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Paper 7
Entered: February 25, 2019

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ENERCORP SAND SOLUTIONS INC.,
Petitioner,

v.

SPECIALIZED DESANDERS INC.,
Patent Owner.

Case IPR2018-01748
Patent 8,945,256 B2

Before RAE LYNN P. GUEST, DONNA M. PRAISS, and CHRISTOPHER M. KAISER, *Administrative Patent Judges.*

PRAISS, *Administrative Patent Judge.*

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314(a)

I. INTRODUCTION

A. Background

Enercorp Sand Solutions Inc. ("Petitioner") filed a Petition to institute an *inter partes* review of claims 1–16 of U.S. Patent No. 8,945,256 B2 ("the '256 patent"). Paper 1 ("Pet."). Specialized Desanders Inc. ("Patent Owner") timely filed a Preliminary Response. Paper 6 ("Prelim. Resp.").

We have authority to determine whether to institute an *inter partes* review under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a). We may not institute an *inter partes* review "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). On April 24, 2018, the Supreme Court held that a decision to institute under 35 U.S.C. § 314(b) may not institute review on less than all claims challenged in the petition. *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1355–56 (2018). Moreover, in accordance with USPTO Guidance, "if the PTAB institutes a trial, the PTAB will institute on all challenges raised in the petition." *See* USPTO, *Guidance on the Impact of SAS on AIA Trial Proceedings* (April 26, 2018) (Available at https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial) ("USPTO Guidance").

Applying those standards, and upon consideration of the information presented in the Petition and the Preliminary Response, we determine that Petitioner has established a reasonable likelihood of success in proving that at least one claim of the '256 patent is unpatentable. Accordingly, we institute an *inter partes* review of all challenged claims (1–16) of the '256 patent, based on all grounds raised in the Petition.

B. Related Proceedings

No related judicial or administrative proceeding is identified by either party.

C. The '256 patent

The '256 patent (Ex. 1001), titled "DESANDING APPARATUS AND SYSTEM," generally relates to an apparatus and its use for removing particulates, such as sand, from fluid streams produced from a well prior to entry to downstream equipment including piping, separators, valves, chokes. Ex. 1001, 1:5–8, 2:33–36. The apparatus features an elongated vessel that is tilted at a non-zero inclination angle. *Id.* at Abstract. Figure 2, an embodiment of the desanding system, is reproduced below:

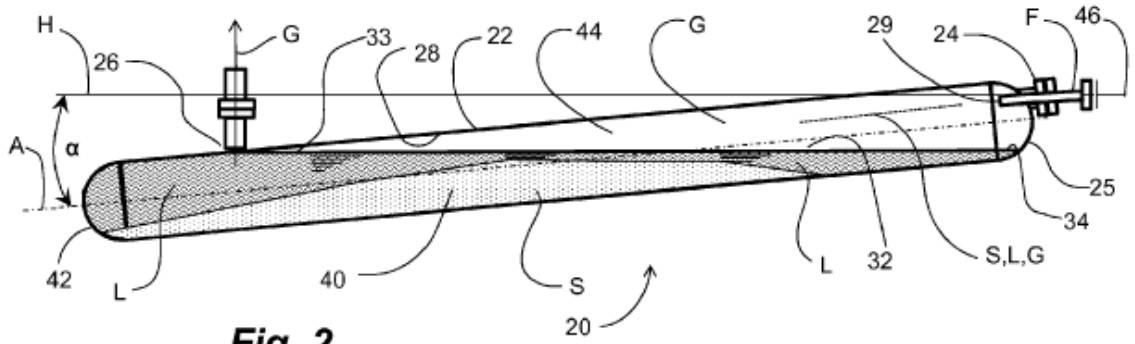

Fig. 2

Figure 2 depicts vessel 22 having axis A oriented at angle α to horizontal H. *Id.* at 4:30–31. Fluid stream F comprises a variety of phases including gas G, liquid L, and entrained particulates such as sand S. *Id.* at 4:33–35. Fluid stream F enters fluid inlet 24 and discharges into freeboard portion 44 which is formed above gas/liquid interface 32; belly portion 40 forms below interface 32 for containing liquid L and particulates S. *Id.* at 4:38–43. Gas G discharges at fluid outlet 26, and, at steady state, when the liquid level

reaches fluid outlet 26, oil and other liquids are re-entrained with gas G exiting at fluid outlet 26. *Id.* at 4:67–5:3. Particulates S continue to be captured in belly portion 40 until volumetric capacity is reached. *Id.* at 5:3–5. The length of the vessel is such that the space between the fluid inlet and the interface is sufficient to minimize turbulence of liquid L in belly portion 40; the spacing is dependent upon design factors including vessel inclination angle α and inlet fluid stream velocity. *Id.* at 4:59–64.

D. Illustrative Claims

Independent claims 1 and 9 illustrate the claimed subject matter and are reproduced below (disputed limitations italicized):

> 1. A desanding system for receiving a gas stream containing entrained liquid and particulates comprising:
>
> a vessel elongated along a longitudinal axis and having a fluid inlet adjacent a first end of the vessel and a fluid outlet spaced along the longitudinal axis from the fluid inlet towards a second end of the vessel, *said vessel being inclined from a horizontal at a non-zero inclination angle at all times during operation such that the fluid outlet is lower than the fluid inlet*, the fluid inlet discharging the gas stream into the vessel at an inlet velocity, *the gas stream travelling down the inclined vessel to the fluid outlet* the vessel having:
>
> a gas/liquid interface formed at the fluid outlet having a belly storage portion formed there below and a freeboard portion formed adjacent an upper portion of the vessel above the interface, *the freeboard portion having a freeboard cross-sectional area which diminishes along the inclined vessel from the fluid inlet to the fluid outlet*; and
>
> the freeboard portion at the fluid inlet causing the gas stream to have a freeboard velocity adjacent the fluid inlet which is less than the velocity of the fluid in the inlet, wherein

the freeboard velocity is such that the entrained liquids and particulates fall out of the gas stream and collect in the belly storage portion, and

wherein a desanded gas/liquid stream flows out of the freeboard portion and out the fluid outlet, being free of a substantial portion of the particulates, and particulates accumulate in the belly portion for flowing downvessel towards said second end.

