

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SCOUT ENERGY MANAGEMENT, LLC, and CHEVRON U.S.A. INC.,
Petitioner,

v.

PILOT INTELLECTUAL PROPERTY, LLC,
Patent Owner.

IPR2024-00385
Patent 8,505,332 B1

Before KEN B. BARRETT, WILLIAM V. SAINDON, and
MICHAEL L. WOODS, *Administrative Patent Judges*.

WOODS, *Administrative Patent Judge*.

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

I. INTRODUCTION

Scout Energy Management, LLC and Chevron U.S.A. Inc. (collectively, “Petitioner”) filed a Petition (Paper 1, “Pet.”) for *inter partes* review of claims 1–4, 6, and 7 (the “Challenged Claims”) of U.S. Patent No. 8,505,332 B1 (Ex. 1001, “the ’332 patent”). Pet. 1.

Pilot Intellectual Property, LLC, (“Patent Owner”) filed a Preliminary Response (Papers 6). With our authorization, Petitioner also filed a Reply (Paper 9, “Pet. Reply” or “Reply”) and Patent Owner filed a Sur-reply (Paper 10, “PO Sur-reply” or “Sur-reply”).

Under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a), we have authority to institute an *inter partes* review if “the information presented in the petition . . . and any response . . . shows that 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). After considering the Petition, the Preliminary Response, the Reply, the PO Sur-reply, and the evidence of record, we determine the information presented shows a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of the Challenged Claims of the ’332 patent. Accordingly, we institute an *inter partes* review of claims 1–4, 6, and 7 of the ’332 patent on the grounds asserted in the Petition.

II. BACKGROUND

A. Real Parties-in-Interest

Petitioner submits that

Scout Energy Management, LLC, Scout Energy Group V LP, Scout Energy Partners V-A, LP, and Chevron U.S.A. Inc. are the real parties-in-interest. Scout Energy Management is

the indirect partial owner of Scout Energy Group V LP and Scout Energy Partners V-A, LP. Scout Energy Group V LP and Scout Energy Partners V-A, LP own the Mabee Plant, an oil and gas facility relevant to Pilot Energy Solutions, LLC v. Chevron U.S.A. Inc. et al., CA 4:23-CV-02505-AHB (discussed below). Scout Energy Management, LLC is the contract operator of the Mabee Plant. Chevron U.S.A. Inc. is a wholly owned indirect subsidiary of Chevron Corporation.

Pet. 1.

Patent Owner submits that Pilot Intellectual Property, LLC, Pilot Energy Solutions, LLC, and Holloman Holdings Corporation are the real parties-in-interest. Paper 5, 1.

B. Related Matters

The parties identify *Pilot Energy Solutions, LLC et al. v. Chevron U.S.A. Inc. et al.*, Case No. 4:23-cv-02505-AHB (S.D. Tex.) (the “Related Litigation”) as a related matter. Pet. 1; Paper 5, 1.

C. Overview of the ’332 Patent

The ’332 patent is titled “Natural Gas Liquid Recovery Process.” Ex. 1001, code (54). The ’332 patent discloses a method for separating a hydrocarbon feed stream into a heavy hydrocarbon rich stream and a carbon dioxide recycle stream and separating the carbon dioxide recycle stream into a natural gas liquids (“NGLs”) rich stream and a purified carbon dioxide recycle stream. *See id.* code (57). We reproduce Figure 1 of the ’332 patent, below:

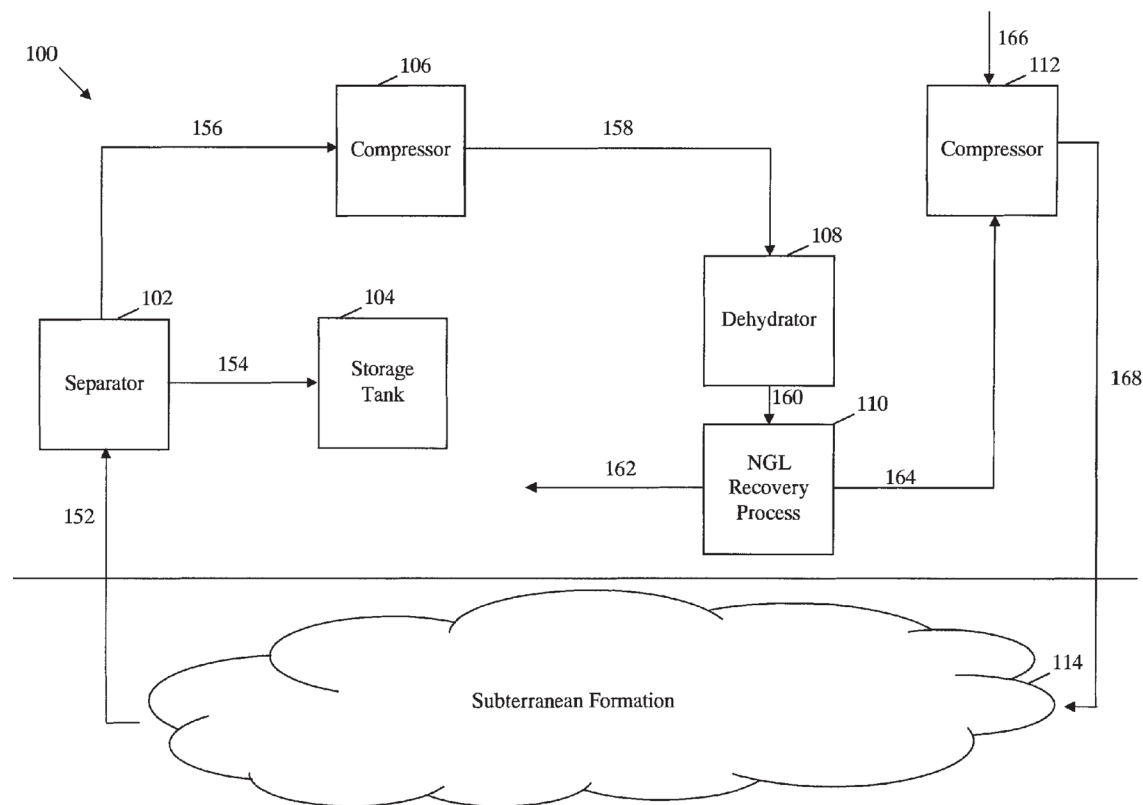


FIG. 1

Figure 1, reproduced above, is a process flow diagram of an embodiment of a carbon dioxide reinjection process. Ex. 1001, 1:66–67. Figure 1 illustrates carbon dioxide reinjection process 100 which receives hydrocarbons and carbon dioxide from subterranean formation 114. *Id.* at 2:36–39. The depicted process receives hydrocarbon field stream 152 from subterranean formation 114. *Id.* at 2:48–50. Field stream 152 may comprise carbon dioxide, methane, ethane, NGLs, heavy hydrocarbons, hydrogen sulfides, helium, nitrogen, water, or combinations thereof. *Id.* at 2:63–65. Stream 152 enters separator 102, which separator 102 may be equipment suitable for separating the inlet stream into a plurality of effluent streams. *Id.* at 3:14–17. For example, separator 102 may produce heavy hydrocarbon stream 154 and carbon dioxide recycle stream 156. *Id.* at 3:41–42. Hydrocarbon stream 154 may be sent to a pipeline for storage in storage tank 104. *Id.* at 3:48–50.

Carbon dioxide recycle stream 156 may enter compressor 106 for increasing its pressure, temperature, and density. *See id.* at 3:64–66. Compressor 106 may produce compressed carbon dioxide recycle stream 158, which may enter dehydrator 108. *See id.* at 4:24–25. Dehydrator 108 may remove water from stream 158 to produce a dehydrated carbon dioxide recycle stream 160. *See id.* at 4:25–27, 4:38–39. Dehydrated carbon dioxide recycle stream 160 may enter NGL recover process 110, which separates dehydrated carbon dioxide stream 160 into an NGL rich stream 162 and purified carbon dioxide recycle stream 164. *See id.* at 4:45–49.

We further reproduce Figure 2 of the '332 patent, below:

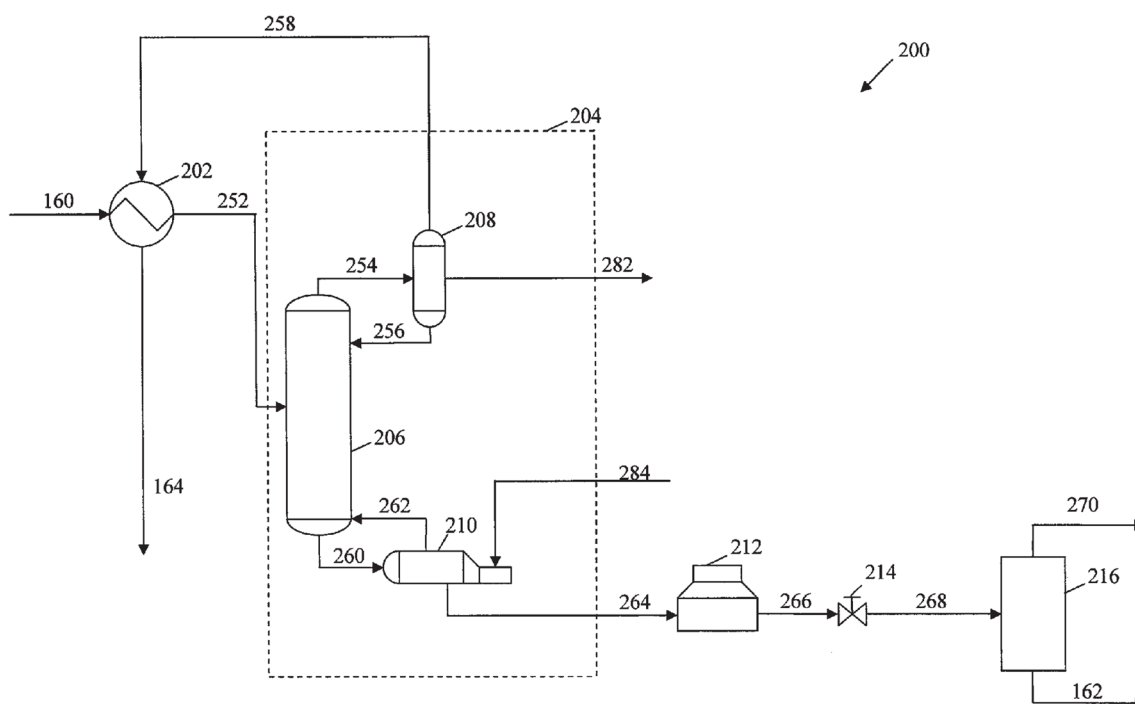


FIG. 2

Figure 2, reproduced above, is a schematic diagram of NGL recovery process 200, which recovers some of the NGLs from the carbon dioxide recycle stream discussed above in connection with Figure 1. Ex. 1001, 2:1–2, 6:27–30. Process 200 may begin by cooling dehydrated carbon dioxide

