ordinary skill in the art would have used solubility parameters to match DRAs to crude oils (*id.* at 31). Second, Patent Owner argues that there would have been no reasonable expectation of success in combining the prior art references. *Id.* at 32. More particularly, Patent Owner argues that Dr. Epps's conflicting opinions on the solubility parameter range fail to show a reasonable expectation of success (*id.* at 33), and a solubility parameter match does not indicate a reasonable expectation of success (*id.* at 35). Finally, Patent Owner argues that conventional wisdom disproves motivation to combine with any reasonable expectation of success. *Id.* at 38. Regarding this last argument, we have addressed variations of the

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“conventional wisdom” argument above, and incorporate those findings herein.

Regarding Patent Owner’s first argument, Petitioner replies that “there is no sound reason why” a person of ordinary skill in the art would disregard the disclosure of Carnahan, a published scientific work that reports a solubility parameter range for heavy crude oils based on experimental data. Reply 15–16. Patent Owner’s argument in this regard appears to be that Carnahan is non-analogous art. To rely upon a reference as a basis for unpatentability, the reference must either (1) be in the field of the inventor’s endeavor or (2) be reasonably pertinent to the particular problem with which the inventor was concerned. *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992). In determining whether a reference is reasonably pertinent to the problem, “it is necessary to consider ‘the reality of the circumstances’ . . . in other words, common sense.” *Id.* (quoting *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979)). That is, “[r]eferences are selected as being reasonably pertinent to the problem based on the judgment of a person having ordinary skill in the art.” *In re Kahn*, 441 F.3d 977, 987 (Fed. Cir. 2006) (citing *Oetiker*, 977 F.2d at 1447).

Here, we find that Carnahan is at least reasonably pertinent to one of the problems confronting the inventors of the ’498 patent. It was known prior to the ’498 patent that solubility of the drag reducing polymer in the liquid hydrocarbon was necessary to achieve drag reduction, and an important requirement in preparing a more effective drag reducing polymer. Ex. 1041 ¶ 29; Ex. 1014, 800–802; Ex. 1015, 1550; *see* Ex. 1002, 1:45–46. Thus, the inventors of the ’498 patent would have been concerned about whether the drag reducing polymer was soluble in the liquid hydrocarbon

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being treated by the polymer. Carnahan, which discloses solubility parameter ranges that one of ordinary skill in the art would have applied to hydrocarbons, is reasonably pertinent to that problem. *See* Reply 15–16.

Regarding Patent Owner’s second argument, Petitioner replies that Dr. Epps’s opinions about solubility parameters based on different references highlight “the remarkably similar solubility parameter ranges obtained using *different methods* described in *different references*.”

Reply 15. We agree. The parties also seem to agree that different methods are available to determine solubility parameters, and solubility parameters obtained by different methods may vary. Ex. 1092 ¶ 20; Ex. 1072, 116:22–117:5; Ex. 1105, 39:5–16. The differences here are insignificant enough that they do not undermine our ultimate findings based on Dr. Epps’s solubility parameter calculations.

Petitioner further replies that it is “irrelevant that solubility alone does not provide an expectation of success.” Reply 16. Petitioner reiterates that its argument is not based on solubility alone, but on Dr. Epps’s assertions that “(1) a DRA must have a straight-chain structure, high molecular weight, and solubility in the target fluid; (2) Holtmyer and Inaoka disclose polymers having the structure and molecular weight necessary to reduce drag; and (3) using solubility parameters, one would [have] predict[ed] that those polymers would be soluble in heavy, asphaltenic crude oil.” *Id.* (citing Ex. 1041 ¶¶ 30, 111, 192). We agree that Petitioner’s case is more multifaceted than just solubility alone. As discussed above in connection with our discussion of a reason to combine the teachings of the asserted references, we credit Dr. Epps’s testimony not only regarding the reasonable expectation of success that the iDMA and 2EHMA drag reducing polymers

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would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26° (Ex. 1041 ¶¶ 93, 177), but also that such success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps calculated (*id.* at ¶¶ 30, 94–111, 178–192). *See supra* Section II.D.4.b. Taken together, the evidence presented by Petitioner underscores that one of ordinary skill in the art would have had a reasonable expectation of success in achieving the claimed method according to Petitioner’s asserted prior art combination.

Petitioner also argues that the “well-known correlation between solubility and drag reduction” enabled Patent Owner “to identify known DRAs for use in heavy oil.” Reply 6. To counter Patent Owner’s argument that using solubility parameters was inventive, Petitioner relies on Dr. Epps’s testimony that a person of ordinary skill in the art would have known that solubility parameters could be used to predict the effectiveness of a drag reducing polymer in a particular fluid, such as a crude oil, and to several articles describing the relationship between solubility parameters and drag reduction. *Id.*; Ex. 1092 ¶¶ 4–9; Ex. 1088, 538 (“drag reduction is greatest when the solubility parameters of solvent and polymer are equal”); Ex. 1089. According to Petitioner, Patent Owner “did no more than apply known solubility parameter relationships to identify known drag reducing polymers that one would expect to be effective in known crude oils. That is the epitome of obviousness.” Reply 7. In this regard, we agree with Petitioner. Introducing a drag reducing agent into a liquid hydrocarbon was

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well-known; the additional limitations Patent Owner added do not overcome this shortcoming. We credit Dr. Epps's testimony that one of ordinary skill in the art would have considered a number of factors, including solubility parameters informing whether a particular drag reducing agent would dissolve in a particular liquid hydrocarbon, to determine the optimum drag reducing agent for a particular crude oil.

e. Objective Evidence

Patent Owner argues that objective evidence supports the nonobviousness of the challenged claims. PO Resp. 39–71.¹¹ Generally, Patent Owner argues that the evidence of record demonstrates that the industry “had a long-felt need, actively tried and failed to find a DRA solution, was stunned by the surprising and unexpected results achieved by the 498 Patent, praised it, and then blatantly copied it.” *Id.* at 39; *see id.* at 45–48 (long-felt need), 48–49 (failure of others), 50–51 (skepticism of experts and unexpected results), 51–52 (praise), 52–54 (commercial success), 55–70 (copying), 71 (acquiescence).

Notwithstanding what the teachings of the prior art would have suggested to one of ordinary skill in the art at the time of the invention, the totality of the evidence submitted, including objective evidence of nonobviousness, may lead to a conclusion that the claimed invention would not have been obvious to one of ordinary skill. *In re Piasecki*, 745 F.2d 1468, 1471–1472 (Fed. Cir. 1984). “For objective evidence of secondary considerations to be accorded substantial weight,” however, “its proponent

¹¹ In this section, we cite to the confidential versions of Patent Owner's Response and Dr. Dunn's declaration, and the arguments and testimony contained therein.

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must establish a nexus between the evidence and the merits of the *claimed invention*.” *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (quoting *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010)). “[N]exus” is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). We apply “a presumption of nexus for objective considerations when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘is the invention disclosed and claimed in the patent.’” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016) (citations omitted). Patent Owner bears the burden of showing that the product or method “is the invention disclosed and claimed in the patent.” *See Demaco*, 851 F.2d at 1392 (discussing a patent owner’s burden in the context of commercial success).

Patent Owner’s argument regarding nexus as to any of its identified secondary considerations is that it is entitled to a presumption of nexus because its evidence is tied to specific products that embody the claims of the ’498 patent. PO Resp. 41; Tr. (confidential) 6:10 (“You don’t get a more direct case of nexus.”). In that regard, Patent Owner contends that its Extreme Power, EP-1000, and EP-2000 products contain the drag reducing polymer [REDACTED] [REDACTED] PO Resp. 41. Patent Owner directs us to [REDACTED] as evidence that [REDACTED] a component of the [REDACTED] products, reduces drag in AHS crude, a heavy, asphaltenic crude oil. [REDACTED] [REDACTED]

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Rather, the challenged claim recites a method of introducing a polymer into a hydrocarbon flowing in a pipeline. *See*, Ex. 1002, 19:17–20:4. Thus, the evidence of record does not indicate that Petitioner, Patent Owner, or Flowchem produces a commercial product that is coextensive with the method recited in the challenged claim. As a result, we determine that Patent Owner is not entitled to a presumption of nexus for any of its proffered secondary considerations. Because Patent Owner does not direct us to additional evidence to establish nexus, Patent Owner does not establish on this record a nexus between its proffered secondary considerations evidence and the claimed invention.

5. Conclusions as to Obviousness

Having considered the parties’ arguments and evidence, we evaluate all of the evidence together to make a final determination of obviousness. *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1075 (Fed. Cir. 2012) (stating that a fact finder must consider all evidence relating to obviousness before finding patent claims invalid). After considering the parties’ arguments and evidence, we are persuaded that Petitioner has made a sufficient showing that a person having

that Petitioner created its FLO ULTIMA product “with the [REDACTED]

PO Resp. 63; *see id.* at 65 (arguing that Flowchem “used LSPI’s Patent Specification as a blueprint” to move “to a substantially different DRA product, [REDACTED]

[REDACTED] But claim 3 encompasses a method of introducing into a pipeline any drag reducing polymer, wherein a plurality of the repeating units comprise a heteroatom selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a phosphorus atom.

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ordinary skill in the art would have combined the teachings in the manner proposed by Petitioner. We conclude that Petitioner has satisfied its burden of demonstrating, by a preponderance of the evidence, that the subject matter of claim 3 of the '498 patent would have been obvious over the combined teachings of Holtmyer Publication, Holtmyer Patent, and Carnahan, and that the subject matter of claim 3 would have been obvious over the combined teachings of Inaoka and Carnahan.

III. MOTION TO EXCLUDE

Patent Owner moves to exclude (1) Exhibits 1062, 1073–82, 1088–91, 1102, and 1092 ¶¶ 4–9, and pages 1–7, 10–11, 13–14, and 17 of Petitioner’s Reply as involving “new theories, arguments, and evidence that exceed the scope of the Petition and are thus irrelevant to the instituted grounds under F.R.E. [Federal Rules of Evidence] 401–403”; (2) Exhibits 1074–78, 1083–87, 1094, 1096–1100, and pages 3, 20, and 21 of Petitioner’s Reply, which involve Patent Owner’s “internal communications and documents that were not public or prior art and thus are irrelevant to the instituted grounds under F.R.E. 401–403”; and (3) Exhibit 1092 ¶¶ 2–3 and ¶¶ 85–91, and the related arguments on pages 9, 10, and 30 of Petitioner’s Reply as “unsupported and unreliable” under *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993) and F.R.E. 702. Paper 63 (redacted), 1; Paper 61 (redacted).

Petitioner filed a Response (Paper 55 (redacted)). With respect to the first category of exhibits, or portions thereof, and portions of Petitioner’s Reply that Patent Owner seeks to exclude, Petitioner argues that Exhibits 1062, 1073–82, and 1102 respond to Patent Owner’s arguments regarding “surprising and unexpected results,” Exhibits 1088–91 and 1092 ¶¶ 4–9 do not raise new theories, but are “completely consistent with arguments made

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in the Petition,” pages 1–7, 10–11, 13–14, and 17 of Petitioner’s Reply are attorney argument, which should not be the subject of a Motion to Exclude, and that Patent Owner fails to identify any new arguments raised for the first time in the Reply. Paper 55, 1–4. Having reviewed these exhibits and papers, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence exceed the scope of a proper reply; rather, they are properly responsive and may be considered as part of our evaluation of the record.