9. A method for desanding a fluid stream emanating from a wellhead, the fluid stream containing gas, entrained liquid and particulates, the method comprising:

providing an elongated vessel having a longitudinal axis, a fluid inlet adjacent a first end of the vessel and a fluid outlet spaced along the longitudinal axis from the fluid inlet;

inclining the vessel at angle from horizontal at a non-zero inclination angle so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid outlet;

discharging the fluid stream from the fluid inlet, into the inclined vessel and substantially parallel to the longitudinal axis for

establishing a liquid interface in a belly portion of the vessel, the belly portion being formed below the fluid outlet, and

directing the liquid and particulates along a trajectory in the freeboard portion of the vessel to intercept a substantial portion of the particulates at the liquid interface for storage in the belly portion; and

recovering a desanded gas stream at the fluid outlet which is substantially free of particulates.

E. The Alleged Grounds of Unpatentability

Petitioner contends that the challenged claims are unpatentable on the following grounds.[1]

Claims Challenged	Basis[2]	References
1–7, 9–11, 13, and 16	§ 103(a)	Hemstock[3] and Davis[4]
1–13 and 16	§ 103(a)	Hemstock and Data Book[5]
8, 12, 14, and 15	§ 103(a)	Hemstock, Davis, and Miller[6]
14 and 15	§ 103(a)	Hemstock, Data Book, and Miller

II. ANALYSIS

A. Person of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art (POSITA) "would have at least a bachelor's degree in petroleum, chemical, or mechanical engineering" or "a bachelor's degree in some other engineering or scientific discipline, and at least three years of experience working with

[1] Petitioner supports its challenge with a Declaration of David Simpson, P.E., dated Sept. 17, 2018 (Ex. 1002, "Simpson Decl.").
[2] The relevant sections of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, took effect on March 16, 2013. Because the application to which the '256 patent claims priority was filed before that date, our citations to Title 35 are to its pre-AIA version.
[3] US 6,983,852 B2, issued Jan. 10, 2006 (Ex. 1004, "Hemstock").
[4] Robert H. Davis, *Sedimentation of Noncolloidal Particles at Low Reynolds Numbers*, 17 ANNUAL REVIEW OF FLUID MECHANICS, 91–118 (1985) (Ex. 1005, "Davis").
[5] ENGINEERING DATA BOOK §§ 7, 17 (Gas Processors Ass'n, ed., Rev. 10th ed. 1994) (Ex. 1008, "Data Book").
[6] US 1,458,234, issued June 12, 1923 (Ex. 1007, "Miller").

separators." Pet. 20–21. Patent Owner does not dispute or offer an alternative description of the level of ordinary skill in the art.

For purposes of this Decision, we adopt Petitioner's description. We also consider the cited prior art as representative of the level of ordinary skill in the art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (finding the absence of specific findings on "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'" (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp*., 755 F.2d 158, 163 (Fed. Cir. 1985))).

B. Claim Construction

In an *inter partes* review proceeding filed prior to November 13, 2018,[7] claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b) (2014). "Therefore, we look to the specification to see if it provides a definition for claim terms, but otherwise apply a broad interpretation." *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007). "That is not to say, however, that the Board may construe claims during IPR so broadly that its constructions are *unreasonable* under general claim construction principles." *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2015).

[7] The revised claim construction standard for interpreting claims in *inter partes* review proceedings as set forth in the final rule published October 11, 2018, does not apply to this proceeding because the new "rule is effective on November 13, 2018 and applies to all IPR, PGR, and CBM petitions filed on or after the effective date." Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings before the Patent Trial and Appeal Board, 83 Fed. Reg. 51340 (Oct. 11, 2018) (to be codified at 37 C.F.R. pt. 42).

Claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). If the specification "reveal[s] a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess[,] . . . the inventor's lexicography governs." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005) (en banc) (citing *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002)). The context of the claim itself can also inform the meaning of a particular claim term. *Phillips*, 415 F.3d at 1314. We apply this standard to the claims of the '256 patent.

Petitioner proposes the following claim constructions under either the BRI standard or the *Phillips* standard (Pet. 18–20):

Term (Claims)	Petitioner's Proposed Construction
Freeboard (claims 1–16)	"the substantially gas-filled portion of the desanding vessel above the gas/liquid interface"
Replaceable (claims 4 and 5)	"the capacity to be removed without requiring welded modifications to the pressure vessel"

Patent Owner responds that neither of Petitioner's proposed constructions is necessary for determining whether to grant or deny the Petition. Prelim. Resp. 6. Patent Owner nevertheless agrees with the construction for "freeboard" and proposes an alternate construction for "replaceable" that does not include methods of detachment (*id.* at 7):

Term (Claim)	Patent Owner's Proposed Construction
Replaceable (claims 4 and 5)	Removable

We conclude that only the term "freeboard" requires construction to resolve the question of whether to institute. We agree with Patent Owner that it is not necessary to our decision to provide an explicit construction for the term "replaceable." *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (only terms in controversy need to be construed, and only to the extent necessary to resolve the controversy).

Accordingly, for purposes of this decision, we adopt Petitioner's proposed construction for the term "freeboard" because it is consistent with the '256 patent specification (Ex. 1001, Abstract, 2:13–17, 4:13–18) and is not opposed by Patent Owner.

C. Obviousness over Hemstock and Davis

We turn now to Petitioner's asserted grounds of unpatentability to determine whether Petitioner has met the threshold standard of 35 U.S.C. § 314(a). We begin with a description of Hemstock, which is asserted in each ground argued in the Petition.

1. Overview of Hemstock

Hemstock relates to a desanding apparatus having a horizontally oriented cylindrical vessel or zero inclination angle. Ex. 1004, 1 (Abstract). The reference has one common inventor with the '256 patent and claims priority to Canadian patent 2,433,741 (Ex. 1013, issued Feb. 3, 2004), which is described in the background section of the '256 patent (Ex. 1001, 2:7–21).

Modified Figure 3 of Hemstock (reproduced below from Pet. 25) depicts the right and left segments of Figure 3 as one combined apparatus.