recycle stream 160 in heat exchanger 202 to produce cooled, purified carbon dioxide recycle stream 252. *Id.* at 6:35–37, 6:50–54. The cooled, purified carbon dioxide recycle stream 252 enters NGL stabilizer 204, which may comprise separator 206, condenser 208, and reboiler 210. *See id.* at 7:1–3. Stabilizer 204 may produce “sour NGL rich stream” 264, which may be like NGL rich stream 162, with the exception that sour NGL rich stream 264 may include some additional acidic gases 270. *See id.* at 7:30–33.

D. Challenged Claims

Petitioner challenges claims 1–4, 6, and 7 of the '332 patent. Pet. 1. Of these claims, claim 1 is independent. *See* Ex. 1001, 17:52–18:58. We reproduce claim 1, below, with Petitioner’s designations of the claim elements:

1. [Limitation 1.P] A method comprising:

[Limitation 1.1] receiving a hydrocarbon feed stream, wherein the hydrocarbon feed stream comprises carbon dioxide, natural gas liquid (NGL), heavy hydrocarbons, and acid gas, wherein the NGL comprises C₃-C₈ hydrocarbons, and wherein the heavy hydrocarbons comprise C₉₊ hydrocarbons;

[Limitation 1.2] separating the hydrocarbon feed stream into a heavy hydrocarbon rich stream and a carbon dioxide recycle stream, wherein the heavy hydrocarbon rich stream comprises the C₉₊ hydrocarbons, and wherein the carbon dioxide recycle stream comprises the carbon dioxide, the C₃-C₈ hydrocarbons, and the acid gas;

[Limitation 1.3] separating the carbon dioxide recycle stream into a sour NGL rich stream and a purified carbon dioxide recycle stream, wherein the sour NGL rich stream comprises the C₃-C₈ hydrocarbons and the acid gas, and wherein the purified carbon dioxide recycle stream comprises the carbon dioxide; and

[Limitation 1.4] separating the sour NGL rich stream into a sweet NGL rich stream and an acid gas stream, wherein the sweet NGL rich stream comprises the C₃-C₈ hydrocarbons, and wherein the acid gas stream comprises the acid gas,

[Limitation 1.5] wherein the carbon dioxide is not removed from the hydrocarbon feed stream and is not removed from the carbon dioxide recycle stream prior to separating the carbon dioxide recycle stream into the sour NGL rich stream and the purified carbon dioxide recycle stream, and

[Limitation 1.6] wherein the hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream are not subjected to cryogenic conditions, membranes, and carbon dioxide recovery solvents between being received and being separated into the heavy hydrocarbon rich stream, the purified carbon dioxide recycle stream, the sweet NGL rich stream, and the acid gas stream.

Id. at 17:52–18:19; *see also* Pet. 18–36 (designating the elements of claim 1 as Limitations 1.P, 1.1, 1.2, 1.3, 1.4, 1.5, and 1.6).

E. Asserted Grounds of Unpatentability

Petitioner asserts that the Challenged Claims are unpatentable based on the following grounds (Pet. 5–6):

Ground	Claim(s) Challenged	35 U.S.C. § ¹	Reference(s)/Basis
1	1	103	Aycaguer ²
2	1	103	Aycaguer, Arand ³
3	1–4, 6, 7	103	Aycaguer, Soldati ⁴
4	2	103	Aycaguer, Soldati, Ryan ⁵
5	1–4, 6, 7	103	Aycaguer, Soldati, Arand
6	2	103	Aycaguer, Soldati, Ryan, Arand

Petitioner also relies on the declaration of David A. Rockstraw, Ph.D., P.E. (Ex. 1002). *See, e.g.*, Pet. 3 (“In support, this petition includes a declaration of Dr. David Rockstraw.”).

In support of its Preliminary Response, Patent Owner relies on the declaration of Trevor Bors (Ex. 2001). *See, e.g.*, Prelim. Resp. 9 (referencing Exhibit 2001).

¹ The ’332 patent was filed on May 16, 2008, and the pre-AIA version of 35 U.S.C. applies to this proceeding. *See* Ex. 1001, code (22).

² Anne-Christine Aycaguer et. al, *Reducing Carbon Dioxide Emissions with Enhanced Oil Recovery Projects: A Life Cycle Assessment Approach*, Energy & Fuels, An American Chemical Society Journal, vol. 15, no. 2 (March/April 2001) (Ex. 1005, “Aycaguer”).

III. DISCRETIONARY DENIAL UNDER 35 U.S.C. § 325(D)

The issue is whether we should exercise our discretion to deny institution based on prior prosecution.

A. Principles of Law

In determining whether to institute an *inter partes* review, “the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office.” 35 U.S.C. § 325(d). The Board evaluates discretionary denial under § 325(d) using a two-part framework: first, the Board considers whether the same or substantially the same art or arguments were previously presented to the Office; and if so, second, the Board considers whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of the challenged claims. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential).

In determining whether the same or substantially the same art or arguments were previously presented to the Office, the Board considers the following nonexclusive factors: (1) the similarities and material differences between the asserted art and the prior art involved during examination; (2) the cumulative nature of the asserted art and the prior art evaluated during examination; and (3) the extent of the overlap between the arguments

³ US 4,474,591, issued Oct. 2, 1984 (Ex. 1004, “Arand”).

⁴ US 4,976,849, issued Dec. 11, 1990 (Ex. 1006, “Soldati”).

⁵ J.M. Ryan et. al, *Treating Acid & Sour Gas: CO₂ Recovery by the Ryan/Holmes Process*, Chemical Engineering Progress (Oct. 1984) (Ex. 1007, “Ryan”).

made during examination and the manner in which the petitioner relies on the prior art. *Advanced Bionics*, Paper 6 at 9–10 & n.10.

B. Prosecution History

During prosecution of the '332 patent, the Examiner rejected claim 1 under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 4,529,411 (“Goddin”) and U.S. Pat. No. 6,128,919 (“Daus”). Ex. 1003, 195. In response to the rejection, the applicant amended claim 1 to recite the negative limitation of Limitation 1.6, namely, “wherein the hydrocarbon feed stream and the carbon dioxide recycle stream are not subjected to cryogenic conditions, membranes, and solvents between being received and being separated into the NGL rich stream and the purified carbon dioxide recycle stream.” *Id.* at 235–236 (emphasis omitted); *see also id.* at 252. Along with the amendment, the applicant argued, *inter alia*, that Goddin and Daus disclosed the use of membranes, cryogenic conditions, and/or carbon dioxide recovery solvents in their separations. *See id.* at 256 (“While Daus may arguably not use carbon dioxide recovery solvents or cryogenic conditions, Daus certainly relies heavily on membranes”); *see also id.* at 257 (“Goddin, clearly uses all three of a membrane, cryogenic conditions, and carbon dioxide recovery solvents.”).

C. Parties’ Arguments

Patent Owner argues that “Aycaguer, Soldati, and Ryan each describe configurations of the Ryan/Holmes process.” Prelim. Resp. 1. Patent Owner further argues that Goddin, which the Examiner applied during prosecution, similarly discloses the Ryan/Holmes process and that “all six of the grounds asserted in the Petition rely upon the basic assertion that the

Ryan/Holmes process renders obvious the challenged claims.” *Id.* at 1, 14; *see also* Ex. 2004 (purporting to demonstrate similarities between Goddin and the “Ryan/Holmes Process”). Patent Owner notes that “amendments were made to the [challenged patent] claims specifically to distinguish the claimed invention from the Ryan/Holmes process, including the negative limitations,” resulting in the claims’ allowance. Prelim. Resp. 14–15; *see also* PO Sur-reply 2 (“The no use of membranes limitation was added to distinguish the ‘332 Patent process from the first stage of the Goddin process”). Based on the purported similarities between Goddin and Aycaguer, Patent Owner contends that “the Examiner meaningfully addressed the Ryan/Holmes prior art.” *Id.*

Petitioner argues that each of its asserted prior art references “materially differs from Goddin because they do not utilize the three forbidden elements of the Challenged Claims that were excluded from the scope of the claims to overcome Goddin.” Pet. Reply 1; *see id.* at 2–10 (detailing how the asserted art does not contain each of the three negative limitations). According to Petitioner, “[t]he Examiner’s rejections focused on specific references—including Goddin—not a broader category of ‘Ryan/Holmes’ processes.” *Id.* at 2. Petitioner also points to differences between Goddin’s use of cryogenic conditions and solvents and the asserted art’s use of distillation to remove CO₂. *See id.*

D. 325(d) Analysis

The Examiner did not consider the art relied on by Petitioner and we do not find Petitioner’s cited art to be similar or cumulative to the art cited during examination. *Compare* Ex. 1001, code (56), *with* Pet. 3; *see also* *Advanced Bionics*, Paper 6 at 9–10 (citation omitted). Aycaguer seems

materially different from Goddin and Daus as Aycaguer appears, based on the current record, to satisfy the negative limitation (i.e., Limitation 1.6) missing from Goddin and Daus. Pet. 34.