With respect to the second category of exhibits and Reply pages that Patent Owner seeks to exclude, Petitioner argues that Patent Owner “relies almost exclusively on internal, confidential documents as support for its assertion of unexpected results,” and that the documents dated after the priority date of the subject patent refer to prior art and, therefore, are relevant. Paper 55, 6–7. Again, having reviewed these exhibits and the Reply pages, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence are irrelevant. Patent Owner’s arguments appear directed to the weight to be given to the documents and argument sought to be excluded, rather than to their admissibility.

As to the third category of exhibits and Reply pages Patent Owner seeks to exclude, Petitioner argues that Patent Owner failed to object to paragraphs 2 and 3 of Exhibit 1092 in a timely manner, and Patent Owner does not respond. Paper 55, 8; Paper 61, 4. Patent Owner must object timely to the evidence it seeks to exclude. 37 C.F.R. § 42.64(b)(1). Petitioner further argues that Dr. Epps’s expertise qualifies him to provide the testimony given in Exhibit 1092. Paper 55, 9. We decline to exclude

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any of this testimonial evidence or any portions of the Reply and, instead, give the evidence more or less persuasive value depending on the degree to which the testimony is supported by reasoning, fact, and Dr. Epps's expertise.

Accordingly, the Motion to Exclude is *dismissed*.

IV. MOTIONS TO SEAL

Patent Owner and Petitioner each filed unopposed Motions to Seal portions of certain papers and exhibits. Paper 18; Paper 26; Paper 27; Paper 36; Paper 45; Paper 49; Paper 56; Paper 58; Paper 60. The Board previously entered a protective order to govern the confidential information produced and filed in this proceeding. Paper 17, 2–4 (granting Patent Owner's motion for entry of a protective order and placing Patent Owner's modified protective order (Paper 14, Addendum A) into effect).

In its first Motion to Seal, Patent Owner seeks to seal portions of the Patent Owner Response and "certain exhibits to the Patent Owner Response that contain confidential information" belonging to Patent Owner, Petitioner, and/or Flowchem, including portions of Dr. Dunn's declaration (Ex. 2050). Paper 18, 1. Other than Dr. Dunn's declaration, Patent Owner does not identify any of the exhibits it seeks to seal. *Id.* In its second Motion to Seal, Patent Owner seeks to seal a sentence, and its accompanying citation, in its Opposition to Petitioner's Motion for Additional Discovery. Paper 27, 1. In its third Motion to Seal, Patent Owner moves to seal a portion of its Motion to Exclude and a portion of its Sur-Reply. Paper 45, 1. In its fourth Motion to Seal, Patent Owner moves to seal portions of its Motion for Observations on Cross-Examination. Paper 49, 1. In its fifth Motion to Seal, Patent Owner moves to seal Exhibit 2154 (Dr. Epps's deposition transcript). Paper

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58, 1. In its sixth Motion to Seal, Patent Owner moves to seal its Reply to Patent Owner's Motion to Exclude. Paper 60, 1.

In its first Motion to Seal, Petitioner seeks to seal Exhibit 1070, which it filed in redacted and unredacted versions. Paper 26, 1. In its second Motion to Seal, Petitioner seeks to seal Exhibits 1074, 1075, 1076, 1077, 1078, 1083, 1084, 1085, 1086, 1087, 1094, 1096, 1097, 1098, 1099, 1100, and 1108, portions of Exhibit 1072 (Dr. Dunn's cross-examination transcript), portions of Exhibit 1092 (Dr. Epps's reply declaration), portions of its Reply, and its updated exhibit list. Paper 36, 1. In its third Motion to Seal, Petitioner moves to seal portions of its Response to Patent Owner's Motion for Observations on Cross-Examination and its Opposition to Patent Owner's Motion to Exclude. Paper 56, 1.

“There is a strong public policy for making all information filed in a quasi-judicial administrative proceeding open to the public, especially in an *inter partes* review which determines the patentability of claims in an issued patent and therefore affects the rights of the public.” *Garmin Int'l v. Cuozzo Speed Techs., LLC*, IPR2012-00001, slip op. at 1-2 (PTAB Mar. 14, 2013) (Paper 34). For this reason, except as otherwise ordered, the record of an *inter partes* review trial shall be made available to the public. *See* 35 U.S.C. § 316(a)(1); 37 C.F.R. § 42.14. The standard for granting a motion to seal is good cause. 37 C.F.R. § 42.54. That standard includes showing that the information addressed in the motion to seal is truly confidential, and that such confidentiality outweighs the strong public interest in having the record open to the public. *See Garmin*, slip op. at 2-3.

After having considered the submissions, we deny the Motions to Seal without prejudice. We are not persuaded that the parties establish good

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cause to seal all of the information identified in their respective motions. For example, both Petitioner and Patent Owner assert that certain information should be sealed because it previously was designated “confidential information,” “highly confidential information,” “protective order material,” or “outside attorneys eyes only” material. *See, e.g.*, Paper 18, 1; Paper 26, 1; Paper 36, 1. As noted above, except for Dr. Dunn’s declaration, Patent Owner’s first Motion to Seal does not identify any of the exhibits it seeks to seal.

We deny the motions without prejudice, and order the parties to work together to jointly file a motion to seal, setting forth: (1) each paper or exhibit that the parties seek to seal, in part or in full; (2) a showing why the information in each paper or exhibit (or the portions thereof) that the parties seek to seal is truly confidential; and (3) a clear identification, by paper or exhibit number, of the redacted and unredacted versions of each paper or exhibit that the parties seek to seal. To the extent that the parties have not yet filed redacted versions of each paper and exhibit they seek to seal, the parties shall file such redacted versions.

We further note that this decision will be entered as a non-public version covering protective order material because it references and cites several documents subject to the parties’ Motions to Seal. The parties may, as part of the joint motion to seal, request that the Board seal portions of this decision and/or the two oral hearing transcripts (Paper 65, Paper 66). The parties shall provide a joint proposed redacted version of this decision and/or the oral hearing transcript exhibits with the joint motion to seal. We caution the parties that there is a strong public interest in an unsealed Final Written Decision, and any justification to seal the decision must meet the good cause

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standard. Furthermore, any proposed redactions to the decision and the oral hearing transcript should be narrowly tailored.

The parties are authorized to file the joint motion to seal within ten (10) business days of the date of this decision. The parties shall meet and confer in good faith as necessary to comply with our orders in this decision. 37 C.F.R. § 42.11.

V. CONCLUSION

For the foregoing reasons, we determine that Petitioner establishes, by a preponderance of the evidence, that claim 3 of the '498 patent is unpatentable under 35 U.S.C. § 103 as obvious over the combination of the Holtmyer Publication, the Holtmyer Patent, and Carnahan, and unpatentable under 35 U.S.C. § 103 as obvious over the combination of Inaoka and Carnahan.

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner establishes, by a preponderance of the evidence, that claim 3 of the '498 patent is unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed* as moot;

FURTHER ORDERED that Patent Owner's and Petitioner's Motions to Seal are *denied* without prejudice;

FURTHER ORDERED that within ten (10) business days of this decision, the parties shall file a joint motion to seal in accordance with the instructions set forth above; and

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FURTHER ORDERED that this is a Final Written Decision;
therefore, parties to the proceeding seeking judicial review of the decision
must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Paper No. 65
Entered: April 4, 2018

BOARD AND PARTIES ONLY

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAKER HUGHES, a GE COMPANY, LLC
(f/k/a BAKER HUGHES INCORPORATED),¹
Petitioner,

v.

LIQUIDPOWER SPECIALTY PRODUCTS INC.
(f/k/a/ LUBRIZOL SPECIALTY PRODUCTS, INC.),
Patent Owner.

Case IPR2016-01905
Patent 8,450,250 B2

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and
MICHELLE N. ANKENBRAND, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION

Holding Claims 1–9 Unpatentable
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

Dismissing Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

Denying Without Prejudice Petitioner's and Patent Owner's Motions to Seal
37 C.F.R. § 42.54

¹ Petitioner represents that its name has changed from Baker Hughes Incorporated to Baker Hughes, a GE Company, LLC. Paper 20, 2. Accordingly, we modify the case caption to reflect that change.

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I. INTRODUCTION

Baker Hughes, a GE Company, LLC (f/k/a Baker Hughes Incorporated) (“Petitioner”) requested an *inter partes* review of claims 1–9 of U.S. Patent No. 8,450,250 B2 (“the ’250 patent,” Ex. 1004). Paper 2 (“Pet.”). LiquidPower Specialty Products Inc. (f/k/a/ Lubrizol Specialty Products, Inc.) (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). We instituted an *inter partes* review of claims 1–9 on certain grounds of unpatentability alleged in the Petition. Paper 10 (“Dec.”).

After institution of trial, Patent Owner filed a Patent Owner Response. Paper 19 (“PO Resp.” (public version)). Petitioner filed a Reply. Paper 31 (“Reply” (public version)). Patent Owner, with Board authorization, filed a Sur-Reply. Paper 40 (“Sur-Reply” (public version)). An oral hearing was held on December 4, 2017. A transcript of the hearing is included in the record. Paper 64 (“Tr.” (public version)).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has established by a preponderance of the evidence that claims 1–9 of the ’250 patent are unpatentable.

A. *Related Proceedings*

Petitioner identifies the following pending litigation involving the ’250 patent: *Lubrizol Specialty Products, Inc. v. Baker Hughes Inc.*, No. 4:15-cv-02915 (S.D. Tex.). Pet. 3; Paper 20, 3. Petitioner also identifies U.S. Patent Application No. 13/209,119, filed on August 12, 2011, as pending, and represents that the ’119 application claims benefit to, and is a continuation in part of, U.S. Patent Application No. 11/615,539 (now U.S.

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Patent No. 8,022,118, “the ’118 patent”) to which the ’250 patent claims priority. Pet. 3.

Petitioner identifies two additional instituted *inter partes* review proceedings involving Petitioner’s challenges to patents related to the ’250 patent: IPR2016-01901 (challenging U.S. Patent No. 8,450,249 B2), and IPR2016-01903 (challenging U.S. Patent No. 8,426,498 B2). *See* Pet. 2; Paper 9, 3. Petitioner also filed an earlier Petition requesting an *inter partes* review of the ’118 patent. *Baker Hughes Inc. v. Lubrizol Specialty Prods., Inc.*, Case IPR2016-00734 (“734 IPR”), Paper 2. We issued a final written decision in the 734 IPR on October 1, 2017. 734 IPR, Paper 79; Paper 85 (public version).

B. The ’250 Patent

The ’250 patent, titled “Drag Reduction of Asphaltenic Crude Oils,” issued on May 28, 2013. Ex. 1004, at [54], [45]. The ’250 patent relates to a “method of preparing a drag reducing polymer wherein the drag reducing polymer is able to be injected into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies,” in which the “drag reducing polymer is injected into a pipeline of liquid hydrocarbon [] having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon.” *Id.* at [57].

According to the specification, “[w]hen fluids are transported by a pipeline, there is typically a drop in fluid pressure due to the friction between the wall of the pipeline and the fluid.” *Id.* at 1:20–22. The pressure drop increases with increasing flow rate, resulting in energy losses and inefficiencies that increase equipment and operation costs. *Id.* at 1:24–32.

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The problems associated with pressure drop are most acute when fluids are transported over long distances. *Id.* at 1:29–31.