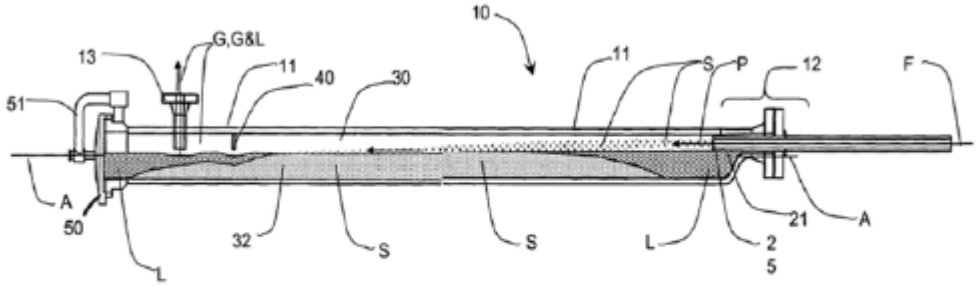

Fig. 3 (modified)

Modified Figure 3 shows desander 10, fluid stream F, fluid inlet 12, fluid outlet 13, gas phase G, liquid phase L, and entrained particulates such as sand S. Ex. 1004, 3:32–42. In operation, fluid stream F containing sand S enters through inlet 12 to a larger cross-sectional area, and substantially gas-phase volume of, freeboard portion 30, slowing the velocity of fluid stream F to a point below the entrainment or elutriation velocity of at least a portion of the particulates S in the fluid stream. *Id.* at 4:18–24. Particulates S accumulate and are removed on a batch basis via cleanout 50. *Id.* at 5:2–6, 5:44–46.

Hemstock teaches that those skilled in the art can determine the elutriation characteristics of fluid stream F and particulates S. *Id.* at 4: 24–27. Freeboard portion 30 has a minimum cross-section area and a preferred length based on elutriation characteristics so as to maximize release of particulates S before they reach outlet 13. *Id.* at 4:47–52. Freeboard portion 30 is maintained using flow barrier 40 to ensure collected liquids L and particulates S only reach a maximum depth in belly portion 32 of vessel 11. *Id.* at 4:44–47. The greater the length or spacing between inlet 12 and flow barrier 40, the greater the opportunity to drop and release entrained particulates S. *Id.* at 4:52–54.

2. Analysis

Petitioner asserts that claims 1–7, 9–11, 13, and 16 would have been obvious over the combination of Hemstock with Davis. Pet. 30–52.

a. Analogous Art

We address at the outset Patent Owner's argument that the combination of Hemstock and Davis is improper because Davis is not analogous art. Patent Owner contends that Davis is nonanalogous art because it is "too remote and unrelated to be treated as prior art." Prelim. Resp. 8. Patent Owner asserts Davis's reference to the "petroleum industry" is merely a single tangential statement in a scholarly, 30-page article analyzing equations for rates of solids settling out of suspensions, such as blood in test tubes. *Id.* at 10. As such, Patent Owner's position is that Davis provides no disclosure how its theoretical or experimental results are intended to be applied or whether they are applicable to devices such as Hemstock's desander. *Id.* at 12. Patent Owner asserts that Davis does not deal with the specific field of endeavor of the '256 patent, removing particles such as sand from fluid streams produced from a well, but, rather, "general phase separation such as blood settling in a test tube." *Id.* at 12–13. Davis's reference to the petroleum industry is said to be only one of a number of possible applications and insufficient to establish Davis as analogous art to the '256 patent. *Id.* at 14 (citing *In re Clay*, 966 F.2d 656, 658–60 (Fed. Cir. 1992)).

Patent Owner also asserts that Davis is not related to the problem that the inventor of the '256 patent was trying to solve, improving separation efficiency of sand from a flow stream, but, instead reducing settling times for solids settling out of liquids based on different fluid mechanics at low

flow rates, and specifically the removal of corpuscles from blood in a test tube, which would not commend itself to the inventor's attention. *Id.* at 15 (citing Davis 17; Ex. 1002 ¶ 83).

The analogous-art test requires that a reference is either in the field of the applicant's endeavor or is reasonably pertinent to the problem with which the inventor was concerned in order to rely on that reference as a basis for rejection. *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992). References are reasonably pertinent to the problem based on the judgment of a person having ordinary skill in the art. *Id.*; *In re Kahn*, 441 F.3d 977, 986–87 (Fed. Cir. 2006); *In re Clay*, 966 F.2d at 659.

We are not persuaded that the analysis in *Clay* precludes finding Davis is reasonably pertinent to the problem addressed by the '256 patent. The problem involved in *Clay* pertained to preventing loss of product in a storage tank for storing refined petroleum, which was determined to be different from the art involving flow profiles through a porous, permeable sedimentary rock of a subterranean formation. *In re Clay*, 966 F.2d at 659–60. Patent Owner describes the difference in *Clay* as "the claimed invention related to storage of oil, and the prior art related to extraction of oil." Prelim. Resp. 15. Here, both Davis and the '256 patent refer to the orientation of a vessel for improving the separation of solids from a fluid stream. Davis 17 ("enhanced sedimentation in inclined channels," "enhancement in the sedimentation rate," and "settling vessels having inclined walls and in which the retention times can be reduced"); '256 patent 2:22–26 ("to improve the ease with which the vessel can be cleaned and further improvement in separation efficiency"), 2:49–51 ("[t]he system comprises a vessel, elongated along a longitudinal axis and inclined from a

horizontal at a non-zero inclination angle"); Ex. 1002 ¶ 83 ("Davis also teaches a method—the use of inclined channels—which can greatly reduce settling times for solids settling out of a liquid."); Pet. 33 ("Davis explains that a simple device that can accomplish solid-liquid separation more rapidly is a settling vessel comprising an inclined, narrow tube or channel.").

In accord with *Clay*, even if Davis does not explicitly disclose the same petroleum industry application as the '256 patent, namely removing particulates from fluid streams produced by a well (Ex. 1001, 1:5–8), it is reasonably pertinent if it logically would have commended itself to an inventor's attention. Since improving separation efficiency of particulates from a fluid stream and reducing settling times for solids settling out of liquids both involve fluid mechanics with similar objectives of efficiently separating out solids in a vessel, one of skill in the art would have logically looked to fluid mechanics publications, such as the Annual Review of Fluid Mechanics in which the Davis article is published, to solve problems related to separation of solids from a fluid, and more particularly, to improving separation efficiency. Ex. 1002 ¶ 83.