During prosecution, the applicant amended the claims to overcome Goddin and Daus by adding Limitation 1.6. Ex. 1003, 235, 256–258. The Examiner allowed the claims as neither Goddin nor Daus satisfied the negative limitation. *See id.* at 270 (“none of the prior art of record[, including Goddin and Daus,] provide for utilizing an overall process for heavy hydrocarbon separation, NGL separation, and CO₂ separation without the utilization of cryogenic conditions, membranes, or solvents and still provide the same method and order of separation as claimed by the applicant”).

As distinguished from prior prosecution, Petitioner relies on Aycaguer for disclosing the negative limitation missing from Goddin and Daus. *See* Pet. 34 (“Aycaguer does not disclose cryogenic conditions, membranes, or carbon dioxide recovery solvents being used at any step.”). As explained below, Petitioner has shown sufficiently, on this record, that Aycaguer’s process does not subject the recited streams to cryogenic conditions, membranes, and carbon dioxide recovery streams, whereas the art applied by the examiner did. *See supra* § IV.D.2.g; *see also* Ex. 1003, 270 (“none of the prior art of record provide for utilizing an overall process for heavy hydrocarbon separation, NGL separation, and CO₂ separation without the utilization of cryogenic conditions, membranes, or solvents and still provide the same method and order of separation as claimed by the applicant.”).

Accordingly, because part 1 of the *Advanced Bionics* framework is not satisfied, we do not exercise our discretion to deny institution under 35 U.S.C. § 325(d).

IV. ANALYSIS

A. Level of Ordinary Skill in the Art

The parties agree that

A person of ordinary skill in the art (POSITA) would have had: (i) a B.S. degree in Chemical Engineering, Petroleum Engineering, or an equivalent field and (ii) two or three years of academic or industry experience in chemical processing systems, oil and gas production and/or refining; or comparable experience. Additional work experience can substitute for educational or research experience, and vice versa.

Pet. 8 (citing Ex. 1002 ¶¶ 26–29); *see also* Prelim. Resp. 16 (agreeing with Petitioner’s proposed definition of a POSITA).

For purposes of this Decision, we adopt the parties’ assessment of the level of ordinary skill in the art.

B. Claim Construction

In this *inter partes* review, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). In applying this standard, we generally give claim terms 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. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (*en banc*).

Petitioner does not explicitly propose construction of any term. *See* Pet. 8.

Patent Owner, on the other hand, proposes constructions of the terms “cryogenic conditions” and “carbon dioxide recovery solvents” recited in Limitation 1.6. *See* Prelim. Resp. 17–21. We address these terms below.

I. “cryogenic conditions”

Limitation 1.6 recites, *inter alia*, that “the hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream are *not subjected to cryogenic conditions* . . . between being received and being separated into the heavy hydrocarbon rich stream, the purified carbon dioxide recycle stream, the sweet NGL rich stream, and the acid gas stream.” Ex. 1001, 18:13–19 (emphasis added).

Patent Owner proposes that the term “cryogenic conditions” “be construed as set forth in the [Gas Processors Suppliers] ‘Engineering Data Book’ definition of ‘*below minus 50°F.*’” Prelim. Resp. 19 (citing Ex. 2001 ¶ 55) (emphasis added). In support of this definition, Patent Owner’s declarant, Mr. Bors, testifies that

In the oil and gas industry, a well-known and most widely used publication is the Gas Processors Association (GPA) and the Gas Processors Suppliers Association (GPSA) “Engineering Data Book.” The Twelfth Edition (2004), Section 1 includes Definitions of Words and Terms Used in the Gas Processing Industry, which includes the following;

cryogenic plant

A gas processing plant which is capable of producing natural gas liquid products, including ethane, at very low operating temperatures, *usually below minus 50°F.*

Ex. 2001 ¶ 55 (emphasis added).

At this stage of the proceeding, we decline to adopt Patent Owner’s interpretation that cryogenic conditions occur only below 50°F. *See* Prelim. Resp. 19 (citing Ex. 2001 ¶ 55). For purposes of this Decision, we need not and do not formally determine the temperature at which cryogenic conditions occur, as our construction would not affect our decision to institute. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those 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)). We agree with Petitioner that “[e]xplicit construction of terms is unnecessary because it is not dispositive—the art teaches the claims under any reasonable construction.” Pet. 8 (citing *Vivid Techs.*, 200 F.3d at 803). As explained below, for purposes of institution, Petitioner has shown a reasonable likelihood that Aycaguer does not disclose subjecting the recited streams to “cryogenic conditions” at any temperature, as recited in Limitation 1.6. *See* Pet. 34–36; *see also infra* § IV.D.2.g.

We further note that Patent Owner’s proposed definition (below minus 50°F) conflicts with its argument in the Related Litigation that “[t]he well-accepted definition for ‘cryogenic conditions’” is when gases are stored at temperatures at or below -130°F. *Compare* Ex. 2001 ¶ 55, *with* Ex. 1011, 8–9 n.2. Patent Owner does not address or otherwise attempt to reconcile the inconsistencies. *See* Prelim. Resp. 17–19. Although we are not aware of a final claim construction from the Related Litigation, adopting Patent Owner’s proposed construction may result in an inconsistency between the Board and the district court.

The Board’s Trial Practice Guide provides that “in an AIA proceeding, the Board will apply the same standard used in federal courts to construe patent claims.” Patent Trial and Appeal Board Consolidated Trial Practice Guide, 46 (Nov. 2019) (“Trial Practice Guide,” “Guide,” or “CTPG”), available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>, (citing 37 C.F.R. §§ 42.100(b), 42.200(b), 42.300(b)). Our Guide further provides that “[s]ubmission of a prior claim construction determination [by a federal court or the ITC] is mandatory under 37 C.F.R. § 42.51(b), if it is ‘relevant information that is inconsistent with a position advanced by the party during the proceeding.’” CTPG 47. Our Guide further provides that “[i]n such cases, the determination should be submitted ‘concurrent with the filing of the documents or things that contains the inconsistency.’” *Id.* (citing 37 C.F.R. § 42.51(b)).

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown a reasonable likelihood that Aycaguer does not disclose subjecting the recited streams to “cryogenic conditions” at any temperature, as recited in Limitation 1.6. *See* Pet. 34–36; *see also infra* § IV.D.2.g.

2. “carbon dioxide recovery solvents”

Limitation 1.6 further recites, *inter alia*, that “the hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream are *not subjected to . . . carbon dioxide recovery solvents* between being received and being separated into the heavy hydrocarbon rich stream, the purified carbon dioxide recycle stream, the sweet NGL rich stream, and the acid gas stream.” Ex. 1001, 18:13–19 (emphasis added).

Patent Owner proposes that the term “carbon dioxide recovery solvents” should be construed according to its plain and ordinary meaning, that is, “solvents used for recovery of carbon dioxide.” Prelim. Resp. 20.

Petitioner does not expressly provide a definition of this term (*see* Pet. 8), but suggests that such a solvent would have an “affinity” for CO₂ (*see id.* at 35 (citing Ex. 1007, 55)). Specifically, Petitioner argues that Aycaguer distinguishes its process from those that use solvents “having CO₂ affinity.” *See* Pet. 35 (quoting Ex. 1007, 55).

For purposes of this Decision, we need not and do not formally construe the term “carbon dioxide recovery solvents,” including whether such a solvent must have an affinity for CO₂, as our construction would not affect our decision to institute. *See Realtime Data*, 912 F.3d at 1375. We agree with Petitioner that, based on the current record, “[e]xplicit construction of terms is unnecessary because it is not dispositive—the art teaches the claims under any reasonable construction.” Pet. 8 (citation omitted).

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown a reasonable likelihood that Aycaguer does not disclose subjecting the recited streams to “carbon dioxide recovery solvents,” as recited in Limitation 1.6, under Petitioner’s or Patent Owner’s applied construction. *See* Pet. 34–36; *see also infra* § IV.D.2.g.

3. Other Claim Terms

For purposes of this Decision, we need not and do not formally address any other claim term. *See Realtime Data*, 912 F.3d at 1375.

C. Principles of Law

Petitioner's challenges are based on obviousness. *See* Pet. 3.

A patent claim is unpatentable as obvious if the differences between the claimed invention and the prior art are such that the claimed invention would have been obvious at the time of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of 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, when presented, (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We analyze the asserted grounds of unpatentability in accordance with these principles.

D. Ground 1: Alleged Obviousness over Aycaguer

Petitioner submits that claim 1 is unpatentable over Aycaguer under 35 U.S.C. § 103. Pet. 3, 18.

1. Aycaguer (Ex. 1005)

Aycaguer is an article published in *Energy & Fuels*, an American Chemical Society Journal. Ex. 1005, 1.⁶ Aycaguer is titled “Reducing Carbon Dioxide Emissions with Enhanced Oil Recovery Projects: A Life

⁶ Our citations to the exhibits, including Aycaguer, are to the exhibit page numbers, rather than the native page numbers.