Before the '250 patent, it was known to use drag reducing polymers in the fluid flowing through a pipeline to alleviate the problems resulting from pressure drop. *Id.* at 1:33–35. A drag reducing polymer “is a composition capable of substantially reducing friction loss associated with the turbulent flow of a fluid through a pipeline,” and such a composition works by “suppress[ing] the growth of turbulent eddies, which results in higher flow rate at a constant pumping pressure.” *Id.* at 1:37–42. Drag reduction generally “depends in part upon the molecular weight of the polymer additive and its ability to dissolve in the hydrocarbon under turbulent flow.” *Id.* at 1:44–46.

According to the specification, because conventional drag reducing polymers do not perform well in crude oils having a low API gravity² and/or a high asphaltene content, there exists a need for “improved drag reducing agents capable of reducing the pressure drop associated with the turbulent flow of low API gravity and/or high-asphaltene crude oils through pipelines.” *Id.* at 1:49–54. The subject matter of the disclosed invention, therefore, “relates generally to high molecular weight drag reducers for use in crude oils.” *Id.* at 1:15–16. More specifically, the '250 patent discloses a method for reducing the pressure drop associated with flowing a liquid hydrocarbon through a conduit, such as a pipeline. *Id.* at 2:66–3:1. The method comprises preparing a drag reducing polymer that is able to be

² The specification defines API gravity as “the specific gravity scale developed by the American Petroleum Institute for measuring the relative density of various petroleum liquids.” *Id.* at 4:3–6.

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injected into a pipeline, into a liquid hydrocarbon having an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° to produce a treated liquid hydrocarbon wherein the viscosity is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer. *Id.* at 19:30–44. The '250 patent provides several examples of suitable heavy crude oils and blended heavy crude oils. *Id.* at 4:44–53, Table 1.

The specification further explains that, “[i]n order for the drag reducing polymer to function as a drag reducer, the polymer should dissolve or be substantially solvated in the liquid hydrocarbon.” *Id.* at 11:45–47. The liquid hydrocarbon and the drag reducing polymer, therefore, have solubility parameters that can be determined according to known methods. *Id.* at 4:25–40 (setting forth known methods for determining the solubility parameter of the liquid hydrocarbon), 11:53–12:25 (setting forth known methods for determining the solubility parameter of the drag reducing polymer).

C. *Illustrative Claim*

Claims 1, 8, and 9 are independent claims of the '250 patent. Claim 1 is illustrative of the challenged claims and recites:

1. A method of preparing a drag reducing polymer comprising:

preparing the drag reducing polymer with a solubility parameter within 4 MPa^{1/2} of the solubility parameter of a liquid hydrocarbon;

wherein the drag reducing polymer is able to be injected into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies, into the liquid hydrocarbon having an asphaltene content of at least 3 weight percent and

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an API gravity of less than about 26° to thereby produce a treated liquid hydrocarbon wherein the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer;

the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw; and

a plurality of the repeating units comprise a heteroatom.

Ex. 1004, 19:30–47.

D. Instituted Grounds of Unpatentability

We instituted an *inter partes* review of claims 1–9 of the '250 patent on two grounds. Dec. 31.

Reference(s)	Statutory Basis	Claim Challenged
Holtmyer Publication, ³ Holtmyer Patent, ⁴ and Strausz ⁵	§ 103(a)	1–9
Inaoka ⁶ and Strausz	§ 103(a)	1–9

Petitioner relies on the declarations of Thomas H. Epps, III, Ph.D. (Ex. 1041; Ex. 1115 (public version)). Patent Owner relies on the declaration of Brian Dunn, Ph.D. (Ex. 2141 (public version)).

³ Marlin D. Holtmyer & Jiten Chatterji, *Study of Oil Soluble Polymers as Drag Reducers*, 20 POLYMER ENG'G & SCI. 7, 473–77 (1980) (“Holtmyer Publication”) (Ex. 1005).

⁴ U.S. Patent No. 3,758,406, issued September 11, 1973 (“Holtmyer Patent”) (Ex. 1006).

⁵ OTTO P. STRAUZ & ELIZABETH M. LOWN, *The Chemistry of Alberta Oil Sands, Bitumens and Heavy Oils* 464–480 (2003) (“Strausz”) (Ex. 1009).

⁶ European Pat. App. No. EP 0,882,739 A2, published December 9, 1998 (“Inaoka”) (Ex. 1007).

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II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable constructions in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under the broadest reasonable construction standard, claim terms are presumed to have their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Only those terms which are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner submits that we need not construe any claim term for purposes of this decision. Pet. 14. Patent Owner does not appear to propose any claim constructions in its Response. We determine that no claim terms require construction.

B. Level of Ordinary Skill in the Art

Petitioner proposes a detailed definition of one of ordinary skill in the art. Pet. 11–13 (citing Ex. 1041 ¶¶ 18–20, 22, 42). Patent Owner does not, in its Response, appear to dispute this definition. In light of the evidence before us, we adopt Petitioner’s definition of one of ordinary skill in the art.

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We also find that Petitioner's proposed level of skill in the art is reflected by the references themselves. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) ("the absence of specific findings on the level of skill in the art does not give rise to reversible error 'where the prior art itself reflects an appropriate level and a need for testimony is not shown.'"); *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (finding that the Board of Patent Appeals and Interferences did not err in concluding that the level of ordinary skill in the art was best determined by the references of record).

C. Overview of the Asserted References

1. Holtmyer Publication

The Holtmyer Publication, titled "Study of Oil Soluble Polymers as Drag Reducers," was published in 1980. Ex. 1005, 473. The Holtmyer Publication is directed to an investigation "undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines." *Id.* at Abstract. A decrease in friction loss "would allow lower energy consumption or alternatively an increased flow rate under the original pumping conditions," making a decrease in friction loss "desirable" and "economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells." *Id.* at 473. Among the polymers for drag reduction synthesized and described by the Holtmyer Publication is poly(isodecyl methacrylate) ("iDMA"), which was tested for drag reduction in kerosene, QC-1156, Cardium, and Ellenberger. *Id.* at 476, Table 9.

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2. *Holtmyer Patent*

The Holtmyer Patent, titled “Methods and Compositions for Reducing Frictional Pressure Loss in the Flow of Hydrocarbon Liquids,” issued in 1973. Ex. 1006. The Holtmyer Patent relates to “methods and compositions for reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit.” *Id.* at 1:15–18. Regarding frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids, the Holtmyer Patent provides that “considerable energy generally in the form of pumping horsepower must be expended” in order to compensate for such pressure loss and, thus, “reduction of the frictional pressure loss in the flow of such hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” *Id.* at 1:56–65. The Holtmyer Patent provides examples of “suitable monomers which may be utilized to form the polymer additives of the present invention.” *Id.* at 3:3–20. When using the polymer additive “with a well-treating fluid containing sand or other solid agent suspended therein,” the Holtmyer Patent states that “it is preferable to use a somewhat larger amount of the polymer additive.” *Id.* at 4:63–67.

3. *Inaoka*

Inaoka, titled “High Molecular Weight Polymer and Producing Method the Same and Drag Reducer,” relates to a method of producing a high molecular weight polymer in which “dissolved oxygen existing in a solvent in a radical polymerization reaction is removed, and to a high molecular weight polymer obtained by the same, and to a drag reducer.” Ex. 1007, 2:5–7. Inaoka describes, generally, the problems with transporting

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“an organic liquid such as crude oil” through a pipeline, caused by “the fact that transporting pressure on the liquid is lost by the friction generated between the liquid and the conduit.” *Id.* at 3:9–11. To suppress such pressure loss, Inaoka states that “a drag reducer has been used conventionally,” and the drag reducer includes a high molecular weight polymer. *Id.* at 3:14–15. Regarding production of such polymers, Inaoka states that “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent] is known.” *Id.* at 3:27. Regarding specific polymer additives, Inaoka states that “2-ethylhexylacrylate (2EHA (carbon number of 8)) and 2-ethylhexylmethacrylate (2EHMA (carbon number of 8)) are particularly preferable.” *Id.* at 4:48–50.

4. *Strausz*

Strausz, titled “The Chemistry of Alberta Oil Sands, Bitumens, and Heavy Oils,” is a book containing relationships and parameters that would have been useful to one working to solubilize materials, such as polymers, in crude oil. Strausz discloses that “[t]he ability of a solvent to solubilize asphaltene or, in general, to dissolve a solid or to form a homogeneous solution with another liquid, may be expressed in terms of solubility parameters.” Ex. 1009, 465. Strausz provides several equations for determining solubility parameters, including the equation provided in the specification of the ’250 patent for determining the solubility parameter of a liquid hydrocarbon. *Id.* at 465–67. Strausz explains that, although the solubility parameter theory “would not be expected to be applicable for colloidal aggregate solutions of polar, random, polydispersed macromolecules like asphaltene . . . the correlation between the solubility of

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asphaltene and solvent solubility parameter is quite good for nonpolar and low-polarity solvents.” *Id.* at 466.

In that regard, Strausz describes a study of the correlation between asphaltene solubility and solubility parameters. *Id.* at 467. The study determined that “asphaltene becomes completely soluble in hydrocarbons with [a solubility parameter] $\geq 17.1 \text{ MPa}^{1/2}$ ” and that the solvation energy of hydrocarbon solvents with a solubility parameter “in the $17.1\text{--}22.1 \text{ MPa}^{1/2}$ range is sufficiently large to overcome the cohesion energy of asphaltene and cause solubilization.” *Id.* The study also established the solubility parameter of asphaltene “as not less than $19.6 \text{ MPa}^{1/2}$.” *Id.*

D. Analysis

A patent 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 to a person of ordinary skill in the art at the time the invention was made. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). Obviousness is resolved based on 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, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Petitioner must demonstrate obviousness by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d); *see*

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also 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”)). A party that petitions the Board for a determination of obviousness must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 408 F.3d 1348, 1361 (Fed. Cir. 2007)). We analyze both parties’ arguments, below, in accordance with the above-stated principles.

1. Petitioner’s Ground 1—Asserted Obviousness Based on the Holtmyer Publication, the Holtmyer Patent, and Strausz

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of the Holtmyer Publication, the Holtmyer Patent, and Strausz, to a method comprising all of the elements recited in claims 1–9. Pet. 20–36, 50–60.

Petitioner argues that the “Holtmyer Publication discloses most of the limitations of claim 1.” *Id.* at 21. In the section of the Petition summarizing the Holtmyer Publication, Petitioner characterizes the Holtmyer Publication as describing an investigation “to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines” and as describing “the problem of frictional pressure losses associated with the turbulent flow of a fluid through a conduit.” *Id.* at 15 (citing Ex. 1005, 473, Abstract). Petitioner further notes that the Holtmyer Publication describes the drag reducing properties of “a series of homo- and copolymers of alkyl styrenes, acrylates, and

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methacrylates in hydrocarbon solvents.” *Id.* (citing Ex. 1005, 473, 474, Table 1). Specifically, Petitioner focuses on the Holtmyer Publication’s preparation and testing of iDMA, which test results are presented in Table 9 of the Holtmyer Publication. *Id.* at 16 (citing Ex. 1005, Table 9). The test results demonstrate iDMA’s drag reduction in kerosene, in two types of crude oil (Cardium and Ellenberger), and in QC-1156 (primarily an aromatic hydrocarbon with an API gravity of 22.5°). *Id.* (citing Ex. 1005, Table 9).