Patent Owner's suggestion that different fluid mechanics are involved in Davis than in the specific application which the inventor of the '256 patent addressed (Prelim. Resp. 15) is not supported by the record. It is not self-evident from the cited portions of the Petition, Davis, and the Simpson Declaration that a difference in the fluid mechanics exists. *See* Prelim. Resp. 15 (citing Pet. 24; Davis 17; Ex. 1002 ¶ 83). Patent Owner's explanation of the alleged difference in fluid mechanics between the separation processes of the '256 patent and the sedimentation process of Davis is insufficient to place the issue of Davis's status as analogous art in dispute, particularly in

light of Patent Owner's failure to explain the significance of any difference in fluid mechanics to the analogous art analysis.

Whether Davis's disclosure is reasonably pertinent to the problem addressed by the inventor of the '256 patent is based on the judgment of a POSITA. *In re Oetiker*, 977 F.2d at 1447. As discussed above, a POSITA in this case would have at least a bachelor's degree in petroleum, chemical, or mechanical engineering. Davis is a reference discussing general engineering principles.[8] The Davis article is authored by members of the Department of Chemical Engineering at University of Colorado and Stanford University. Ex. 1005, 3. Davis teaches in its introduction that the subject of the disclosure, sedimentation, has application to the petroleum industry as a way of separating particles from fluid. *Id.* In addition, the Simpson Declaration is submitted by a person who also meets the definition of a POSITA in this case and identifies the problem addressed by Davis as improving separation efficiency in a sedimentation process. Ex. 1002 ¶¶ 4, 5, 83. Therefore, the present record sufficiently supports the position that Davis is analogous art to the '256 patent because it is reasonably pertinent to the problem of separation efficiency of particulates from a fluid stream produced from a well.

b. Claim 1

Regarding claim 1, Petitioner asserts that Hemstock teaches each of the claim limitations except Hemstock teaches a horizontal vessel rather than

[8] The blood separation example is described in Davis merely as a proof of concept of an engineering principle and not as a sole application. Ex. 1005, 17 ("The phenomena of enhanced sedimentation in inclined channels has a long history . . . [and] many investigators have studied the phenomenon for a variety of suspensions and have reported that a severalfold increase in the sedimentation rate could indeed be achieved.").

a vessel inclined from a horizontal at a non-zero inclination angle as required by the claim. *Id.* at 32. Petitioner contends that Hemstock discloses a gas stream travelling down the vessel to the fluid outlet even though it is not inclined as recited in the claim. *Id.* at 34. Petitioner also contends that if Hemstock's vessel were inclined, the cross-sectional area of the freeboard portion would necessarily diminish along the vessel from the inlet to the outlet or that, alternatively, Hemstock discloses a smaller cross-sectional area at at least one point between the fluid inlet and the fluid outlet (the point where flow barrier 40 is installed). *Id.* at 35–36.

To cure the deficiencies of Hemstock, Petitioner relies on Davis's teaching that solid-liquid separation can be accomplished more rapidly in a settling vessel comprising an inclined, narrow tube or channel. *Id.* at 33 (citing Davis 17). Petitioner points out that Davis teaches sedimentation is commonly used in the chemical and petroleum industries to separate particles from fluid. *Id.* at 32 (citing Davis 3). According to Petitioner, a POSITA would have been motivated to incline Hemstock's desander for the reason that a more rapid separation between the solid and liquid phases is achieved with an inclined tube or channel as taught by Davis. *Id.* at 48 (citing Davis 17; Ex. 1002 ¶ 168).

Petitioner explains that a POSITA would have desired more rapid sand settling in the liquid to prevent re-entrainment of the solid particulates with the liquid stream leaving outlet 13, which Hemstock teaches occurs in normal operation (Hemstock 4:55–59) and that such entrained particulates were known to contaminate surface equipment, contaminate produced fluids, and impair the normal operation of oil and gas gather systems and facilities (Ex. 1002 ¶ 168; Hemstock 1:47–50). Pet. 48–49. Petitioner asserts that no

negative impact would have been expected due to the changes inclining the vessel would have and that it would have been within the knowledge and ability of a POSITA to size the vessel to achieve the appropriate separation and to modify the angle of the connection to the inlet and/or outlet piping using angled pipe fittings or bending the pipe. *Id.* at 51–52 (citing Ex. 1002 ¶¶ 175, 176).

Patent Owner contends that Petitioner has not shown that three elements of claim 1 are disclosed by the combination of Hemstock and Davis. Prelim. Resp. 26–37. First, Patent Owner contends that the combination does not teach a vessel that is "inclined from a horizontal" as recited in claim 1 because Davis discloses inclining a settler from a vertical, not from a horizontal. *Id.* at 26. Patent Owner contends that Hemstock (unmodified) also is not "inclined from a horizontal" and that Hemstock modified with Davis has not been shown to inherently or necessarily have a fluid outlet lower than the fluid inlet. *Id.* at 27–28. Patent Owner does not dispute that Hemstock (unmodified) discloses a fluid outlet lower than the fluid inlet, but, rather, that the combination fails to teach this limitation because Davis does not disclose a preference for which direction its channel is inclined. *Id.* at 29.

Second, Patent Owner contends that Petitioner does not establish where the gas/liquid interface is located in Hemstock's modified device, much less whether the interface is "formed at the fluid outlet" as recited in the claim. *Id.* at 31. Patent Owner notes that only Hemstock is relied upon for disclosing this limitation.

Third, Patent Owner asserts that the prior art combination does not disclose "a freeboard cross-sectional area which diminishes along the

inclined vessel from the fluid inlet to the fluid outlet" as recited in the claim because Hemstock does not teach an "inclined vessel." Prelim. Resp. 33. Patent Owner contends "at best Petitioner has shown that the freeboard portion has a smaller cross-sectional area at a single point in the vessel, and not along the entire vessel from inlet to outlet . . . ." *Id.* at 34.

We determine that Petitioner has demonstrated sufficiently for purposes of institution that claim 1 would have been obvious in view of Hemstock in combination with Davis.

Patent Owner does not dispute that Davis discloses an inclined vessel. By definition, "inclined" means "deviating in direction from the horizontal or vertical; sloping."[9] The "inclined" channels, tubes, and vessels disclosed on page 17 of Davis are shown in Davis's Figure 4 as having a slope or angle from both the vertical and horizontal axes.[10] Davis also describes the depicted channel as "tilted." Thus, Davis teaches an inclined vessel that has a non-zero angle from the horizontal axis as shown by Davis's Figure 4.