Cycle Assessment Approach” (*id.* at 4) and indicates a publication date of March/April 2001 (*see id.* at 1).

Aycaguer discloses,

Reducing greenhouse gas emissions to the atmosphere can be accomplished by improving the efficiency of equipment and processes to reduce energy consumption, by developing renewable energy sources, by shifting to lower carbon content fuels, or by implementing storage projects in geologic formations where CO₂ may potentially remain for many decades.

Ex. 1005, 4.

Aycaguer further discloses,

The production of oil is driven by extraction wells positioned throughout the surface of the field. Water is injected alternately with CO₂ in a process called water-alternating-gas (WAG) to divert the CO₂ to different areas, sweep additional oil, and help maintain reservoir pressure. Some of the CO₂ and water injected travel from the injection point to the producing wells and are produced along with the oil. Each production well is controlled by a power source for pumping and compressing the extraction-produced fluids (oil, water, and a mix of compounds in the gas phase). The pressure differential allows the liquid and gas phases to move from one point to the next in decreasing pressure.

Ex. 1005, 6.

Aycaguer also discloses,

The analysis was limited to the boundary of the facility and included the extraction of the oil and associated gas from the oil reservoir, the processing of the associated gas for separation of the different components (water, hydrogen sulfide -H₂S, CO₂, CH₄, natural gas liquids), the compression of the separated CO₂ stream destined for injection, and the transport and injection of the CO₂ in the oil reservoir for extraction of additional oil and for long-term storage.

Id. Aycaguer further discloses,

The separation of gas and oil/water is a simple process assisted by heat, chemicals, and retention time in the vessels and relies on phase separation. The liquid phase undergoes further separation to recover the crude oil for sale, while the gas phase is directed to the gas processing plant. The water is recycled for injection in the WAG process. The gas processing stage is the most complex stage of the system. The gas is dried to avoid pipeline corrosion arising from the association of CO₂ and water. In addition, because typical sales gas specifications require low acidic concentration, the H₂S and CO₂ have to be removed before the sale of the gas.

Id.

The removal of CO₂ from the produced gas stream is referred to as the “Ryan/Holmes” process. *See* Ex. 1005, 6. As explained in Aycaguer,

The separation of CO₂ from hydrocarbons and H₂S can be achieved by using the Ryan/Holmes process. This technology is a distillation separation relying on the relative volatility of the gas components and using an additive introduced at the top of the distillation tower. The additive is then regenerated and reused in the same process. The Ryan/Holmes process is highly compound-specific and will only separate CO₂ from the remaining gas stream. To separate H₂S from the natural gas liquids, we used a nonselective chemical absorption amine process, in which acidic elements are removed by countercurrent contact with an amine solution. The separated H₂S is then either transformed to elemental sulfur or incinerated.

Id.

We further reproduce Figure 2 of Aycaguer, below:

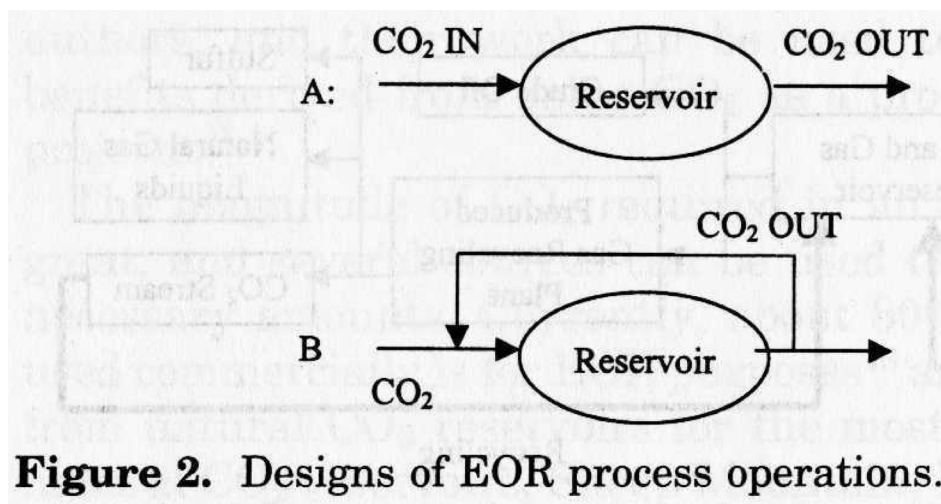


Figure 2, reproduced above, is described as “Designs of [Enhanced Oil Recovery, or ‘EOR’] process operations.” Ex. 1005, 7. Figure 2 depicts two sub-figures, Figure 2A and Figure 2B. Figure 2A depicts a linear process in which CO₂ produced with the oil is vented to atmosphere. *See id.* Figure 2B depicts a cyclic process, in which “all [of] the produced CO₂ [is] reinjected in the reservoir as a solvent.” *Id.*

2. Analysis

We address each of the limitations of claim 1 as partitioned by Petitioner. *See* Pet. 21–34.

a. Limitation 1(Preamble) “A method comprising”

Petitioner submits that Aycaguer teaches the preamble to the extent it is limiting. Pet. 18 (citing Ex. 1003 ¶ 68). In support of this position, Petitioner quotes Aycaguer’s disclosure that

the extraction of the oil and associated gas from the oil reservoir, the processing of the associated gas for separation of the individual components (water, hydrogen sulfide–H₂S, CO₂, CH₄, natural gas liquids), the compression of the separated CO₂ stream destined for injection, and the transport and injection of

the CO₂ in the oil reservoir for the extraction of additional oil and for long-term storage.

Id. at 18–19 (quoting Ex. 1005, 6; citing Ex. 1002 ¶ 79).

Patent Owner does not dispute Petitioner’s position. *See generally* Prelim. Resp.

Without determining whether the preamble is limiting, Petitioner has shown sufficiently for purposes of institution that Aycaguer discloses a method.

b. Limitation 1.1 “receiving a hydrocarbon feed stream, wherein the hydrocarbon feed stream comprises carbon dioxide, natural gas liquid (NGL), heavy hydrocarbons, and acid gas, wherein the NGL comprises C₃-C₈ hydrocarbons, and wherein the heavy hydrocarbons comprise C₉₊ hydrocarbons”

Petitioner submits that Aycaguer satisfies limitation 1.1. *See* Pet. 19–24 (citing in part Ex. 1005, Fig. 1). In referencing Figure 1 of Aycaguer, Petitioner submits that Aycaguer’s process includes “receiving, from an ‘Oil and Gas Reservoir,’ an oil and associated gas stream (i.e., ‘a hydrocarbon feed stream’) that has as its components separated into different outputs, ‘Crude Oil’ (i.e., heavy hydrocarbons), ‘Natural Gas Liquids’ (i.e., C₃-C₈), and ‘CO₂ Stream’ (i.e., carbon dioxide).” *Id.* at 19.

Petitioner’s declarant, Dr. Rockstraw, testifies that the stream from the oil and gas reservoir disclosed in Aycaguer is generated from a CO₂ injection process. Ex. 1002 ¶ 81 (citing Ex. 1005, 6). Aycaguer discloses that “[w]ater is injected alternately with CO₂ in a process called water-alternating gas.” Ex. 1005, 6.

Dr. Rockstraw further testifies that a “POSITA, relying on their background knowledge in the art, would have understood that [Aycaguer’s] hydrocarbon feed stream derived from an oil and gas reservoir undergoing enhanced oil recovery with CO₂ injection would include at least C₃-C₉₊ hydrocarbons, carbon dioxide, and hydrogen sulfide.” *See* Ex. 1002 ¶ 82; *see also id.* ¶ 81 (citing Ex. 1005, 6).

Petitioner further submits that Aycaguer teaches removal of H₂S, an acidic gas, from NGLs. *See* Pet. 23–24 (citing Ex. 1005, 6; Ex. 1001, 5:18–19; Ex. 1002 ¶ 88).

Patent Owner argues that the “Ryan/Homes” process disclosed in Aycaguer *teaches away* from the patent process of the ’332 patent, the “Prim” invention. *See* Prelim. Resp. 1–3, 45–48; *see also* PO Sur-reply 8 (“Patent Owner asserts that the Petitioners’ Ryan/Holmes Asserted Art ‘teaches away’ from the Prim ‘332 Patent process.”). In support of this argument, Patent Owner submits that

The Ryan/Holmes process uses hydrocarbon solvents (“additives”), and an extensive amount of process equipment (up to four distillation columns), to solve two particular problems in the separation of methane and ethane from carbon dioxide recycle streams. The Ryan/Holmes additives avoid carbon dioxide freezing (solidification) in the separation of methane from carbon dioxide, and allows for the separation of ethane from carbon dioxide, by eliminating the formation of what is known as the ethane-carbon dioxide “azeotrope” which otherwise would preclude a separation of ethane from carbon dioxide.

Prelim. Resp. 45–46 (citing Ex. 2001 ¶ 111). Patent Owner argues,

While the Ryan/Holmes process uses additives and extensive process equipment to improve the process of separating methane and ethane from carbon dioxide recycle streams, the innovative process described and claimed in the

‘332 Patent improves the process of recovering NGLs from carbon dioxide recycle streams by “disregarding the recovery” of methane and ethane from the carbon dioxide recycle stream, to recover NGLs “with relatively little process equipment or energy.”

Prelim. Resp. 2 (quoting Ex. 1001, 4:55–60). Patent Owner submits that, when compared to the process taught in Aycaguer, the “Prim ‘332 invention goes in the opposite direction by NOT using additives or extensive processing equipment to separate methane and ethane from carbon dioxide recycle streams.” *Id.* at 2.