Petitioner relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have known in 2005 that a plurality of the repeating units of the iDMA polymer comprise oxygen heteroatoms.” *Id.* at 22 (citing Ex. 1041 ¶ 57). Petitioner further relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have understood that introduction of the iDMA polymer into a liquid hydrocarbon” would reduce “friction loss associated with the turbulent flow through the pipeline . . . by suppressing the growth of turbulent eddies” as recited in claim 1. *Id.* at 22–23 (citing Ex. 1041 ¶ 71). Regarding the claim 1 requirement that “the viscosity of the treated liquid hydrocarbon is not less than the viscosity of the liquid hydrocarbon prior to treatment with the drag reducing polymer,” Petitioner relies on Dr. Epps’s testimony that adding the iDMA drag reducing polymer of the Holtmyer Publication to a liquid hydrocarbon would achieve this effect. *Id.* at 23 (citing Ex. 1041 ¶¶ 76–77). Finally, Petitioner relies on Dr. Epps’s testimony that the Holtmyer Publication would have directed a person of ordinary skill in the art to add iDMA to a liquid hydrocarbon, such as that defined by the claims of the ’250 patent, “at a concentration within the ‘about 0.1 ppmw to about 500 ppmw’ range recited by claim 1,”

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specifically, at a concentration of about 300 ppm. *Id.* at 24 (citing Ex. 1041 ¶¶ 72–75; Ex. 1005, Table 6).

Petitioner posits that the only limitation of claim 1 that the Holtmyer Publication does not disclose explicitly is the introduction of the iDMA drag reducing polymer “into a liquid hydrocarbon having the following properties: (i) an asphaltene content of at least 3 weight percent and (ii) a solubility parameter that is within $4 \text{ MPa}^{1/2}$ of the solubility parameter of the iDMA polymer.” *Id.* at 25. Petitioner argues, however, that (i) crude oils having the claimed properties were well known, as acknowledged in the ’250 patent itself and other contemporaneous publications (*id.* at 25–26 (citing Ex. 1004, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been motivated by the known economic benefits associated with drag reduction to introduce the iDMA polymer into a crude oil having the claimed properties (*id.* at 26–27 (citing Ex. 1005, 473; Ex. 1041 ¶¶ 114–116)); (iii) one of ordinary skill would have had a reasonable expectation that the iDMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 27–34 (citing Ex. 1041 ¶¶ 118–139)); and (iv) one of ordinary skill would have been prompted to utilize the iDMA polymer in crude oils in which it was expected to be most effective, based on an understanding that a fairly large proportion of heavy, asphaltenic crude oils would have solubility parameters within $4 \text{ MPa}^{1/2}$ of the solubility parameter of the iDMA homopolymer (*id.* at 34–36 (citing Ex. 1041 ¶¶ 140–44)).

Regarding asphaltene, Petitioner argues the Holtmyer Patent addresses the effect of asphaltene content on the ability of the iDMA polymer to achieve drag reduction, relying on Dr. Epps’s testimony that “the optimum

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quantity of polymer to be introduced to a hydrocarbon liquid may vary depending on the type of liquid hydrocarbon involved” and that “when a solid agent is suspended in the liquid hydrocarbon, it is preferable to use a somewhat larger amount of the polymer additive,” such as between about 160 ppm and 1600 ppm. *Id.* at 29 (citing Ex. 1041 ¶ 121 (citing Ex. 1006, 4:51–59, 4:63–75)). Regarding solubility, Petitioner argues that solubility parameters “were (and are) commonly consulted to predict solubility of one compound in another.” *Id.* at 30 (citing Ex. 1041 ¶ 124). Petitioner relies on Strausz (Ex. 1009, 467–68) and Dr. Epps’s calculations of the solubility parameters of heavy, asphaltenic crude oils (“within [Strausz’s] disclosed range of about 17.1 MPa^{1/2} to about 22.1 MPa^{1/2},” Ex. 1041 ¶¶ 136–37) and the iDMA polymer (“about 17.84 MPa^{1/2},” Ex. 1041 ¶¶ 125–27) to argue that because the solubility parameter of the iDMA polymer falls squarely within the range disclosed by Strausz, a person of ordinary skill in the art “would have had a reasonable expectation that the iDMA drag reducing polymer would be effective at achieving drag reduction in a liquid hydrocarbon having both an API gravity of less than about 26° and an asphaltene content of at least 3 weight percent undergoing turbulent flow through a pipeline.” Pet. 33–34 (citing Ex. 1041 ¶ 139).

2. Petitioner’s Ground 2—Asserted Obviousness Based on Inaoka and Strausz

Petitioner asserts that a person of ordinary skill in the art would have been led from the above-referenced disclosures of Inaoka and Strausz to a method comprising all of the elements recited in claims 1–9. Pet. 36–48, 50–60.

Petitioner argues that “Inaoka discloses most of the limitations of claim 1.” *Id.* at 36. In the section of the Petition summarizing Inaoka,

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Petitioner characterizes Inaoka as describing a high molecular weight polymer having a straight-chain structure with less branching, being soluble in an organic solvent, and “suitably adopted as a drag reducer.” *Id.* at 17 (quoting Ex. 1007, Abstract). Petitioner further characterizes Inaoka as describing the problem of frictional pressure losses associated with the turbulent flow of fluid through a conduit and the conventional use of drag reducers to address the problem of pressure loss. *Id.* at 17–18 (quoting Ex. 1007, 3:9–13, 3:14–21). Petitioner notes that Inaoka refers to drag reducing polymers that may be produced by “a method disclosed in USP No. 3,758,406 [the Holtmyer Patent].” *Id.* at 18 (quoting Ex. 1007, 3:27). Inaoka’s drag reducing polymer “can be suitably adopted in transporting of an organic liquid such as crude oil through a conduit, such as a pipeline.” *Id.* at 19 (quoting Ex. 1007, 17:1–5). Inaoka’s two “particularly preferable” drag reducing polymers are 2-ethylhexylacrylate (“2EHA”) and 2-ethylhexylmethacrylate (“2EHMA”); the latter, according to Dr. Epps, is the same as Polymer A of the ’250 patent. *Id.* at 20 (citing Ex. 1007, 4:48–50; Ex. 1041 ¶ 155).

Petitioner relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have known that a plurality of the repeating units of the 2EHMA polymer comprise oxygen heteroatoms.” *Id.* at 37 (citing Ex. 1041 ¶ 156). Petitioner further relies on Dr. Epps’s testimony that “a person of ordinary skill in the art would have understood that introducing the 2EHMA polymer into crude oil flowing through a pipeline would reduce drag by suppressing the growth of turbulent eddies” as recited in claim 1. *Id.* at 37–38 (citing Ex. 1041 ¶ 167). Regarding the claim 1 requirement that “the viscosity of the treated liquid hydrocarbon is not less than the viscosity of

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the liquid hydrocarbon prior to treatment with the drag reducing polymer,” Petitioner relies on Dr. Epps’s testimony that adding the 2EHMA drag reducing polymer of Inaoka to a liquid hydrocarbon would achieve this effect. *Id.* at 38 (citing Ex. 1041 ¶¶ 169–71). Finally, Petitioner relies on Dr. Epps’s testimony that Inaoka would have directed a person of ordinary skill in the art to add 2EHMA to a liquid hydrocarbon “at a concentration within the ‘about 0.1 ppmw to about 500 ppmw’ range recited by claim 1,” preferably in a range of 0.1 ppm to 100 ppm. *Id.* at 39 (citing Ex. 1041 ¶ 168; Ex. 1007, 8:18–20).

Petitioner argues that although Inaoka does not disclose “introducing the 2EHMA drag reducing polymer into a crude oil having (i) an asphaltene content of at least 3 weight percent and an API gravity of less than about 26° and (ii) a solubility parameter that is within 4 MPa^{1/2} of the solubility parameter of the 2EHMA polymer,” it would have been obvious to a person of ordinary skill in the art to do so. *Id.* at 40. Petitioner argues that (i) crude oils having the claimed properties were well known, as acknowledged in the ’250 patent itself (*id.* (citing Ex. 1004, Table 1; Ex. 1017, 12; Ex. 1018, 557–58)); (ii) one of ordinary skill would have been prompted by the known economic benefits associated with drag reduction to introduce the 2EHMA polymer into a crude oil having the claimed properties (*id.* at 40–41 (citing Ex. 1041 ¶¶ 195–97)); (iii) one of ordinary skill would have had a reasonable expectation that the 2EHMA polymer would be effective at reducing drag in a crude oil having the claimed properties (*id.* at 42–47 (citing Ex. 1041 ¶¶ 199–216)); and (iv) one of ordinary skill would have been prompted to utilize the 2EHMA polymer in crude oils in which it was expected to be most effective, based on an understanding that a fairly large

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proportion of heavy, asphaltenic crude oils would have solubility parameters within $4 \text{ MPa}^{1/2}$ of the solubility parameter of the 2EHMA polymer (*id.* at 47–48 (citing Ex. 1041 ¶¶ 217–21)).

Regarding solubility, Petitioner argues that solubility parameters “were (and are) commonly consulted to predict solubility of one compound in another.” *Id.* at 43 (citing Ex. 1041 ¶ 201). Petitioner relies on Strausz (Ex. 1009, 467–68) and Dr. Epps’s calculations of the solubility parameters of heavy, asphaltenic crude oils (“within [Strausz’s] disclosed range of about $17.1 \text{ MPa}^{1/2}$ to about $22.1 \text{ MPa}^{1/2}$,” Ex. 1041 ¶¶ 213–14) and the 2EHMA polymer (“about $18.04 \text{ MPa}^{1/2}$,” Ex. 1041 ¶¶ 202–04) to argue that, because the solubility parameter of the 2EHMA polymer falls squarely within the range disclosed by Strausz, a person of ordinary skill in the art would have had a reasonable expectation that the 2EHMA drag reducing polymer of Inaoka “would be effective at achieving drag reduction in a crude oil having an asphaltene content of at least 3 weight percent and an API gravity less than about 26° undergoing turbulent flow through a pipeline.” Pet. 46–47 (citing Ex. 1041 ¶ 216).

3. *Additional Claims*

Petitioner presents arguments directed to both grounds regarding the additional limitations of claims 2–9. Pet. 50–60. Regarding the solubility parameter limitation of claim 2, Petitioner refers to its claim 1 arguments that a person of ordinary skill in the art would readily have been able to calculate the solubility parameters of iDMA and 2EHMA. *Id.* at 50–51 (relying on Ex. 1041 ¶¶ 125–127, 202–204). Petitioner also argues that a person of ordinary skill in the art “would have understood that the iDMA homopolymer of Holtmyer and the 2EHMA polymer of Inaoka each has

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well above 25,000 repeating units,” a limitation found in claims 3 and 9. Pet. 51–52, 60 (relying on Ex. 1041 ¶¶ 64–67, 162–165). Petitioner argues that a person of ordinary skill in the art would have understood that the iDMA homopolymer of Holtmyer has an average molecular weight well above “at least 1×10^6 g/mol,” and “that the polymers disclosed by Inaoka as being preferred for drag reduction have molecular weights well above ‘at least 1×10^6 g/mol’,” a limitation found in claims 4 and 9. *Id.* at 52–53, 60 (relying on Ex. 1041 ¶¶ 61–63, 157–161). Regarding the claim 5 limitation that the drag reducing polymer have a solubility parameter within $2.5 \text{ MPa}^{1/2}$ of the liquid hydrocarbon, Petitioner argues that, based on Strausz, a person of ordinary skill in the art would have understood that at least some, and likely many, heavy, asphaltenic crude oils would have solubility parameters between $17.1 \text{ MPa}^{1/2}$ and $20.34 \text{ MPa}^{1/2}$ (for iDMA) or $17.1 \text{ MPa}^{1/2}$ and $20.54 \text{ MPa}^{1/2}$ (for 2EHMA). *Id.* at 54 (relying on Ex. 1041 ¶¶ 141, 144, 218, 221).