Regarding the claim requirement that the fluid outlet is lower than the fluid inlet, Patent Owner does not disagree that this limitation is taught by Hemstock alone (Prelim. Resp. 27). The fact that Petitioner combines the teachings of Davis to incline a vessel does not negate the teachings of Hemstock regarding the location of the fluid outlet relative to the fluid inlet on a vessel for desanding. At this stage in the proceeding, and absent evidence that a POSITA would have been motivated to incline the vessel of Hemstock such that the fluid outlet is higher than the fluid inlet, we determine that the Petition sufficiently shows for purposes of institution that

[9] http://www.dictionary.com.
[10] A horizontal angle is the complement of any vertical angle.

the combination of Hemstock and Davis discloses the fluid outlet is lower than the fluid inlet and that the modified vessel is inclined as required by claim 1.

Regarding the cross-sectional area of the freeboard portion, Patent Owner does not dispute that Hemstock discloses at least one point between the fluid inlet and the fluid outlet where the cross-sectional area of the freeboard portion is reduced or diminished (Prelim. Resp. 33–34). Claim 1 does not recite "along the entire vessel from inlet to outlet" when describing how the cross-sectional area of the freeboard section diminishes nor does Patent Owner explain why the claim should be construed to require the cross-sectional area to diminish along the entire length of the vessel from inlet to outlet (Prelim. Resp. 34). Neither party proposes a claim construction for this term. Accordingly, we construe the claim term consistent with Petitioner's argument that the cross-sectional area of the freeboard section in Hemstock is diminished at least at one point between the fluid inlet and fluid outlet.

Additionally, Petitioner argues that when Hemstock's vessel is inclined as taught by Davis, the cross-sectional area of the freeboard section will necessarily diminish along the vessel from the inlet to the outlet. Pet. 36. This argument is supported by the Simpson Declaration which explains that this is because the lightest phase will decrease due to the accumulation of the heavier phase in the downward direction and because the liquid phase interface must remain level as shown in Davis's Figure 4 with respect to region A. Ex. 1002 ¶¶ 105–106. Therefore, Petitioner sufficiently demonstrates for purposes of institution that the prior art combination discloses this claim limitation.

Regarding the "gas/liquid interface formed at the fluid outlet having a belly storage portion formed therebelow,"[11] Petitioner identifies in Hemstock belly portion 32 in Figure 3, which stores liquids and sand, as being below freeboard portion 30, which is substantially gas phase. Pet. 34–35. Petitioner asserts that a gas/liquid interface is formed where the freeboard portion and the belly portion meet. *Id.* at 35 (citing Hemstock 4:15–21, 4:37–43, Fig. 3). Petitioner also asserts that freeboard portion 30 is formed adjacent the upper portion of the vessel. *Id.* (citing Hemstock Figs. 1b, 3). As shown in Figure 3 of Hemstock, the identified gas/liquid interface is at the fluid outlet portion of Hemstock's vessel, the fluid outlet previously identified by Petitioner as item 13 in Figure 3. *Id.* at 31. Therefore, Petitioner's position is supported by the cited record.

In sum, the elements of claim 1 have been sufficiently identified in the Petition for purposes of institution.

c. Claim 9

Regarding independent claim 9, Petitioner asserts that normal use and operation of Hemstock's desander discloses each of the claimed steps of the method except "inclining the vessel at angle from a horizontal at a non-zero inclination angle so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid outlet" as recited by the claim. Pet. 38–40. Petitioner contends that Hemstock's desander creates a freeboard section as required by the claim even though it is not inclined, based on the combination of the weir (depending flow barrier 40) and/or the extended

[11] Although we conclude that we need not construe this phrase precisely to determine whether or not to institute trial, we note that this phrase appears difficult to interpret precisely, and we invite the parties to address the proper construction during trial.

nozzle 21, thus, if Hemstock were inclined, it would necessarily perform the claimed step. *Id.* at 39 (citing Ex. 1002 ¶¶ 119–120, which refers back to the discussion of claim 1 and, specifically, its requirement that the fluid outlet of the inclined vessel is lower than the fluid inlet during operation).

Patent Owner contends that Petitioner's reliance on its previous discussion of various elements of claim 1 despite the difference in claim language with claim 9 leaves multiple limitations not identified. Prelim. Resp. 38. Patent Owner further contends that because Hemstock alone or modified with Davis does not disclose elements of claim 1, it likewise does not disclose the corresponding element of claim 9. *Id.* at 38–39. In addition, Patent Owner asserts that the Simpson Declaration fails to support the Petition because it is conclusory and unsupported with regard to the inherent operation of the prior art combination. *Id.* at 39.

We determine that Petitioner has demonstrated sufficiently for purposes of institution that Hemstock in combination with Davis renders claim 9 obvious. While Petitioner's arguments with respect to method claim 9 largely repeat the arguments made with respect to system claim 1, we note that system claim 1 claims the system "during operation." '256 patent 7:53. Therefore claim 9's method of using the desander understandably overlaps the inclined desander of claim 1 "during operation." Accordingly, we determine that Petitioner has sufficiently shown the limitations of claim 9 are disclosed by the combination of Hemstock and Davis for essentially the same reasons discussed above in connection with claim 1.

d. Dependent Claims 2–7, 10, 11, 13, and 16

Regarding the dependent claims, Patent Owner contends the challenges fail for the same reasons provided with respect to claim 1.

Prelim. Resp. 40. Because we find (1) the challenge to claim 1 over the combination of Hemstock and Davis is reasonably likely to be successful and (2) Petitioner's arguments regarding the dependent claims to be supported by the record, we determine that the challenges to dependent claims 2–7, 10, 11, 13, and 16 are also reasonably likely to be successful.

Petitioner shows that Hemstock's fluid inlet 12 has a discharge end (protruding discharge portion 25 of nozzle 21) that extends into upper freeboard portion 30, which meets claim 2's requirement that the discharge end of the fluid inlet is "oriented for discharging the gas stream into the freeboard portion." *Id.* at 40 (citing Hemstock 3:43–4:14, Figs. 2a, 2b, 3). Claim 3, which requires the discharge end of the fluid inlet "directs the gas stream into the freeboard portion and parallel to the longitudinal axis," is also shown to be disclosed by Hemstock's nozzle 21 which directs the incoming fluid stream containing gas, liquid, and solid particulates, into the freeboard portion along path (P) substantially parallel to the vessel's longitudinal axis (A). *Id.* at 41 (citing Hemstock 4:5–14, Figs. 2a, 2b, 3).