At this stage of the proceeding, we do not find that the process disclosed in Aycaguer *teaches away* from the process recited in claim 1, as Patent Owner argues. *See* Prelim. Resp. 1–3, 45–48, 53–55. Patent Owner’s argument is premised on a position that Aycaguer’s process, including the “Ryan/Holmes process,” is “opposite” of the process recited in the challenged claims. *See id.* at 54 (“The Ryan/Holmes process and the Prim ‘332 Patent process go in opposite directions for recovering salable components of carbon dioxide recycle streams”). It is not clear to us what, precisely, Patent Owner contends that Aycaguer teaches away from. Petitioner addresses Limitation 1.1 with extensive citations to the record and the testimony of Dr. Rockstraw (Ex. 1002). *See* Pet. 19–24. To the extent Patent Owner’s argument is directed to Limitation 1.6, we address that argument below. *See infra* § IV.D.2.g.

Figure 1 of Aycaguer, reproduced below, depicts the process that Petitioner relies on. *See* Pet. 19.

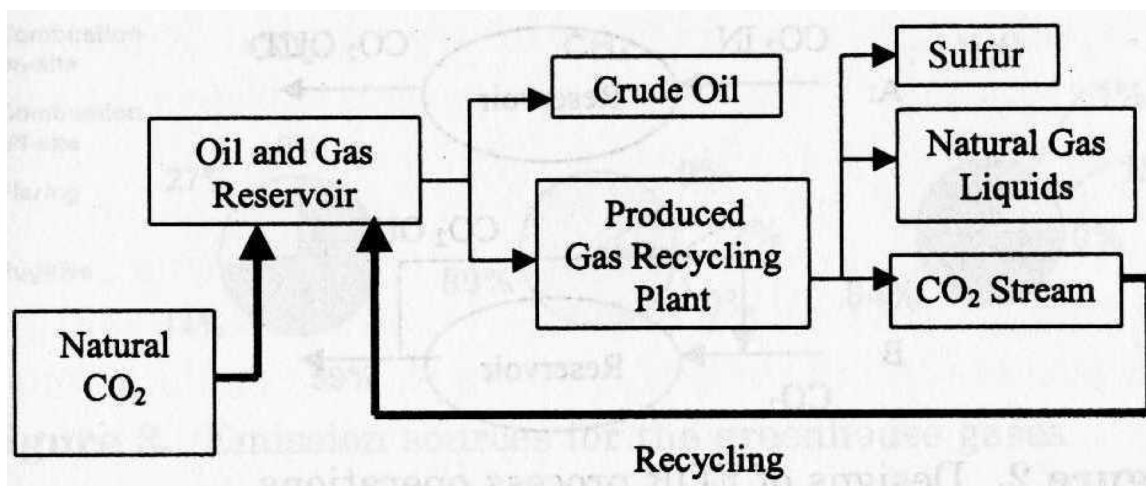


Figure 1, reproduced above, depicts a process for separating gas from an oil reservoir. *See* Ex. 1005, 6. The depicted process, when read in view of Aycaguer, discloses:

- (a) providing a stream from an “Oil and Gas Reservoir,” which receives “Natural CO₂” and recycled CO₂ (discussed later);
- (b) separating crude oil from the stream to create a gas stream that is sent to a “Produced Gas Recycling Plant”;
- (c) separating the gas stream into CO₂, Sulfur, and Natural Gas Liquids (“NGL”); and
- (d) recycling the CO₂ stream back to the Oil and Gas Reservoir.

See id. For the purposes of institution, this figure sufficiently supports Petitioner’s position.

Patent Owner further argues that there is no motivation to modify or combine Aycaguer with other teachings. *See* Prelim. Resp. 53 (“Ground 1: Claim 1 is Not Obvious Over Aycaguer [as there is] No Motivation to Modify or Combine Aycaguer with Other Teachings”) (emphasis omitted). In support of this argument, Patent Owner submits that “Petitioners fail to attempt, let alone make,” a “showing of a suggestion or motivation to

modify the teachings of” Aycaguer in support of its obviousness position. *See id.* at 55 (citing *SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.*, 225 F.3d 1349, 1356 (Fed. Cir. 2000)).

We disagree with Patent Owner that Petitioner fails to make a showing of obviousness. *See* Prelim. Resp. 53.

Dr. Rockstraw testifies that a “POSITA would have understood, and at the very least found it obvious, that crude oil contains C₉₊ (as well as some residual lighter hydrocarbons), and thus the hydrocarbon feed stream described in Aycaguer would have contained at least C₉₊ (which are heavy hydrocarbons) [in order] for crude oil to be separated from it.” Ex. 1002 ¶ 83; *see also* Pet. 20–21 (quoting the same). The ’332 patent refers to “heavy hydrocarbons” as generally including “liquid crude oil, which may comprise C₉₊ hydrocarbons, branched hydrocarbons, aromatic hydrocarbons, and combinations thereof.” Ex. 1001, 3:9–13; *see also* Pet. 20–21 (citing the same).

Dr. Rockstraw further testifies that there are three categories of hydrocarbons. *See* Ex. 1002 ¶¶ 34–36.

Dr. Rockstraw explains that the “first category of hydrocarbons a person of skill in the art would recognize is natural gas.” Ex. 1002 ¶ 34. Dr. Rockstraw further explains that “[n]atural gas typically refers to methane (C₁) and ethane (C₂), as those two compounds exist as a gas at atmospheric conditions.” *Id.*

As to the second category of hydrocarbons, Dr. Rockstraw testifies that the “second category [is] the natural gas liquids, or NGLs.” Ex. 1002 ¶ 35. Dr. Rockstraw explains that these “compounds are called NGLs because they can be found as a vapor with natural gas at standard

temperature and pressure, but (unlike methane and ethane) can be liquified at room temperature when placed under pressure.” *Id.* Dr. Rockstraw further explains that “NGLs range from C₃-C₈.” *Id.* (citing Ex. 1004, 5:41–46).

As to the third category, Dr. Rockstraw testifies that the third category is crude oils and that these “are heavy hydrocarbons that can only exist in very small quantities in the vapor phase at standard temperature and pressure [and that these] compounds range from C₉ and higher.” Ex. 1002 ¶ 36 (citing Ex. 1004, 5:41–46).

In referencing Aycaguer, Dr. Rockstraw testifies that a POSITA would understand that “natural gas liquids” is a term that includes C₃–C₈ hydrocarbons. *See, e.g., supra* at ¶¶ 34–36; EX1004 at 5:44-45. A POSITA reading Aycaguer would have thus understood, and at the very least found it obvious, that the “natural gas liquids” disclosed by Aycaguer include the entire range of C₃-C₈—and not just a subset of C₃-C₈—because Aycaguer discloses a hydrocarbon feed stream from an oil and natural gas reservoir that contains methane (C₁), natural gas liquids, and crude oil (C₉₊). Hydrocarbon feed streams from oil and natural gas reservoirs naturally contain all the hydrocarbons within the full range between the lightest produced hydrocarbon and the heaviest produced hydrocarbon; underground oil reservoirs do not “skip” members of the homologous series of alkane hydrocarbons.

Ex. 1002 ¶ 85 (citing Ex. 1005, 6). Aycaguer discloses that hydrocarbons derived from the reservoir include methane, natural gas liquids, and crude oil. *See* Ex. 1005, 6.

Petitioner further submits that the ’332 patent includes admitted prior art, that the ’332 patent’s description of NGLs includes C₃-C₈ hydrocarbons, and that “liquid crude oil” comprises C₉₊ hydrocarbons. *See* Pet. 22–23 (citing Ex. 1001, 3:4–8, 11–13).

Petitioner reasons that

At the very least, a POSITA would have found it obvious to apply the oil and gas processing methods taught in Aycaguer on a feed stream from a reservoir containing each of C₃-C₈. A POSITA would have been motivated to apply the Aycaguer method to a stream containing all components C₃-C₈ because that would allow the system to work as intended to remove the crude oil (C₉₊), and maximize NGLs (C₃-C₈) for recovery.

Pet. 23 (citing Ex. 1002 ¶ 87). Dr. Rockstraw testifies that such a “POSITA would have expected the separation steps taught in Aycaguer to successfully result in a separation of such a feed stream due to the well-known and predictable nature of the distillation and processing steps employed.” Ex. 1002 ¶ 87; *see also* Pet. 23 (citing the same).