Regarding the equation expressed in claim 6, Petitioner argues that the Strausz study cited in the ’250 patent used this equation, and relies on Dr. Epps’s testimony that one of ordinary skill in the art would have determined the solubility parameter range for heavy, asphaltenic crude oils by using this equation. *Id.* at 55–56 (relying on Ex. 1041 ¶¶ 128–137, 205–214). Regarding the equation expressed in claim 7, Petitioner argues that the Brandrup group contribution method cited in the ’250 patent is well-known, and relies on Dr. Epps’s testimony that one of ordinary skill in the art would have determined the solubility parameter for a drag reducing polymer using this equation. *Id.* at 56–57 (relying on Ex. 1041 ¶¶ 125–127, 202–204). Regarding the limitation that the type of heteroatom be selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a

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phosphorus atom, found in claims 8 and 9, Petitioner argues that the iDMA polymer disclosed by Holtmyer and the 2EHMA homopolymer disclosed by Inaoka contain oxygen heteroatoms, as previously argued in connection with claim 1. Pet. 57–58 (relying on Ex. 1041 ¶¶ 57, 156). Patent Owner does not appear to separately dispute Petitioner’s arguments regarding these additional limitations.

Having reviewed both of Petitioner’s grounds, and the evidence in support thereof, we find that the evidence of record supports Petitioner’s arguments, and we adopt those arguments as to these grounds. Next, we consider Patent Owner’s arguments and evidence in the manner in which they were presented.

4. Patent Owner’s Arguments

a. Heavy, Asphaltenic Liquid Hydrocarbon

Patent Owner argues that neither the Holtmyer Publication nor Inaoka discloses, teaches, or suggests the claimed heavy, asphaltenic liquid hydrocarbon. PO Resp. 5–7. Rather, Patent Owner argues, the Holtmyer Publication discloses only processed solvents and light crudes, and Inaoka treats only kerosene and xylene. *Id.* at 5–6.

Petitioner replies that the claimed “liquid hydrocarbon” was well-known, and moreover, “that Holtmyer and Inaoka do not explicitly disclose the claimed liquid hydrocarbon is irrelevant because Petitioner hasn’t asserted that the claimed liquid hydrocarbon was disclosed by either reference.” Reply 10, 12. Rather, Petitioner argues, “each of Holtmyer and Inaoka discloses the use of DRAs *in crude oil generally*,” (citing Pet. 25–26, 39–40) and one of ordinary skill in the art would not have understood “the

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term ‘crude oil’ in Holtmyer and Inaoka to *exclude* heavy crude oil.” *Id.* at 10.

We are persuaded by Petitioner’s arguments on this point. As a preliminary matter, because only obviousness grounds are at issue in this case, an argument that a particular reference does not individually disclose the exact limitation within its four corners is inapposite. Additionally, although the Holtmyer Publication and Inaoka do not specifically discuss the particular liquid hydrocarbon of the claims, “crude oil” is discussed generally. Ex. 1005, 473; Ex. 1007, 3, 4, 8. In the prosecution history of the parent application, of which the ’250 patent is a continuation, applicant represented: “Broadly speaking, the genus of crude oil can be broken down to three different broad species of heavy, medium and light crude oil.” Ex. 1022 (Response to Final Office Action), 8. The specification of the ’250 patent provides that the “present invention relates generally to high molecular weight drag reducers for use in crude oils,” indicating that heavy, asphaltenic crude oils, as identified in the claims, are not excluded from the category of crude oils. Ex. 1004, 1:15–16. The title of the ’250 patent is “Drag Reduction of Asphaltenic Crude Oils,” which identifies “asphaltenic” as a characteristic of certain crude oils. *Id.* at [54]. Heavy crude oil is defined as containing asphaltenes. Ex. 1062, 3; *see also* Ex. 2028 (indicating that both light crude and heavy crude contain asphaltenes). In the prosecution history, applicant further represented that the “specific characteristics of applicant’s liquid hydrocarbon are defined by one of ordinary skill in the art as ‘heavy crude oil’ or ‘heavy crude.’” Tr. 30:17–31:5; Ex. 1022, 8. Given this matrix of evidence, we are not apprised of any persuasive reason, notwithstanding Patent Owner’s arguments to the

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contrary, that the general category of “crude oil” referred to in the Holtmyer Publication and Inaoka would exclude the claimed liquid hydrocarbon.

b. Patent Owner’s Argument that Grounds 1 and 2 Fail Because There Would Have Been No Basis To Modify The Holtmyer Publication Or Inaoka To Add The Claimed Heavy, Asphaltenic “Liquid Hydrocarbon”

Patent Owner argues that there would have been no basis to modify the Holtmyer Publication or Inaoka to add the claimed heavy, asphaltenic “liquid hydrocarbon.” PO Resp. 7–19.

i. Economic Benefits

First, Patent Owner argues that Petitioner’s “well-known economic benefits” rationale is flawed. *Id.* at 7–12, 16–18. In this regard, Patent Owner criticizes Dr. Epps’s testimony regarding the benefits of drag reduction based on the Holtmyer references⁷ as being “conclusory” and “problematic.” *Id.* at 9–12. Patent Owner also criticizes Dr. Epps’s testimony regarding the Holtmyer Patent and its references to suspended solid materials, which Patent Owner asserts only refer to proppants, not asphaltenes. *Id.* at 12–14.

Regarding Patent Owner’s “economic motivation” argument, Petitioner replies that the parties agree that reducing drag was known to reduce the cost of transporting crude oil via pipelines. Reply 11 (citing Ex. 1029; Ex. 1030; Ex. 2096; Ex. 1072, 9:15–10:1, 88:17–89:4). Petitioner argues that Dr. Epps supports his testimony with quotes from the Holtmyer Publication and the Holtmyer Patent that indicate the disclosures of the two references do not relate solely to hydraulic fracturing. *Id.* at 12.

⁷ We refer to the Holtmyer Publication and Holtmyer Patent collectively as the “Holtmyer references,” where appropriate.

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We find that the Holtmyer Publication and the Holtmyer Patent—both of which are concerned with more effectively and economically moving oil through pipelines by introducing a drag reducing agent (“DRA”)—would have provided a person of ordinary skill in the art with a reason to reduce drag in crude oil flowing through a pipeline. The Holtmyer Publication is directed to a “study of oil soluble polymers as drag reducers,” which was “undertaken to find the most effective material which would reduce the friction coefficient in turbulent flow when added in small quantities to oil pipelines.” Ex. 1005, 473; *see* Pet. 25–27; Ex. 1041 ¶¶ 114–116. The Holtmyer Patent, cited in Inaoka for its method of producing certain polymers, is directed to “reducing the frictional pressure loss encountered in the turbulent flow of hydrocarbon liquids through a conduit” and provides that “reduction of the frictional pressure loss in the flow of [] hydrocarbon liquids brings about an advantageous reduction in horsepower requirements, or alternatively, an increased flow rate of the hydrocarbon liquids under the same pumping conditions.” Ex. 1006, 1:16–18, 1:56–65; Ex. 1007, 3:27; *see* Pet. 40–41; Ex. 1041 ¶¶ 195–197. Also, despite Patent Owner’s argument that being “economically profitable” in general is insufficient to demonstrate obviousness (PO Resp. 19), we find that the Holtmyer references are sufficiently directed to the specific economic benefits of drag reducing oil flowing through pipelines by using drag reducing agents, rather than directed generally to an unspecified market need. *Cf. Celsis In Vitro, Inc. v. CellzDirect, Inc.*, 664 F.3d 922, 928 (Fed. Cir. 2012) (explaining, in the context of affirming a preliminary injunction grant, that “vague references to ‘market need’” are not probative of obviousness).

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We note, also, that in connection with its presentation of objective evidence, Patent Owner itself argues that there was “a tremendous economic incentive” to solve the long-felt, unmet need that existed before Patent Owner’s invention. PO Resp. 47 (“billions of barrels of heavy crude oil have been produced and imported into the U.S. for decades, which created a tremendous economic incentive to solve the long-felt, unmet need that existed many years before LSPI’s invention.”); *see also id.* at 45 (“operators needed and demanded better, safer, and more economic solutions for improving the pipeline transport of heavy crude oils.”).

Regarding Patent Owner’s argument that the Holtmyer references concern fracking, rather than transporting heavy crude oil, we observe that the Holtmyer references use hydraulic fracturing as an example, rather than as an exclusive focus. *See, e.g.*, Ex. 1005, 473 (stating generally that “it is economically profitable to industrial organizations engaged in movement of large volumes of liquid at high flow rates for considerable distance as in hydraulic fracturing of oil and gas wells.”); Ex. 1006, 1:56–65 (describing the benefits of drag reducing agents generally). Relatedly, regarding Patent Owner’s argument that the “solid agent” the Holtmyer Patent discloses is “unrelated to asphaltenes” (PO Resp. 12–13), we credit Petitioner’s assertion that Dr. Epps never argued that the “solid agent” disclosed or referred to asphaltenes. Reply 12–13. Rather, Petitioner argues, Dr. Epps’s statement was intended to convey that a person of ordinary skill in the art would have understood that suspended solids in a liquid hydrocarbon “may necessitate a higher concentration of DRA” and would have been informative as to the potential effects of asphaltene on drag reduction, because asphaltene is a solid colloidally suspended in crude oil. *Id.* at 13 (citing Ex. 1041 ¶¶ 95–

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98). After reviewing the arguments and testimony, we find this adequately supported by the record.

ii. Obvious to Try

Patent Owner argues that it would not have been “obvious to try” the drag reducing polymers in the specific claimed species of liquid hydrocarbon based on the allegedly well-known economic benefits, because Petitioner has not shown that one of ordinary skill of the art “would have chosen the particular species of liquid hydrocarbon in the claims.” PO Resp. 14. Because crude oils are complex, because the art was unpredictable, and because there are at least 450 different crudes in the world, Patent Owner argues that there were not a finite number of identified, predictable solutions. *Id.* at 14–16.

Petitioner replies that it would have been obvious to try a DRA in a crude oil in which it was expected to be effective. Reply 13. The Supreme Court set forth the standard for when a combination may be “obvious to try”: “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.” *KSR*, 550 U.S. at 421. The Court continued: “If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* Petitioner contends that it “has shown that one would have had an economic motivation to introduce a DRA into any pipeline-transported crude oil in which it would have been expected to be effective.” Reply 13.

Having considered the trial record as a whole, we find Petitioner’s position is supported by the preponderance of the evidence. We have found

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that market pressure or economic motivation existed. *See supra* Section II.D.4.b.i.; *see, e.g.*, Ex. 1005, 473; Ex. 1006, 1:56–65; Ex. 1041 ¶¶ 114–116, 195–197. Regarding the finite number of identified, predictable solutions, drag reducing agents were well-known and were often an effective solution to the problems of flow in oil pipelines, but the effective use of drag reducing agents in heavy crude oil was difficult. Ex. 1004, 1:49–51 (“Conventional polymeric drag reducers, however, typically do not perform well in crude oils having a low API gravity and/or a high asphaltene content.”). We credit Dr. Epps’s testimony that a person of ordinary skill in the art would have had a reasonable expectation of success that the iDMA drag reducing agent of the Holtmyer Publication and the 2EHMA drag reducing agent of Inaoka would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less than 26°. Ex. 1041 ¶¶ 117, 198. As Dr. Epps explains, success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps calculated for the iDMA and 2EHMA drag reducing agents. *Id.* ¶¶ 30, 118–138, 201–215; *see also id.* ¶ 29 (the “more soluble a drag reducing polymer is in the fluid, the greater the drag reducing effect of the polymer”). Accordingly, in view of the knowledge of one of ordinary skill in the art, we find that introducing the DRAs identified in the Holtmyer Publication and Inaoka into any pipeline-transported crude oil in which they would have been expected to be effective based on the parameters Petitioner

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identifies would have been obvious to try with a reasonable expectation of success.