Claim 4, which requires that the fluid inlet further comprise a replaceable nozzle having a discharge end oriented for discharging the gas stream into the freeboard portion, is shown to be disclosed by Hemstock's nozzle 21 with discharge end 25 having threaded inlet 23 for connection with coupling 24 on wellhead piping 9. *Id.* at 41 (citing Hemstock 3:48–60, Figs. 1, 2a, 2b). Petitioner also shows that nozzle 21 is connected to fluid inlet 12 at flange 20 to meet claim 5's requirement that the replaceable nozzle is connected to the fluid inlet at a flange. *Id.* at 42 (citing Hemstock 3:48–60, Figs. 2a, 2b). Claim 6 requires a receiving end for receiving a gas stream from a wellhead that is orthogonal to the wellhead, which Petitioner

shows such connective piping between a wellhead and downstream equipment is "typically in rectilinear or orthogonal arrangements." *Id.* at 42–43 (citing '256 patent 5:6–8; Ex. 1002 ¶¶ 136–137). Hemstock is also shown to teach a conduit for carrying fluid stream F containing entrained particulates, from a wellhead and connects to inlet end 12 of desander 10 as required by claim 7, which claim also requires a fluid inlet discharge and receiving end as discussed with respect to claims 2, 3, and 6. *Id.* at 43 (citing Hemstock 3:32–39).

Regarding claim 10, which requires that the gas/liquid interface formed during operation extends horizontally from about the fluid outlet, is shown to be disclosed by Hemstock in Figure 4c (gas/liquid interface 30/32). Pet. 44–45. Claim 11, which requires that the cross-section area of the freeboard portion is at its greatest adjacent the fluid inlet, is shown to be expected from inclining Hemstock's desander due to accumulation of liquid and solids in the belly storage portion as they fall out of the inlet stream. *Id.* at 45–46 (citing Ex. 1002 ¶ 145; Hemstock Fig. 3). Claim 13's requirement that the desanding system comprise an access closure at a second end for removal of accumulated particulates is shown to be disclosed by Hemstock's cleanout 50 for access to clean out accumulated particles in vessel 11. *Id.* at 46 (citing Hemstock 5:44–58, Fig. 3). The disclosure in Hemstock regarding removing the accumulated particulates is also shown to meet the requirement of claim 16, which depends from claim 9 and recites "periodically removing accumulated particulates." *Id.* at 47.

Accordingly, based on the current record, we determine that Petitioner has shown a reasonable likelihood of prevailing on its assertion that claims

1–7, 9–11, 13, and 16 are unpatentable over the combination of Hemstock and Davis.

D. Obviousness over Hemstock and Data Book

Petitioner asserts that one of ordinary skill in the art would have had reason to combine the teachings of Data Book with Hemstock's desander apparatus rendering obvious claims 1–13 and 16. Pet. 30–48, 49–53. According to Petitioner, Data Book is in the same field of endeavor as the '256 patent because it addresses the separation of gases, liquids, and solids, including streams containing hydrocarbons, and teaches ways to improve separation efficiency. *Id.* at 24; Ex. 1002 ¶ 85 (citing Data Book 3–17, 41–42). Petitioner contends that a POSITA looking to improve the liquid/vapor separation efficiency of Hemstock would have maximized the device's ability to handle liquid slugs based on Hemstock's disclosure that the expected multiphase flow is unstable, and that "[l]arge slugs of fluid followed by a gas mist is [sic] common." Pet. 50 (quoting Hemstock 2:8–9; Ex. 1002 ¶ 171). Petitioner also contends a POSITA would have been motivated to make an inclination angle variable to suit varying stream conditions as suggested by Data Book's disclosure that angles between 1–10 degrees used in slug catchers are a design choice. *Id.* at 53 (citing Ex. 1002 ¶¶ 180–181).

1. Analogous Art

We address at the outset Patent Owner's argument that the combination of Hemstock and Data Book is improper because Data Book is not analogous art. Patent Owner contends that Data Book, an engineering data book published by the Gas Processors Suppliers Association, is not analogous art if it is merely in the same general field of endeavor. Prelim.

Resp. 16–17 (citing *In re Clay*, 966 F.2d at 659–60). Patent Owner contends that Data Book is not in the specific field of endeavor of the '256 patent, namely, removing particles, such as sand, from fluid streams produced from a well. *Id.* at 17. Patent Owner contends that Dr. Simpson's opinion that Data Book is related to "the separation of gases, liquids and solids, including streams containing hydrocarbons such as well production streams" is not supported by the cited sections of the Data Book. *Id.* at 17–18. According to Patent Owner, the section relating to filtering refers to hydrocarbon vapors not connected to oil from a well production stream and the other section cited relating to "Fluid Flow and Piping" does not mention hydrocarbons or the separation of solids from a fluid flow. *Id.* at 18.

Patent Owner further contends that Data Book does not relate to the particular problem as the '256 patent, namely improving separation efficiency of sand from a flow stream. *Id.* at 18–19. Patent Owner points out that Petitioner refers to Data Book as "a well-known general reference publication" and does not assert Data Book is trying to solve any problem. *Id.* at 19.

We are not persuaded that Data Book is non-analogous art because Hemstock itself acknowledges that the multiphase flow in the oil and gas operation in which its system functions commonly involves large slugs of fluid followed by a gas mist (Hemstock 2:8–10), and Data Book specifically addresses how slugs are addressed in the oil and gas industry (Data Book 41). Therefore, Petitioner adequately demonstrates that those skilled in the art would have looked to this well-known general reference publication to solve the problem identified by Hemstock as being particularly applicable to a desanding system.

2. Claim 1

Patent Owner contends that the obviousness arguments presented in the Petition must fail because Data Book distinguishes between "vessel" slug catchers and "pipe" slug catchers, and, because Petitioner does not provide evidence or argument that the pipe implementation of a slug catcher can be considered a "vessel," Petitioner has not shown that Data Book discloses a "vessel inclined from a horizontal" as required by claim 1. Prelim. Resp. 49–50.