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that Aycaguer satisfies Limitation 1.1.

c. Limitation 1.2 “separating the hydrocarbon feed stream into a heavy hydrocarbon rich stream and a carbon dioxide recycle stream, wherein the heavy hydrocarbon rich stream comprises the C₉₊ hydrocarbons, and wherein the carbon dioxide recycle stream comprises the carbon dioxide, the C₃-C₈ hydrocarbons, and the acid gas”

Petitioner submits that Aycaguer teaches separating the hydrocarbon feed stream, as recited in Limitation 1.2, while submitting an annotated version of Aycaguer’s Figure 1. *See* Pet. 24–25. We reproduce Petitioner’s annotations to Aycaguer’s Figure 1, below:

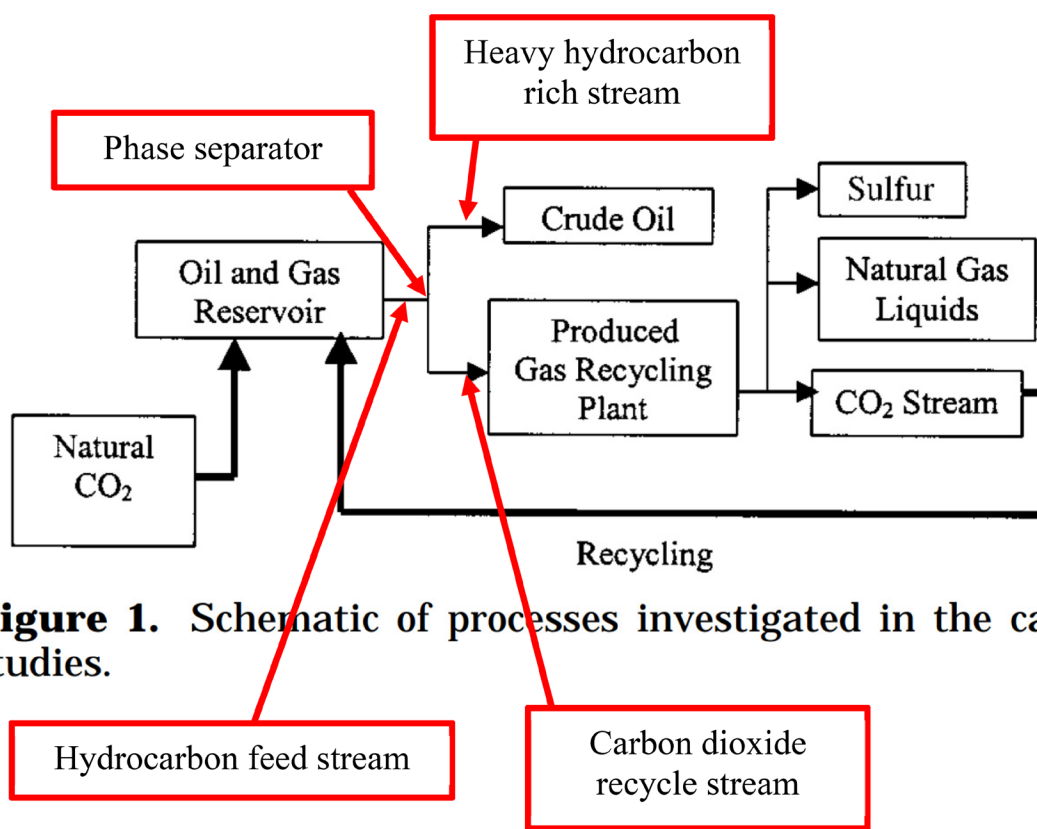


Figure 1. Schematic of processes investigated in the case studies.

Aycaguer’s Figure 1, reproduced above and as annotated by Petitioner, includes red annotations with arrows pointing to Aycaguer’s Figure 1 process. *See* Pet. 25. Petitioner annotates Figure 1 to include red boxes with arrows indicating a “Phase separator,” a “Heavy hydrocarbon rich stream,” a “Hydrocarbon feed stream,” and a “Carbon dioxide recycle stream.” *See id.* Petitioner submits that the “process described by Aycaguer discloses separating the hydrocarbon stream released by the oil and gas reservoir (‘hydrocarbon feed stream’) into a ‘Crude Oil’ stream (‘heavy hydrocarbon rich stream’) and a stream sent to a Produced Gas Recycling Plant (‘carbon dioxide recycle stream’).” *Id.* at 24–25.

Patent Owner does not present separate arguments addressing Limitation 1.2. *See generally* Prelim. Resp.

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that the hydrocarbon stream released by the oil and gas reservoir described in Aycaguer satisfies Limitation 1.2.

d. Limitation 1.3 “separating the carbon dioxide recycle stream into a sour NGL rich stream and a purified carbon dioxide recycle stream, wherein the sour NGL rich stream comprises the C₃-C₈ hydrocarbons and the acid gas, and wherein the purified carbon dioxide recycle stream comprises the carbon dioxide”

Petitioner submits that Aycaguer’s phase separation teaches the recited “carbon dioxide recycle stream.” *See* Pet. 29. Dr. Rockstraw testifies that because Aycaguer’s “carbon dioxide recycling stream with C₃–C₈ hydrocarbons, CO₂, and H₂S, is directed into the gas processing plant, Aycaguer thus teaches separating the CO₂ from a carbon dioxide recycle stream, resulting in one stream containing CO₂ and a second stream containing C₃–C₈ hydrocarbons and H₂S.” Ex. 1002 ¶ 100 (citing Ex. 1005, Fig. 1, 5). Dr. Rockstraw further testifies that Aycaguer’s H₂S must be removed from the natural gas liquids after the CO₂ is removed, confirming that the second stream contains both the C₃–C₈ hydrocarbons and H₂S. *Id.* (citing Ex. 1005, 5).

Petitioner submits an annotated version of Aycaguer’s Figure 1 (Pet. 31), a copy of which we reproduce, below:

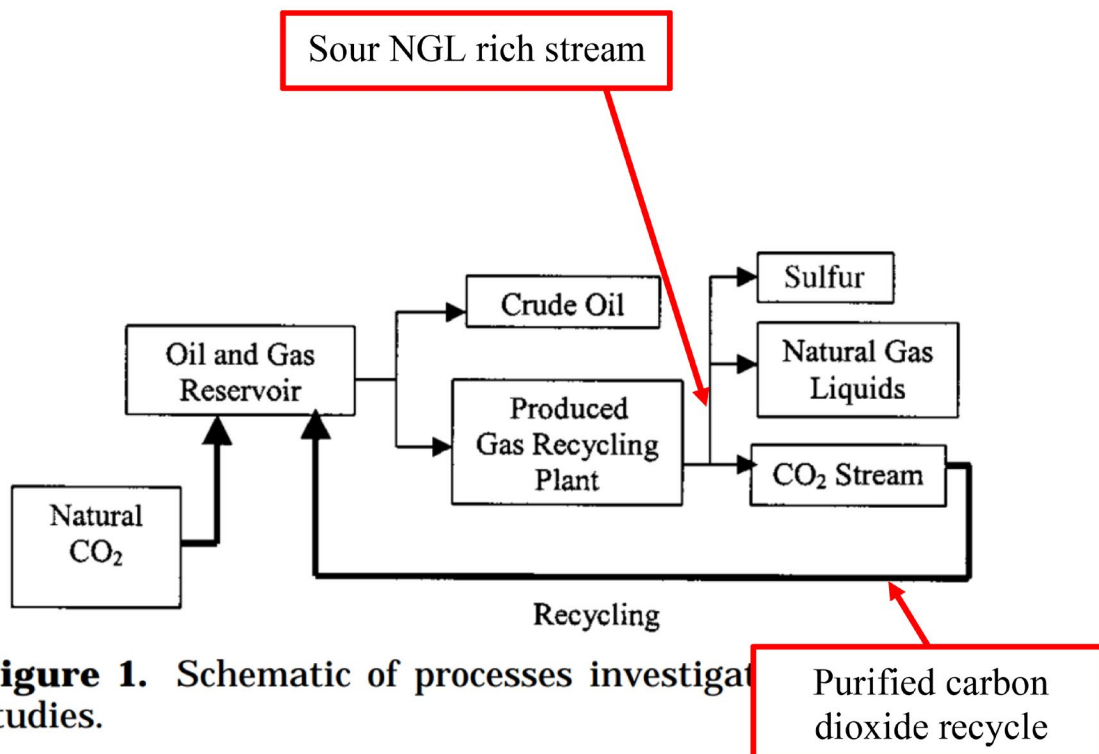


Figure 1. Schematic of processes investigated in the studies.

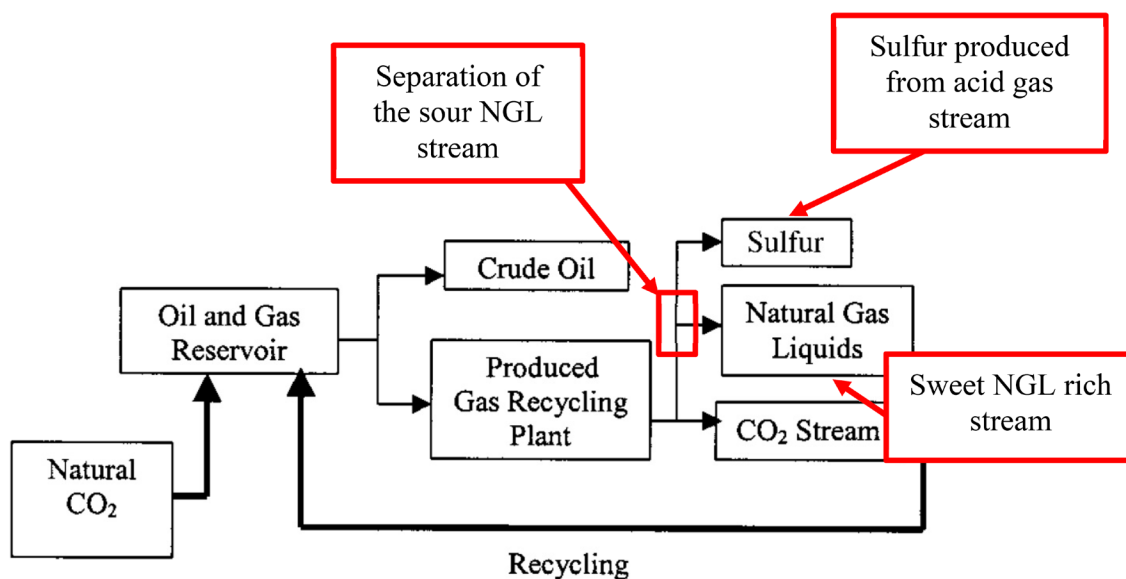
Annotated Figure 1, reproduced above, depicts two red boxes with arrows pointing to the “Sour NGL rich stream” and the “Purified carbon dioxide recycle.” Pet. 31; *see also* Ex. 1002 ¶ 101. Referring to this annotated figure, Dr. Rockstraw testifies that the first stream with CO₂ teaches the claimed “purified carbon dioxide recycle stream” comprising the carbon dioxide and the second stream with C₃–C₈ hydrocarbons and H₂S thus teaches the claimed “sour NGL rich stream” comprising the C₃–C₈ hydrocarbons and the acid gas. Ex. 1001 ¶ 101.