Regarding Patent Owner's criticism of Petitioner's reliance on Buckley⁸ and Ferguson⁹ to assert that heavy, asphaltenic crudes were well known in 2005 and earlier (PO Resp. 8–9), we acknowledge that those references were not named as primary references, but agree with Petitioner that Dr. Epps relied on them in providing his testimony regarding, among other things, common knowledge in the art about heavy, asphaltenic crude oils and solubility parameters. Tr. 8:16–21.

iii. Conventional Wisdom

Patent Owner argues that the “conventional wisdom” of one of ordinary skill in the art was that “drag reduction of heavy crudes was generally not believed to be a viable option.” PO Resp. 16–18 (citing Ex. 2028 (“Traditional DRA doesn’t work in heavy crude.”); Ex. 2106 (“Heavy crude oil is frequently a challenge for traditional drag reducing agents.”); Ex. 2056, 5 (“[C]urrent DRA technology does not work effectively with heavy oil.”). Patent Owner emphasized at oral hearing that “conventional wisdom was that it was impossible” for current DRA technology to work effectively with heavy oil. Tr. 24:2–4, 25:17–18 (“where the claimed liquid hydrocarbon was, this impossible zone where the prior art has said it won’t work here.”).

⁸ Buckley, J.S., et al., *Asphaltene Precipitation and Solvent Properties of Crude Oils*, 16 PETROLEUM SCI. & TECH. 3–4, 251–285 (1998) (Ex. 1017).

⁹ Ferguson, K.R., et al., *Microbial Pilot Test for the Control of Paraffin and Asphaltenes at Prudhoe Bay*, Society of Petroleum Engineers, Inc. 36630, 557–564 (1996) (Ex. 1018).

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Petitioner replies that Patent Owner’s arguments “stem from a false premise that reducing drag in heavy, asphaltenic oils was thought unachievable.” Reply 2. Petitioner argued in the Petition that Patent Owner acknowledged, in its own promotional material and in arguments presented to the Office, that use of a drag reducing agent in heavy crude oil was viable. Pet. 9–10 n.1 (citing Exs. 1020, 1028, 1029, 1030, 1040). Petitioner also discusses this evidence in its Reply, which we consider properly responsive to Patent Owner’s argument, indicating that reducing drag in heavy, asphaltenic crude oils was not an unexpected result since at least the 1980s. Reply 2–3 (citing Ex. 1040, 25 (examining achievement of drag reduction in heavy crude oil); Ex. 1028–1030 (indicating that Patent Owner’s own traditional DRAs were marketed for reducing drag in heavy crude oils); Ex. 1074–1076 (examining drag reduction of heavy crude oils in the 1980s–1990s); Ex. 1078–1079, 1081–1082 (discussing 7–27% drag reduction of three heavy crude oils having API gravities of 23.7°, 25° and 21.8°, and asphaltene contents of 10–11 wt.%, 8–13 wt.% and 9 wt.%, respectively, by Patent Owner’s drag reducing products)).

Petitioner further replies that Patent Owner’s “conventional wisdom” argument relates only to “traditional” polyalphaolefin DRAs and not to the acrylate/methacrylate DRAs of the prior art. Reply 4. Thus, Petitioner argues, even if “traditional” polyalphaolefins were ineffective in heavy crude oil—and Petitioner asserts they were not—Patent Owner’s expert says nothing about the conventional wisdom regarding acrylate/methacrylate polymers, such as those disclosed by Holtmyer and Inaoka. *Id.* at 4–5 (citing Ex. 2050 ¶¶ 102–103; Ex. 1072, 52:23–53:8, 55:17–23). Additionally, Petitioner argues, the “perceived shortcomings of

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polyalphaolefin DRAs in heavy crude oil would have motivated a POSA to try other types of DRAs, such as the acrylate/methacrylate DRAs of Holtmyer and Inaoka.” *Id.* at 6. At oral hearing, Petitioner criticized Patent Owner’s “impossibility” argument as not “supported by its own evidence,” which characterized traditional drag reducing agents as not working well in heavy crude oil and not efficient as drag reducing additives in heavy crude oil, but “they still reduce drag and that’s exactly what’s shown in Patent Owner’s marketing materials.” Tr. 44:14–45:1.

In this regard, we agree with Petitioner. Although Patent Owner was pressed at oral hearing to identify a point at which the characteristics of heavy crude oil rendered drag reduction impossible, it was unable to do so. Tr. 33:18–34:16. Petitioner’s evidence indicates that drag reduction with traditional DRAs was not particularly efficient, but extant. Accordingly, Patent Owner’s addition of a drag reducing agent to a heavy crude oil was not as unexpected or novel as Patent Owner argues. Moreover, Patent Owner, despite filing a Sur-Reply, did not address Petitioner’s argument distinguishing traditional polyalphaolefins from acrylate/methacrylate polymers. Accordingly, we find that “conventional wisdom” was not that drag reduction of heavy asphaltenic crude oils was impossible, but simply that it wasn’t being done as well as it could have been as of the critical date.

iv. Hindsight

Finally, Patent Owner argues that Petitioner’s argument to add the claimed heavy, asphaltenic liquid hydrocarbon is based on hindsight. PO Resp. 18–19. Petitioner replies that “one would have had an economic motivation to introduce a DRA into any pipeline-transported crude oil in which it would have been expected to be effective,” and that no hindsight

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would be required. Reply 13. We do not find Petitioner’s obviousness analysis to be based on hindsight reconstruction. Petitioner articulates a reason having rational underpinnings for making a proposed combination of the prior art teachings of the Holtmyer Publication, the Holtmyer Patent, and Strausz, as well as Inaoka and Strausz, namely, that crude oils having the claimed properties were well known, and that one of ordinary skill would have been prompted by known economic benefits and would have had a reasonable expectation that the identified polymers would be effective. Pet. 25–36, 40–48. We find that Petitioner’s articulated reasoning is effective to support its contentions of obviousness. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971) (“Any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.”).

c. Drag Reduction Limitation

Patent Owner argues that none of the prior art references teach or suggest the drag reduction limitation. PO Resp. 20–27. First, Patent Owner argues that drag reduction is a substantive limitation of the claims. *Id.* at 20–24. Next, Patent Owner argues that none of the cited prior art references teach or suggest “drag reduction of the claimed, heavy asphaltenic ‘liquid hydrocarbon.’” *Id.* at 25. Finally, Patent Owner argues that Petitioner’s combinations fail under *KSR* because Patent Owner’s claimed invention yielded more than a predictable result. *Id.* at 27 (citing PO Resp. Section II(B)(2)(d), concerning “conventional wisdom”).

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Petitioner does not appear to materially dispute that drag reduction is a substantive limitation of the claims. Reply 11. Given Patent Owner's arguments and given the lack of a dispute between the parties, we consider the limitation as substantive. Petitioner replies that, notwithstanding whether the drag reduction limitation is a claim limitation, evidence shows that it would have been obvious for a person of ordinary skill in the art "to have introduced the DRAs of Inaoka and/or Holtmyer into the claimed liquid hydrocarbon to reduce drag (i.e., have the intended effect) in that hydrocarbon." *Id.* For the reasons articulated in the Petition, we are persuaded by Petitioner's argument. With respect to Ground 1, Dr. Epps testifies that the reduction in frictional pressure loss demonstrated by Table 9 of the Holtmyer Publication is brought about by the ability of the iDMA drag reducing agent to suppress the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See* Pet. 22–23 (citing Ex. 1041 ¶ 71). Similarly, for Ground 2, Dr. Epps testifies that a person of ordinary skill in the art would have understood that the drag reducing agents of Inaoka achieve a reduction in frictional pressure losses associated with turbulent flow by suppressing the growth of turbulent eddies—that suppression being the mechanism by which persons of ordinary skill in the art would have understood (and do understand) DRAs to function in turbulent flow. *See id.* at 37–38 (citing Ex. 1041 ¶ 167). Accordingly, Petitioner has shown sufficiently that the references disclose introducing a drag reducing polymer into a pipeline, such that the friction loss associated with the turbulent flow through the pipeline is reduced by suppressing the growth of turbulent eddies.

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Regarding Patent Owner's second point that none of the cited prior art references teach or suggest drag reduction of the claimed heavy, asphaltenic liquid hydrocarbon, we note that all grounds in this case are based on obviousness and, thus, it is not imperative that any one of the cited prior art references teach drag reduction of the claimed liquid hydrocarbon within its four corners. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Our discussions regarding the suggestions of the references and the obviousness of the claimed combinations are interspersed throughout this opinion and directed to this point.

Regarding Patent Owner's third point, Petitioner replies that there is no evidence of "unpredictability," in that Dr. Dunn's testimony relies on a single discredited document, and that the cited examples in the '250 patent do not provide enough information to assess whether the results were predictable. Reply 18–19. We are not persuaded that the drag-reducing result of using DRAs in the claimed hydrocarbon is "unpredictable." Although some unpredictability may exist as to whether a particular DRA will work in a particular hydrocarbon (Ex. 2050 ¶ 148), the art sets forth general guidelines to assist one of ordinary skill in the art in this determination. Ex. 1041 ¶¶ 118–138, 201–215. We agree with Petitioner that the weight of the evidence presented in this case indicates that there are "correlations between solubility parameters and drag reduction" that one of ordinary skill in the art would have used to determine whether a particular DRA would be effective in a particular liquid hydrocarbon, which is contrary to Dr. Dunn's assertions of unpredictability and contrary to Dr. Dunn's reliance on Exhibit 2137 ("Transport Phenomena: A Unified Approach"). Reply 18 (citing Ex. 2050 ¶ 148; Ex. 1088–1091 (articles

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examining the effects of solubility parameters on drag reduction)). We also agree that the examples cited in the '250 patent do not support Patent Owner's assertions of unpredictability, as they do not disclose the solubility parameters that would allow for such a conclusion. *Id.* at 18–19.

Accordingly, because we determine that the claimed invention yields no more than a predictable result, Petitioner's asserted prior art combinations do not fail.

d. Reasonable Expectation of Success

Patent Owner argues that there would have been no reasonable expectation of success to make Petitioner's combinations. PO Resp. 27–37. First, Patent Owner argues that there was no reason to combine Strausz with the Holtmyer references or Inaoka, because Strausz is a disparate reference directed to a different endeavor than the Holtmyer references and Inaoka (*id.* at 28), and because the Petition presents no evidence that one of ordinary skill in the art would have used solubility parameters to match drag reducing agents to crude oils (*id.* at 29). Second, Patent Owner argues that there would have been no reasonable expectation of success in combining the prior art references. *Id.* at 30. More particularly, Patent Owner argues that Dr. Epps's conflicting opinions on the solubility parameter range fail to show a reasonable expectation of success (*id.* at 31), and a solubility parameter match does not indicate a reasonable expectation of success (*id.* at 33). Finally, Patent Owner argues that conventional wisdom disproves motivation to combine with any reasonable expectation of success. *Id.* at 35. Regarding this last argument, we have addressed variations of the “conventional wisdom” argument above, and incorporate those findings herein.