Patent Owner contends that inclining Hemstock does not necessarily result in "the fluid outlet is lower than the fluid inlet" as required by claim 1 based on the scenario of Hemstock tilted in a clockwise direction. *Id.* at 51. Patent Owner argues further that Data Book's pipe slug catcher is depicted as having an outlet that is higher than its inlet, thus providing a "counterexample" to Petitioner's inherency argument. *Id.*

Patent Owner also contends that Petitioner has not shown that the prior art combination discloses "a gas/liquid interface formed at the fluid outlet" as recited in claim 1. *Id.* at 53–56. According to Patent Owner, Petitioner's position that the pipe slug catcher in Data Book "necessarily has a gas/liquid interface which extends horizontally from the fluid outlet in the same manner as disclosed" is disproved by Dr. Simpson's statement that slug catchers operate in three modes, two of which do not have a gas/liquid interface at the fluid outlet. *Id.* at 54 (citing Ex. 1002 ¶ 104).

We determine that Petitioner has shown a reasonable likelihood of success in prevailing on its obviousness ground based on Hemstock as modified by Data Book. Petitioner provides a rational basis (Pet. 49–51) for modifying Hemstock's horizontal desander by inclining the vessel to

improve the ability to handle slug flow. Petitioner's position that Data Book teaches slug catchers may be a single vessel or constructed of pipe and that such devices are "generally inclined from one to ten degrees" (Pet. 33) is sufficiently supported by the cited record for purposes of this institution decision. Although Patent Owner points out that the discussion of inclination angles on page 41 of Data Book refers to a pipe rather than a vessel type slug catcher, the beginning of the paragraph notes that "slug catchers are frequently made of pipe" for the reason that pipes are frequently less expensive than vessel type slug catchers due to thinner wall requirements of smaller diameter pipe. Data Book 41. Thus, the fact that Data Book teaches inclination angles are favored and generally inclined from one to ten degrees for pipe slug catchers does not necessarily mean that one skilled in the art would not understand such inclination angles to apply equally to vessel slug catchers. Patent Owner will have an opportunity during trial to cross-examine Dr. Simpson about Data Book's disclosure and the understanding of a person of ordinary in the art that are not properly decided at this stage. Those issues are appropriately resolved after the record is fully developed, including, deposition testimony of Petitioner's expert.

Regarding the claim requirement that the fluid outlet is lower than the fluid inlet, Patent Owner does not disagree that this limitation is taught by Hemstock alone. Pet. 32; Prelim. Resp. 27. The fact that Petitioner combines the teachings of Data Book to address liquid slugging with an angle from one to ten degrees (Data Book 41) does not negate the teachings of Hemstock regarding the location of the fluid outlet relative to the fluid inlet. At this stage in the proceeding, and absent evidence that a POSITA

would have been motivated to not only incline the vessel of Hemstock, but to additionally modify Hemstock in accordance with the illustration in Data Book (Data Book 41) such that: (1) the fluid outlet is higher than the fluid inlet; and (2) the location of the fluid outlet is changed, we determine that the Petition sufficiently shows for purposes of institution that the combination of Hemstock and Data Book discloses the fluid outlet is lower than the fluid inlet and that the modified vessel is inclined as required by claim 1.

Regarding the cross-sectional area of the freeboard portion, Patent Owner does not dispute that Hemstock discloses at least one point between the fluid inlet and the fluid outlet where the cross-sectional area of the freeboard portion is reduced or diminished. Pet. 36; Prelim. Resp. 34. Neither party proposes a claim construction for this term. Accordingly, we construe the claim term consistent with Petitioner's argument that the cross-sectional area of the freeboard section in Hemstock is diminished at least at one point between the fluid inlet and fluid outlet.

Additionally, Petitioner argues that when Hemstock's vessel is inclined as taught by Data Book, the cross-sectional area of the freeboard section will necessarily diminish along the vessel from the inlet to the outlet. Pet. 36. This argument is supported by the Simpson Declaration which explains that this is because the gas/liquid interface must remain level. Ex. 1002 ¶¶ 105, 107. Therefore, Petitioner sufficiently demonstrates for purposes of institution that the prior art combination discloses this claim limitation.

Regarding the "gas/liquid interface formed at the fluid outlet having a belly storage portion formed therebelow," Petitioner identifies in Hemstock

belly portion 32 in Figure 3, which stores liquids and sand, as being below freeboard portion 30, which is substantially gas phase. Pet. 34–35. Petitioner asserts that a gas/liquid interface is formed where the freeboard portion and the belly portion meet. *Id.* at 35 (citing Hemstock 4:15–21, 4:37–43, Fig. 3). Petitioner also asserts that freeboard portion 30 is formed adjacent the upper portion of the vessel. *Id.* (citing Hemstock Figs. 1b, 3). As shown in Figure 3 of Hemstock, the identified gas/liquid interface is at the fluid outlet portion of Hemstock's vessel, the fluid outlet previously identified by Petitioner as item 13 in Figure 3. *Id.* at 31. Therefore, Petitioner's position is supported by the cited record.

Based on the current record, we determine that Petitioner has shown a reasonable likelihood that it would prevail in its assertion that claim 1 would have been obvious over Hemstock in view of Data Book.

3. Claim 9

Regarding independent claim 9, Petitioner asserts that normal use and operation of Hemstock's desander discloses each of the claimed steps of the method except "inclining the vessel at angle from a horizontal at a non-zero inclination angle so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid outlet" as recited by the claim. Pet. 38–40. Petitioner contends that Hemstock's desander creates a freeboard section as required by the claim even though it is not inclined, based on the combination of the weir (desanding flow barrier 40) and/or the extended nozzle (21), thus, if Hemstock were inclined, it would necessarily perform the claimed step. *Id.* at 39 (citing Ex. 1002 ¶¶ 119–120, which refers back to the discussion of claim 1 and, specifically, its requirement that the fluid outlet of the inclined vessel is lower than the fluid inlet during operation).

Patent Owner contends that Petitioner's reliance on its previous discussion of various elements of claim 1 despite the difference in claim language with claim 9 leaves multiple limitations not identified. Prelim. Resp. 38. Patent Owner further contends that because Hemstock alone or modified with Davis does not disclose elements of claim 1, it likewise does not disclose the corresponding element of claim 9. *Id.* at 38–39. In addition, Patent Owner asserts that the Simpson Declaration fails to support the Petition because it is conclusory and unsupported with regard to the inherent operation of the prior art combination. *Id.* at 39.