Patent Owner does not present separate arguments addressing Limitation 1.3. *See generally* Prelim. Resp.

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that Aycaguer’s phase separation teaches a “carbon dioxide recycle stream” as recited in Limitation 1.3.

e. Limitation 1.4 “separating the sour NGL rich stream into a sweet NGL rich stream and an acid gas stream, wherein the sweet NGL rich stream comprises the C₃-C₈ hydrocarbons, and wherein the acid gas stream comprises the acid gas”

Petitioner submits, “Aycaguer teaches that applying the Ryan/Holmes process to a carbon dioxide recycle stream results in a sour NGL rich stream that includes C₃-C₈ hydrocarbons and H₂S.” Pet. 32 (referencing the analysis from Limitation 1.3). In support of this position, Petitioner provides another annotated version of Aycaguer’s Figure 1 (Pet. 32), a copy of which we reproduce, below:



Annotated Figure 1, reproduced above, includes Petitioner’s annotations with three red boxes having arrows pointed to the “Separation of the sour NGL stream,” “Sulfur produced from acid gas stream,” and “Sweet NGL rich stream.” See Pet. 32. Referencing this annotated figure, Dr. Rockstraw testifies that “[t]he natural gas liquids stream includes the C₃–C₈ originally found in the sour NGL stream” and that the “H₂S is removed to ‘pass safety requirements.’” Ex. 1002 ¶ 105 (citing Ex. 1005, 6). Dr. Rockstraw

explains, “[a]n NGL stream with H₂S removed from it was known in the art as a sweet NGL stream.” *Id.* (citing Ex. 1002 ¶ 42). Dr. Rockstraw further testifies that the “sweet NGL stream produced after the H₂S is removed thus teaches the claimed ‘sweet NGL rich stream.’” *Id.*

Dr. Rockstraw further testifies, “According to Aycaguer, the H₂S is absorbed into an amine solution before being ‘transformed into elemental sulfur or incinerated.’” *Id.* ¶ 106 (citing Ex. 1005, 6). Dr. Rockstraw also testifies that “[t]his stream of amine/H₂S solution thus teaches the claimed ‘acid gas stream.’” *Id.* ¶ 106 (citing Ex. 1005, 6).

Patent Owner does not present separate arguments addressing Limitation 1.4. *See generally* Prelim. Resp.

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that Aycaguer’s phase separation teaches “separating the sour NGL rich stream” as recited in Limitation 1.4.

f. Limitation 1.5 “wherein the carbon dioxide is not removed from the hydrocarbon feed stream and is not removed from the carbon dioxide recycle stream prior to separating the carbon dioxide recycle stream into the sour NGL rich stream and the purified carbon dioxide recycle stream”

Petitioner submits that the method disclosed in Aycaguer does not “remove CO₂ before the carbon dioxide recycle stream is processed using the Ryan/Holmes process,” referencing Figure 1 of Aycaguer. Pet. 33–34 (citing Ex. 1005, 6; Ex. 1002 ¶ 108).

Dr. Rockstraw testifies in support of the same. Ex. 1002 ¶ 109.

Aycaguer depicts a process in which there are no steps that remove CO₂ before the CO₂ stream is separated from the sulfur and NGL. Ex. 1005, 6 (Fig. 1).

Patent Owner does not present separate arguments addressing Limitation 1.5. *See generally* Prelim. Resp.

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that Aycaguer's method does not remove carbon dioxide "prior to separating the carbon dioxide recycle stream into the sour NGL rich stream and the purified carbon dioxide recycle stream" as recited in Limitation 1.5.

g. Limitation 1.6 "wherein the hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream are not subjected to cryogenic conditions, membranes, and carbon dioxide recovery solvents between being received and being separated into the heavy hydrocarbon rich stream, the purified carbon dioxide recycle stream, the sweet NGL rich stream, and the acid gas stream."

Petitioner submits that Aycaguer's method does not use cryogenic conditions, membranes, or carbon dioxide recovery solvents at any step. *See* Pet. 34.

Patent Owner argues that the Ryan/Holmes process disclosed in Aycaguer "subjects the carbon dioxide recycle stream to cryogenic conditions and carbon dioxide recovery solvents in the process steps in which [Limitation 1.6] specifically excludes cryogenic conditions and carbon dioxide recovery solvents." Prelim. Resp. 55–56. In support of this argument, Patent Owner references its claim construction of "Cryogenic Conditions" (Prelim. Resp. § V.A), claim construction of "Carbon Dioxide

Recovery Solvents” (Prelim. Resp. § V.B), and summary of Aycaguer (Prelim. Resp. § VI.C). *See* Prelim. Resp. 55–56.

At this stage of the proceeding, we do not find disclosure within Aycaguer to support Patent Owner’s position that Aycaguer’s process “subjects the carbon dioxide recycle stream to cryogenic conditions and carbon dioxide recovery solvents.” Prelim. Resp. 55–56. Patent Owner’s argument is premised on an assumption that Aycaguer’s process includes steps not expressly taught or disclosed in Aycaguer. *See id.* Yet, Aycaguer’s Figure 1 omits the presence of these steps. For example, Patent Owner argues that Aycaguer’s Figure 1 process “leaves off the methane stream.” *See* Prelim. Resp. 32 (“Figure 1, relied upon by Rockstraw as proof of obviousness does not even do the Ryan/Holmes process justice as it leaves off the methane stream.”). For purposes of institution, Dr. Rockstraw’s testimony that “Aycaguer does not disclose the use of cryogenic conditions, membranes, or carbon dioxide recovery solvents” (Ex. 1002 ¶ 110) along with Aycaguer’s Figure 1, which supports Dr. Rockstraw’s testimony, establishes a reasonable likelihood that Aycaguer satisfies Limitation 1.6.

At this preliminary stage of the proceeding, based on the current briefing and evidence, Petitioner has shown sufficiently that Aycaguer’s “hydrocarbon feed stream, [] carbon dioxide recycle stream, and [] sour NGL rich stream are not subjected to cryogenic conditions, membranes, and carbon dioxide recovery solvents between being received and being separated into the heavy hydrocarbon rich stream, the purified carbon dioxide recycle stream, the sweet NGL rich stream, and the acid gas stream,” as recited in Limitation 1.6.

h. Summary of Independent Claim 1

At this preliminary stage, Petitioner has shown sufficiently that claim 1 would have been obvious based on Aycaguer.

E. Ground 2: Alleged Obviousness over Aycaguer and Arand

Petitioner submits that claim 1 would have been obvious over Aycaguer and Arand. *See* Pet. 3, 36–37.

1. Arand (Ex. 1004)

Arand is a U.S. Patent titled “Processing Produced Fluids of High Pressure Gas Condensate Reservoirs.” Ex. 1004, code (54). Arand discloses a method of processing and producing: (1) a residue gas stream comprising predominantly methane; (2) a natural gas liquids stream; and (3) a stabilized condensate stream. *See id.* at 4:1–7. Arand further discloses that

it is expected that the benefits of the invention will be best realized if the produced fluid stream contains in addition to sales quantities of natural gas, a ratio of natural gas liquids (C₃-C₈) to heavy condensate (C₉ and higher) of 0.5 or higher and preferably about 1 or higher.

Id. at 5:41–46.

2. Analysis

Ground 2 is like Ground 1, with the exception being that Petitioner relies on Arand for teaching “that natural gas liquids are hydrocarbons that have between three and eight carbon atoms (C₃-C₈)” and “that heavy

hydrocarbons contain nine or more carbon atoms (C₉₊).” Pet. 37 (citing Ex. 1004, 5:44–45).

Based on this additional teaching, Petitioner reasons that “a POSITA would have been motivated to implement Aycaguer’s Produced Gas Recycling Plant using the understanding of natural gas liquids and heavy hydrocarbons found in Arand to identify the constituent hydrocarbons in the mixtures that would result from the separations performed by Aycaguer.” Pet. 37 (citing Ex. 1002 ¶¶ 114–117). Specifically, Petitioner relies on Arand to address Limitations 1.1 and 1.2. *See id.* at 38–41.

Patent Owner argues that “Ground 2 suffers from the same defects as Ground 1, including no motivation to combine.” Prelim. Resp. 56. Patent Owner argues that Petitioner fails to show a motivation to combine Aycaguer and Arand (*see id.* (citations omitted)) and that “Arand’s focus of recovery of methane and ethane teaches away from” claim 1 (*see id.* at 57).

At this stage of the proceeding, we disagree with Patent Owner.

Even if Arand teaches recovery of methane and ethane, as Patent Owner argues (*see* Prelim. Resp. 57), this is not relevant to Ground 2, as Petitioner simply relies on Arand for expressly teaching the basic components of hydrocarbons (i.e., C₃–C₉₊). *See* Pet. 37 (citing Ex. 1004, 5:44–45). Indeed, Patent Owner acknowledges as much. *See* Prelim. Resp. 45 (“Petitioners appear to rely upon Arand only to propose definitions for the claim terms Natural Gas Liquids (‘NGL’) and heavy hydrocarbons.”).

Further, we disagree that Petitioner has failed to provide a motivation to combine Aycaguer and Arand.