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Regarding Patent Owner's first argument, Petitioner replies that Strausz is cited in the '250 patent itself, as well as in Dr. Dunn's testimony. Reply 15–16. Patent Owner's argument in this regard appears to be that Strausz is non-analogous art. To rely upon a reference as a basis for unpatentability, the reference must either (1) be in the field of the inventor's endeavor or (2) be reasonably pertinent to the particular problem with which the inventor was concerned. *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992). In determining whether a reference is reasonably pertinent to the problem, "it is necessary to consider 'the reality of the circumstances' . . . in other words, common sense." *Id.* (quoting *In re Wood*, 599 F.2d 1032, 1036 (CCPA 1979)). That is, "[r]eferences are selected as being reasonably pertinent to the problem based on the judgment of a person having ordinary skill in the art." *In re Kahn*, 441 F.3d 977, 987 (Fed. Cir. 2006) (citing *Oetiker*, 977 F.2d at 1447).

Here, we find that Strausz is at least reasonably pertinent to one of the problems confronting the inventors of the '250 patent. It was known prior to the '250 patent that solubility of the drag reducing polymer in the liquid hydrocarbon was necessary to achieve drag reduction, and an important requirement in preparing a more effective drag reducing polymer. Ex. 1041 ¶ 29; Ex. 1014, 800–802; Ex. 1015, 1550; *see* Ex. 1004, 1:45–46. Thus, the inventors of the '250 patent would have been concerned about whether the drag reducing polymer was soluble in the liquid hydrocarbon being treated by the polymer. Strausz, which is the source of the solubility parameter ranges recited in the '250 patent, is reasonably pertinent to that problem. *See* Reply 16.

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Regarding Patent Owner's second argument, Petitioner replies that Dr. Epps's opinions about solubility parameters based on different references highlight "the remarkably similar solubility parameter ranges obtained using *different methods* described in *different references*." Reply 15. We agree. The parties also seem to agree that different methods are available to determine solubility parameters, and solubility parameters obtained by different methods may vary. Ex. 1092 ¶ 20; Ex. 1072, 116:22–117:5; Ex. 1105, 39:5–16. The differences here are insignificant enough that they do not undermine our ultimate findings based on Dr. Epps's solubility parameter calculations.

Petitioner further replies that it is "irrelevant that solubility alone does not provide an expectation of success." Reply 17. Petitioner reiterates that its argument is not based on solubility alone, but on Dr. Epps's assertions that "(1) a DRA must have a straight-chain structure, high molecular weight, and solubility in the target fluid; (2) Holtmyer and Inaoka disclose polymers having the structure and molecular weight necessary to reduce drag; and (3) using solubility parameters, one would [have] predict[ed] that those polymers would be soluble in heavy, asphaltenic crude oil." *Id.* (citing Ex. 1041 ¶¶ 30, 111, 192). We agree that Petitioner's case is more multifaceted than just solubility alone. As discussed above in connection with our discussion of a reason to combine the teachings of the asserted references, we credit Dr. Epps's testimony not only regarding the reasonable expectation of success that the iDMA and 2EHMA drag reducing polymers would have been effective at reducing the frictional pressure losses associated with turbulent flow when introduced into a crude oil having an asphaltene content of at least 3 weight percent and an API gravity of less

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than 26° (Ex. 1041 ¶¶ 117, 198), but also that such success would depend on the molecular weight of the drag reducing agent, the structure of the drag reducing agent, and the solubility of the drag reducing agent in the liquid hydrocarbon, which was calculable and which Dr. Epps calculated (*id.* at ¶¶ 118–138, 201–215). *See supra* Section II.D.4.b. Taken together, the evidence presented by Petitioner underscores that one of ordinary skill in the art would have had a reasonable expectation of success in achieving the claimed method according to Petitioner’s asserted prior art combination.

Petitioner also argues that the “well-known correlation between solubility and drag reduction” enabled Patent Owner “to identify known DRAs for use in heavy oil.” Reply 6. To counter Patent Owner’s argument that using solubility parameters was inventive, Petitioner relies on Dr. Epps’s testimony that a person of ordinary skill in the art would have known that solubility parameters could be used to predict the effectiveness of a drag reducing polymer in a particular fluid, such as a crude oil, and to several articles describing the relationship between solubility parameters and drag reduction. *Id.* at 6–7; Ex. 1092 ¶¶ 4–9; Ex. 1088, 538 (“drag reduction is greatest when the solubility parameters of solvent and polymer are equal”); Ex. 1089. According to Petitioner, Patent Owner “did no more than apply known solubility parameter relationships to identify known drag reducing polymers that one would expect to be effective in known crude oils. That is the epitome of obviousness.” Reply 7. In this regard, we agree with Petitioner. Introducing a drag reducing agent into a liquid hydrocarbon was well-known; the additional limitations Patent Owner added do not overcome this shortcoming. We credit Dr. Epps’s testimony that one of ordinary skill in the art would have considered a number of factors,

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including solubility parameters informing whether a particular drag reducing agent would dissolve in a particular liquid hydrocarbon, to determine the optimum drag reducing agent for a particular crude oil.

e. Solubility Parameter Limitations in Claims 1–8

Claims 1–8 require that the drag reducing polymer have a solubility parameter within either $4 \text{ MPa}^{1/2}$ (claims 1–4 and 6–8) or $2.5 \text{ MPa}^{1/2}$ (claim 5) of the solubility parameter of the liquid hydrocarbon. Patent Owner argues that the '250 patent “discloses that the liquid hydrocarbon at issue can have a solubility parameter of up to about ‘ $24 \text{ MPa}^{1/2}$,’” which “is about $6 \text{ MPa}^{1/2}$ greater than Epps’ calculated solubility parameters for the iDMA and 2-EHMA polymers.” PO Resp. 37–38 (citing Ex. 1004, 4:40–43). Patent Owner further argues that the Petition fails to identify “any example of a heavy, asphaltenic liquid hydrocarbon in any cited prior art reference that satisfies both the ‘ $4 \text{ MPa}^{1/2}$ ’ solubility parameter limitation and the Drag Reduction Limitation for any of the polymers cited in the Petition.” *Id.* at 38.

Petitioner replies that Patent Owner’s argument that the '250 patent describes the claimed crude oils as having “solubility parameters of up to about $24 \text{ MPa}^{1/2}$ ” is both “irrelevant to what a [person of ordinary skill in the art] would have understood from the prior art,” and “a mischaracterization of the patent disclosure.” Reply 15 n.9.

Patent Owner relies on the following specification passage, describing an embodiment found in Strausz, to support its argument: “In one embodiment, the liquid hydrocarbon can have a solubility parameter of at least about $17 \text{ MPa}^{1/2}$, or in the range of from about 17.1 to about $24 \text{ MPa}^{1/2}$, or in the range of from 17.5 to $23 \text{ MPa}^{1/2}$.” Ex. 1004, 4:40–43. As Dr. Dunn

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acknowledges, this passage refers to only one embodiment that Strausz discloses, and not necessarily to a claimed embodiment of the '250 patent. Ex. 1072, 115:21–116:21. Without language in the claims specifying the solubility parameter of the liquid hydrocarbon, we are not apprised of any reason that only the upper portion of one of the ranges the specification identifies is critical or limiting. Moreover, this embodiment on which Patent Owner relies describes a range of solubility parameters from 17.1 to about 24 MPa^{1/2}, and the solubility parameters Dr. Epps calculated for iDMA and 2EHMA are 17.84 and 18.04 MPa^{1/2}, respectively, which both lie within that range. Pet. 30 (citing Ex. 1041 ¶¶ 125–127), 44 (citing Ex. 1041 ¶¶ 202–204). Given the foregoing, we are persuaded by Petitioner's arguments and Dr. Epps's testimony that it would have been obvious for one of ordinary skill in the art to prepare a drag reducing agent (such as iDMA or 2EHMA) for use in a crude oil having a solubility parameter within 4 MPa^{1/2} or within 2.5 MPa^{1/2} of the drag reducing agent.

f. Objective Evidence

Patent Owner argues that objective evidence supports the nonobviousness of the challenged claims. PO Resp. 39–70.¹⁰ Generally, Patent Owner argues that the evidence of record demonstrates that the industry “had a long-felt need, actively tried and failed to find a DRA solution, was stunned by the surprising and unexpected results achieved by the 250 Patent, praised it, and then blatantly copied it.” *Id.* at 39; *see id.* at 44–47 (long-felt need), 48–49 (failure of others), 49–50 (skepticism of

¹⁰ In this section, we cite to the confidential versions of Patent Owner's Response and Dr. Dunn's declaration, and the arguments and testimony contained therein.

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experts and unexpected results), 51–52 (praise), 52–54 (commercial success), 54–70 (copying), 70 (acquiescence).

Notwithstanding what the teachings of the prior art would have suggested to one of ordinary skill in the art at the time of the invention, the totality of the evidence submitted, including objective evidence of nonobviousness, may lead to a conclusion that the claimed invention would not have been obvious to one of ordinary skill. *In re Piasecki*, 745 F.2d 1468, 1471–1472 (Fed. Cir. 1984). “For objective evidence of secondary considerations to be accorded substantial weight,” however, “its proponent must establish a nexus between the evidence and the merits of the *claimed invention*.” *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (quoting *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010)). “[N]exus” is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). We apply “a presumption of nexus for objective considerations when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘is the invention disclosed and claimed in the patent.’” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1329 (Fed. Cir. 2016) (citations omitted). Patent Owner bears the burden of showing that the product or method “is the invention disclosed and claimed in the patent.” *See Demaco*, 851 F.2d at 1392 (discussing patent owner’s burden in the context of commercial success).

Patent Owner’s argument regarding nexus as to any of its identified secondary considerations is that it is entitled to a presumption of nexus

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because its evidence is tied to specific products that embody the claims of the '250 patent. PO Resp. 40; Tr. (confidential) 6:10 (“You don’t get a more direct case of nexus.”). In that regard, Patent Owner contends that its Extreme Power, EP-1000, and EP-2000 products contain the drag reducing polymer [REDACTED]

[REDACTED] PO Resp. 41. Patent Owner directs us to [REDACTED] as evidence that [REDACTED] a component of the [REDACTED] products, reduces drag in AHS crude, a heavy, asphaltenic crude oil. [REDACTED]

[REDACTED]

Patent Owner also contends that Petitioner’s and third party Flowchem LLC’s (“Flowchem”) commercial products embody the claims of the '250 patent. For example, Patent Owner points to Petitioner’s FLO ULTIMA product as “[REDACTED]

[REDACTED]

[REDACTED] Likewise, Patent Owner states that Flowchem’s commercial heavy crude oil DRA [REDACTED]

[REDACTED] *Id.* at 65.

Patent Owner’s Sur-Reply asserts that Petitioner ignores Patent Owner’s detailed showing of nexus (Sur-Reply 1), and that Petitioner’s argument that the objective evidence is “not commensurate with the scope of the claims” fails (*id.* at 2).

We do not find that Patent Owner is entitled to a presumption of nexus. As noted above, a presumption of nexus requires that the product “‘is the invention disclosed and claimed in the patent.’” *WBIP*, 829 F.3d at 1329 (citations omitted). That is, a nexus is presumed when the commercial product “both ‘embodies the claimed features’ and is ‘coextensive’ with the

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claims at issue.” *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1319 (Fed. Cir. 2015).