We determine that Petitioner has demonstrated sufficiently for purposes of institution that Hemstock in combination with Data Book renders claim 9 obvious. While Petitioner's arguments with respect to method claim 9 largely repeat the arguments made with respect to system claim 1, we note that system claim 1 claims the system "during operation." '256 patent 7:53. Therefore claim 9's method of using the desander understandably overlaps the inclined desander of claim 1 "during operation." Accordingly, we determine that Petitioner has sufficiently shown the limitations of claim 9 are disclosed by the combination of Hemstock and Data Book for essentially the same reasons discussed above in connection with claim 1.

4. Dependent claims 2–8, 10–13, and 16

Regarding dependent claims 2–8, 10–13, and 16, Petitioners' citations to Hemstock and Data Book are supported by the evidence of record. Pet. 40–47. Patent Owner does not provide arguments in the Preliminary Response regarding these dependent claims apart from those presented with respect to independent claims 1 and 9. Prelim. Resp. 58. Because these

dependent claims depend directly or indirectly from claim 1, and because their further limitations are likewise disclosed in Hemstock (as discussed in detail above in section II.C.2.d.), we are persuaded at this preliminary stage in the proceeding that Petitioner has established a reasonable likelihood of success in proving that 2–8, 10–13, and 16 are unpatentable over Hemstock and Data Book.

E. Other Grounds

Petitioner asserts that dependent claims 8 and 12 would have been obvious over the combination of Hemstock with Davis and Miller and that dependent claims 14 and 15 would have been obvious over Hemstock in combination with either (1) Davis and Miller or (2) Data Book and Miller. Pet. 54–60. Patent Owner does not separately address the obviousness challenges to these dependent claims apart from noting the claims' dependency from claim 1 and relying upon the arguments presented with respect to the challenges to claim 1. Prelim. Resp. 63–64.

Claims 8, 12, and 14 depend directly from claim 1. Claim 15 depends from claim 14, which, in turn, depends from claim 1. In view of our above analysis of Petitioner's assertions that claim 1 would have been obvious over the combination of either Hemstock and Davis or Hemstock and Data Book, we focus on Petitioner's citations to Miller and reasons to combine the teachings of Miller. According to Petitioner, Miller discloses drilling mud used in drilling wells undergoing the same type of separation method as Davis, sedimentation, whereby particles fall under the action of gravity through a fluid in which they are suspended. Pet. 28–29; Miller 2:9–20, 2:51–61, 2:88–3:24, 3:14–21; Ex. 1002 ¶¶ 49–51. Miller's separation vessel is shown by Petitioner to be inclined with the solids migrating toward the

lower end of the vessel to which a smaller diameter outlet pipe is attached eccentrically. Pet. 29, 56; Miller 2:51–61; Ex. 1002 ¶ 191.

Miller's disclosure that the inclination angle is variable to suit varying stream conditions (Miller 2:51–59) and the Simpson Declaration's determination that a POSITA would have understood Miller to disclose an angle between 2 and 20 degrees (Ex. 1002 ¶ 185) support Petitioner's argument that the limitations of claim 8 ("wherein the inclination angle is variable for varying fluid stream conditions") and claim 12 ("wherein said inclination angle is between about 2 degrees and about 20 degrees") are met by the teachings of Miller. Petitioner's argument is reasonable because it is supported by the Simpson Declaration, which provides a reason for modifying Hemstock's vessel with the teachings of Davis or Data Book and Miller. Ex. 1002 ¶¶ 166–173, 184–185. Absent evidence to the contrary, Petitioner has established a reasonable likelihood of success in proving that claims 8 and 12 would have been obvious over the combination of Miller with either Hemstock and Davis or Hemstock and Data Book.

The requirement that the vessel have a smaller diameter downstream of the fluid outlet (claim 14) and that the second end of the vessel have an eccentric end (claim 15) are shown to be disclosed by Miller's eccentrically located, smaller diameter outlet pipe 8. Pet. 46 (citing Miller 1, 2:51–64, 3:21–24; Ex. 1002 ¶¶ 148, 192–198). Petitioner's argument that a person having ordinary skill in the art would have understood from Miller's disclosure of a smaller diameter pipe that a smaller diameter section of the pressure vessel itself is suggested is supported by the Simpson Declaration. Pet. 56; Ex. 1002 ¶¶ 191–196. The Simpson Declaration explains that a person having skill in the art would understand Miller's disclosure to suggest

a smaller diameter portion of the vessel itself for the reason that such pressure vessels were well-known in the art before the filing date of the time of the '256 patent. Ex. 1002 ¶¶ 191–196. Dr. Simpson explains that there is also a cost benefit to a smaller diameter section for the required functionality. *Id.* ¶¶ 192. The cost benefit is due to (1) less material being used by the smaller diameter cylindrical elements and (2) smaller diameter quick-release closures are significantly less expensive. *Id.* Dr. Simpson additionally explains that a POSITA would have been motivated to locate the smaller diameter end an eccentric end because the lowest part of the vessel is where solids naturally will tend to accumulate, therefore a concentric end would create a dead space from which it would be difficult to remove accumulated solids. *Id.* ¶ 198. Absent evidence to the contrary, Petitioner's position is sufficient for institution purposes.

Based on this limited record, Petitioner's position is sufficiently supported for the purpose of instituting trial. Patent Owner will have an opportunity during trial to cross-examine Dr. Simpson about Miller's disclosure and the understanding of a person of ordinary skill in the art that are not properly decided at this stage. Those issues are appropriately resolved after the record is fully developed, including, deposition testimony of Petitioner's expert.

III. CONCLUSION

For the foregoing reasons, based on the evidence before us, we determine that Petitioner has demonstrated a reasonable likelihood that at least one of claims 1–16 of the '256 patent is unpatentable.

The Board has not made a final determination on the construction of any claim term or the patentability of any challenged claim.

IV. ORDER

Accordingly, it is

ORDERED that *inter partes* review is *instituted* with respect to all grounds of unpatentability asserted in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(a), *inter partes* review of the ’256 patent is hereby instituted commencing on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

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