Here, the Extreme Power products, as well as Petitioner’s and Flowchem’s products, are not coextensive with the challenged claims. All the products Patent Owner identifies are polymers. The challenged claims of the ’250 patent, however, are not directed to a polymer composition.¹¹ Rather, the challenged claims recite a method of preparing a drag reducing polymer, wherein the drag reducing polymer is able to be injected into a pipeline. *See, e.g.*, Ex. 1004, 19:30–47. Thus, the evidence of record does not indicate that Petitioner, Patent Owner, or Flowchem produces a commercial product that is coextensive with the method recited in the challenged claims. As a result, we determine that Patent Owner is not entitled to a presumption of nexus for any of its proffered secondary

¹¹ Patent Owner appears to treat the challenged claims as though they are directed to a specific polymer, when they are not. For example, Patent Owner contends that Petitioner created its FLO ULTIMA product “with the

PO Resp. 62; *see id.* at 64 (arguing that Flowchem “used LSPI’s Patent Specification as a blueprint” to move “to a substantially different DRA product,

But the challenged claims encompass any method of preparing a drag reducing polymer comprising preparing a drag reducing polymer with a particular solubility parameter, with additional limitations relating thereto. The additional limitations (the drag reducing polymer is added to the liquid hydrocarbon in the range from about 0.1 to about 500 ppmw, having a heteroatom selected from the group consisting of an oxygen atom, a nitrogen atom, a sulfur atom and/or a phosphorus atom; having at least about 25,000 repeating units; having an average molecular weight of at least 1×10^6 g/mol) do not transform the claims to method of preparing a drag reducing polymer into a claim directed to a specific polymer.

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considerations. Because Patent Owner does not direct us to additional evidence to establish nexus, Patent Owner does not establish on this record a nexus between its proffered secondary considerations evidence and the claimed invention.

5. Conclusions as to Obviousness

Having considered the parties' arguments and evidence, we evaluate all of the evidence together to make a final determination of obviousness. *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1075 (Fed. Cir. 2012) (stating that a fact finder must consider all evidence relating to obviousness before finding patent claims invalid). After considering the parties' arguments and evidence, we are persuaded that Petitioner has made a sufficient showing that a person having ordinary skill in the art would have combined the teachings in the manner proposed by Petitioner. We conclude that Petitioner has satisfied its burden of demonstrating, by a preponderance of the evidence, that the subject matter of claims 1–9 of the '250 patent would have been obvious over the combined teachings of the Holtmyer Publication, Holtmyer Patent, and Strausz, and that the subject matter of claims 1–9 of the '250 patent would have been obvious over the combined teachings of Inaoka and Strausz.

III. MOTION TO EXCLUDE

Patent Owner moves to exclude (1) Exhibits 1062, 1073–82, 1088–91, 1102, and 1092 ¶¶ 4–9, and pages 1–7, 10–11, 13–14, and 17 of Petitioner's Reply as involving "new theories, arguments, and evidence that exceed the scope of the Petition and are thus irrelevant to the instituted grounds under F.R.E. [Federal Rules of Evidence] 401–403;" (2) Exhibits 1074–78, 1083–87, 1094, 1096–1100, and pages 3, 20, and 21 of Petitioner's Reply, which

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involve Patent Owner's "internal communications and documents that were not public or prior art and thus are irrelevant to the instituted grounds under F.R.E. 401–403;" and (3) Exhibit 1092 ¶¶ 2–3 and ¶¶ 85–91, and the related arguments on pages 9, 10, and 30 of Petitioner's Reply as "unsupported and unreliable" under *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993) and F.R.E. 702. Paper 46 (redacted), 1; Paper 59 (redacted).

Petitioner filed a Response (Paper 54 (redacted)). With respect to the first category of exhibits, or portions thereof, and portions of Petitioner's Reply that Patent Owner seeks to exclude, Petitioner argues that Exhibits 1062, 1073–82, and 1102 respond to Patent Owner's arguments regarding "surprising and unexpected results;" Exhibits 1088–91 and 1092 ¶¶ 4–9 do not raise new theories, but are "completely consistent with arguments made in the Petition;" pages 1–7, 10–11, 13–14, and 17 of Petitioner's Reply are attorney argument that should not be the subject of a Motion to Exclude; and Patent Owner fails to identify any new arguments raised for the first time in the Reply. Paper 54, 1–5. Having reviewed these exhibits and papers, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence exceed the scope of a proper reply; rather, they are properly responsive and may be considered as part of our evaluation of the record.

With respect to the second category of exhibits and Reply pages that Patent Owner seeks to exclude, Petitioner argues that Patent Owner "relies almost exclusively on internal, confidential documents as support for its assertion of unexpected results," and that the documents dated after the priority date of the subject patent refer to prior art, and, therefore, are relevant. Paper 54, 6–7. Again, having reviewed these exhibits and the

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Reply pages, and having considered the arguments presented by both parties, we are not persuaded that the arguments and evidence are irrelevant. Patent Owner's arguments appear directed to the weight to be given to the documents and argument sought to be excluded, rather than to their admissibility.

As to the third category of exhibits and Reply pages Patent Owner seeks to exclude, Petitioner argues that Patent Owner failed to object to paragraphs 2 and 3 of Exhibit 1092 in a timely manner, and Patent Owner does not respond. Paper 54, 8; Paper 59, 4. Patent Owner must object timely to the evidence it seeks to exclude. 37 C.F.R. § 42.64(b)(1). Petitioner further argues that Dr. Epps's expertise qualifies him to provide the testimony given in Exhibit 1092. Paper 54, 9. We decline to exclude any of this testimonial evidence or any portions of the Reply and, instead, give the evidence more or less persuasive value depending on the degree to which the testimony is supported by reasoning, fact, and Dr. Epps's expertise.

Accordingly, the Motion to Exclude is *dismissed*.

IV. MOTIONS TO SEAL

Patent Owner and Petitioner each filed unopposed Motions to Seal portions of certain papers and exhibits. Paper 17; Paper 25; Paper 26; Paper 35; Paper 44; Paper 48; Paper 55; Paper 56; Paper 58. The Board previously entered a protective order to govern the confidential information produced and filed in this proceeding. Paper 16, 2–4 (granting Patent Owner's motion for entry of a protective order and placing Patent Owner's modified protective order (Paper 13, Addendum A) into effect).

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In its first Motion to Seal, Patent Owner seeks to seal portions of the Patent Owner Response and “certain exhibits to the Patent Owner Response that contain confidential information” belonging to Patent Owner, Petitioner, and/or Flowchem, including portions of Dr. Dunn’s declaration (Ex. 2050). Paper 17, 1. Other than Dr. Dunn’s declaration, Patent Owner does not identify any of the exhibits it seeks to seal. *Id.* In its second Motion to Seal, Patent Owner seeks to seal a sentence, and its accompanying citation, in its Opposition to Petitioner’s Motion for Additional Discovery. Paper 26, 1. In its third Motion to Seal, Patent Owner moves to seal a portion of its Motion to Exclude and a portion of its Sur-Reply. Paper 44, 1. In its fourth Motion to Seal, Patent Owner moves to seal portions of its Motion for Observations on Cross-Examination. Paper 48, 1. In its fifth Motion to Seal, Patent Owner moves to seal Exhibit 2154 (Dr. Epps’s deposition transcript). Paper 56, 1. In its sixth Motion to Seal, Patent Owner moves to seal its Reply to Patent Owner’s Motion to Exclude. Paper 58, 1.

In its first Motion to Seal, Petitioner seeks to seal Exhibit 1070, which it filed in redacted and unredacted versions. Paper 25, 1. In its second Motion to Seal, Petitioner seeks to seal Exhibits 1074, 1075, 1076, 1077, 1078, 1083, 1084, 1085, 1086, 1087, 1094, 1096, 1097, 1098, 1099, 1100, 1108, and 1111, portions of Exhibit 1072 (Dr. Dunn’s cross-examination transcript), portions of Exhibit 1092 (Dr. Epps’s reply declaration), portions of its Reply, and its updated exhibit list. Paper 35, 1. In its third Motion to Seal, Petitioner moves to seal portions of its Response to Patent Owner’s Motion for Observations on Cross-Examination and its Opposition to Patent Owner’s Motion to Exclude. Paper 55, 1.

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“There is a strong public policy for making all information filed in a quasi-judicial administrative proceeding open to the public, especially in an *inter partes* review which determines the patentability of claims in an issued patent and therefore affects the rights of the public.” *Garmin Int’l v. Cuozzo Speed Techs., LLC*, IPR2012–00001, slip op. at 1–2 (PTAB Mar. 14, 2013) (Paper 34). For this reason, except as otherwise ordered, the record of an *inter partes* review trial shall be made available to the public. *See* 35 U.S.C. § 316(a)(1); 37 C.F.R. § 42.14. The standard for granting a motion to seal is good cause. 37 C.F.R. § 42.54. That standard includes showing that the information addressed in the motion to seal is truly confidential, and that such confidentiality outweighs the strong public interest in having the record open to the public. *See Garmin*, slip op. at 2–3.

After having considered the submissions, we deny the Motions to Seal without prejudice. We are not persuaded that the parties establish good cause to seal all of the information identified in their respective motions. For example, both Petitioner and Patent Owner assert that certain information should be sealed because it previously was designated “confidential information,” “highly confidential information,” “protective order material,” or “outside attorneys eyes only” material. *See, e.g.*, Paper 17, 1; Paper 25, 1; Paper 35, 1. As noted above, except for Dr. Dunn’s declaration, Patent Owner’s first Motion to Seal does not identify any of the exhibits it seeks to seal.

We deny the motions without prejudice, and order the parties to work together to jointly file a motion to seal, setting forth: (1) each paper or exhibit that the parties seek to seal, in part or in full; (2) a showing why the information in each paper or exhibit (or the portions thereof) that the parties

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seek to seal is truly confidential; and (3) a clear identification, by paper or exhibit number, of the redacted and unredacted versions of each paper or exhibit that the parties seek to seal. To the extent that the parties have not yet filed redacted versions of each paper and exhibit they seek to seal, the parties shall file such redacted versions.

We further note that this decision will be entered as a non-public version covering protective order material because it references and cites several documents subject to the parties' Motions to Seal. The parties may, as part of the joint motion to seal, request that the Board seal portions of this decision and/or the two oral hearing transcripts (Paper 63, Paper 64). The parties shall provide a joint proposed redacted version of this decision and/or the oral hearing transcript exhibits with the joint motion to seal. We caution the parties that there is a strong public interest in an unsealed Final Written Decision, and any justification to seal the decision must meet the good cause standard. Furthermore, any proposed redactions to the decision and the oral hearing transcript should be narrowly tailored.

The parties are authorized to file the joint motion to seal within ten (10) business days of the date of this decision. The parties shall meet and confer in good faith as necessary to comply with our orders in this decision. 37 C.F.R. § 42.11.

V. CONCLUSION

For the foregoing reasons, we determine that Petitioner establishes, by a preponderance of the evidence, that claims 1–9 of the '250 patent are unpatentable under 35 U.S.C. § 103 as obvious over the combination of the Holtmyer Publication, the Holtmyer Patent, and Strausz, and unpatentable

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under 35 U.S.C. § 103 as obvious over the combination of Inaoka and Strausz.

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner establishes, by a preponderance of the evidence, that claims 1–9 of the '250 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed* as moot;

FURTHER ORDERED that Patent Owner's and Petitioner's Motions to Seal are *denied* without prejudice;

FURTHER ORDERED that within ten (10) business days of this decision, the parties shall file a joint motion to seal in accordance with the instructions set forth above; and

FURTHER ORDERED that this is a Final Written Decision; therefore, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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