To address Limitation 1.1, Petitioner reasons that

a POSITA would have found it obvious to apply the oil and gas processing methods taught in Aycaguer on a feed stream from a

reservoir containing C₃-C₈ as expressly taught in Arand. A POSITA would have been motivated to apply the Aycaguer method to a feed stream containing each of C₃-C₈, as taught in Arand, because that would allow the Aycaguer system to work as intended to remove the crude oil (C₉₊), and maximize NGLs (C₃-C₈) for recovery. Such a POSITA would have expected the separation steps taught in Aycaguer to successfully result in a separation of such a feed stream due to the well-known and predictable nature of the distillation and processing steps employed, and thus the combination of Aycaguer and Arand renders obvious receiving such a stream.

Pet. 39 (citing Ex. 1002 ¶ 121).

To address Limitation 1.2, Petitioner further reasons that a POSITA as of the Priority Date would have understood that Aycaguer discloses a carbon dioxide recycle stream that includes C₃-C₈, or (iii) a POSITA as of the Priority Date would have understood that Aycaguer discloses a heavy hydrocarbon rich stream that includes C₉₊, Arand provides such understanding.

Id. at 40.

Upon review of the parties' arguments and supporting evidence, and based on the current state of briefing, Petitioner shows a reasonable likelihood that the subject matter of claim 1 would have been obvious over Aycaguer and Arand.

F. Ground 3: Alleged Obviousness over Aycaguer and Soldati

Petitioner submits that claims 1–4, 6, and 7 are unpatentable over Aycaguer and Soldati. Pet. 3, 42.

1. Soldati (Ex. 1006)

Soldati is a U.S. Patent titled “Fractionation Process for Gaseous Hydrocarbon Mixtures with a High Acid Gas Content.” Ex. 1006, code (54). Soldati’s “invention relates to a process for recovering ethane and heavy hydrocarbons and for removing acid gases such as carbon dioxide and hydrogen sulphide [sic] by distillation from gaseous hydrocarbon mixtures which contain them, such as natural gas, synthesis gas or associated gases.” *Id.* at 1:8–13. Soldati purports that a “new process has been found which results in a considerable reduction in energy consumption mainly by recycling smaller liquid hydrocarbon stream throughputs while at the same time increasing the percentage of ethane recovery.” *Id.* at 1:54–58.

2. Analysis of Claim 1

Petitioner combines Aycaguer with Soldati “such that the fractionation process/plant of Soldati is used to implement the gas processing plant (i.e., the ‘Produced Gas Recycling Plant’ of Figure 1) in Aycaguer, where the natural gas liquids, CO₂, and H₂S described as outputs of that plant in Aycaguer are the outputs of the Soldati fractionation process/plant.” Pet. 42. Petitioner reasons, “A POSITA would have understood that the method of Soldati when applied to the natural gas streams disclosed in Aycaguer would predictably result in the processing of that natural gas stream as described in Soldati and would have had a reasonable expectation of success in doing so.” *Id.* at 44 (citing Ex. 1002 ¶ 133).

Petitioner relies on Soldati’s fractionation process and plant to address Limitations 1.3, 1.4, 1.5, and 1.6. *See* Pet. 45–55.

Patent Owner argues that “Ground 3 suffers from the same defects as Grounds 1 and 2, including no motivation to modify.” Prelim. Resp. 58.

At this preliminary stage of the proceeding, we disagree with Patent Owner.

For purposes of institution, Petitioner has made a sufficient showing that a skilled artisan would have combined the teachings of Aycaguer with Soldati to arrive at the invention recited in claim 1. For example, Petitioner reasons,

[A] POSITA would have been motivated to implement Aycaguer’s Produced Gas Recycling Plant using the natural gas liquid processing methods described by Soldati. This straightforward modification of Aycaguer’s oil and natural gas processing system uses a known process (e.g., the processing steps described in Soldati) *to improve a similar system* (e.g., the gas processing plant described in Aycaguer) in the same way (using the Ryan/Holmes process, which is the process used by the gas processing plant in Aycaguer).

Pet. 44 (citing Ex. 1002 ¶¶ 128–134) (emphasis added). Petitioner cites to Soldati’s teaching of “variations and improvements on the Ryan/Holmes process” as including “a sweetening step adapted for use in its process, in which hydrogen sulfide is removed from the natural gas liquid stream through distillation.” *Id.* at 43 (citing in part Ex. 1002 ¶ 131) (emphasis added). In addressing Limitation 1.3, Petitioner reasons that

a POSITA would have found it obvious to apply Aycaguer’s [sic] separation methods to a stream containing each of C₃-C₈. A POSITA would have expected the separation of such a stream to occur in a similar fashion and with similar proportions as taught in Soldati due to the predictable nature of the distillation methods taught in Soldati.

Id. at 50 (citing in part Ex. 1002 ¶ 143).

Soldati discloses a process for removing hydrogen sulfide by distillation (*see* Ex. 1006, 1:8–13) and purports that its “new process . . . results in a considerable reduction in energy consumption” (*see id.* at 1:54–58).

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner shows a reasonable likelihood that the subject matter of claim 1 would have been obvious over Aycaguer and Soldati.

3. Claims 2, 3, and 6

Petitioner contends, with citations to the evidence and testimony, that Aycaguer in view of Soldati discloses or renders obvious every limitation of claims 2, 3, and 6. *See* Pet. 55–74. Patent Owner does not address Petitioner’s arguments with respect to these additional claims, apart from the arguments addressed above. *See* Prelim. Resp. 61, 62.

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner shows a reasonable likelihood that the subject matter of claims 2, 3, and 6 would have been obvious over Aycaguer and Soldati.

4. Claims 4 and 7

Claims 4 and 7 depend from claims 3 and 6, respectively, and further recite,

wherein the sweet NGL rich stream comprises no more than 1 molar percent methane, no more than 1 molar percent ethane, and no more than 1 molar percent acid gases (claim 4) and

wherein the sour NGL rich steam comprises no more than 5 molar percent carbon dioxide, no more than 1 molar percent methane, and no more than 5 molar percent ethane, and wherein the sweet NGL rich stream is substantially free of carbon dioxide (claim 7).

Ex. 1001, 18:35–38, 18:54–58.

Petitioner submits that the combination of Soldati and Aycaguer satisfies the limitations of claims 4 and 7. *See* Pet. 67 (citing Ex. 1002 ¶¶ 177–179; *see also id.* at 74 (citing Ex. 1002 ¶¶ 186–194)).

Patent Owner submits that both Aycaguer and Soldati’s sweet NGL rich streams comprise more than 1 molar percent ethane and do not satisfy claim 4. *See* Prelim. Resp. 61 (citation omitted). Patent Owner further submits that the sour NGL rich streams of Aycaguer and Soldati comprise more than 5 molar percent ethane and do not satisfy claim 7. *See id.* at 62 (citation omitted).

At this stage of the proceeding, we disagree with Patent Owner, as Patent Owner’s arguments do not fully respond to Petitioner’s challenges.

To address claim 4, Petitioner cites to Table III from Soldati (Pet. 66) and submits, *inter alia*, that

A POSITA would have reasonably expected that the separation method of Soldati applied to the feed stream of Arand [sic] would have resulted in less than 1% methane, less than 1% ethane, less than 1% CO₂, and less than 1% hydrogen sulfide, because Soldati teaches that its separation steps result in none of those components in the sweet NGL rich stream 28.

Id. (citing Ex. 1002 ¶ 178).⁷

⁷ We understand that page 66 of the Petition includes a typographical error as Petitioner intended to refer to *Aycaguer* instead of *Arand*.

To address claim 7, Petitioner also cites to Table III of Soldati (Pet. 71) and further submits, *inter alia*, that “a POSITA would have been motivated to optimize the separation steps in the combined Aycaguer and Soldati system such that the sour NGL rich stream contains minimal carbon dioxide, methane, and ethane, and the sweet NGL rich stream is substantially free of carbon dioxide, as required in Claim 7.” Pet. 73. At this preliminary stage, Dr. Rockstraw’s testimony sufficiently supports Petitioner’s position. *See, e.g.*, Ex. 1002 ¶ 193 (“The 1% and 5% thresholds recited in Claim 7 are merely design choices that a POSITA could have easily achieved using routine and predictable optimizations to the process variables (for instance, by adjusting the reboiler temperature).”).

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner shows a reasonable likelihood that the subject matter of claims 4 and 7 would have been obvious over Aycaguer and Soldati.

5. Summary of Ground 3

Petitioner shows a reasonable likelihood that the subject matter of claims 1–4, 6, and 7 would have been obvious over Aycaguer in view of Soldati.

G. Ground 4: Alleged Obviousness over Aycaguer, Soldati, and Ryan

Petitioner submits that claim 2 is unpatentable over Aycaguer, Soldati, and Ryan. Pet. 3, 42.

1. Ryan (Ex. 1007)

Ryan is an article titled “Treating Acid & Sour Gas: CO₂ Recovery by the Ryan/Holmes Process” from the publication, “Chemical Engineering Progress.” Ex. 1007, 3. Ryan discloses a method of processing CO₂ and hydrocarbon liquids derived from natural gas streams. *See id.*

2. Analysis

Petitioner identifies where it contends that Aycaguer in view of Soldati and Ryan teach or suggest every limitation of claim 2. *See* Pet. 73–84.

Patent Owner does not address Petitioner’s arguments with respect to claim 2, apart from the arguments addressed above. *See* Prelim. Resp. 63 (“Ground 4 suffers from the same defects as Grounds 1, 2, and 3”); *see also id.* at 63–64 (“The addition of Ryan . . . adds nothing to overcome the failure of the combination of Aycaguer and Soldati to teach [limitation 1.6].”).

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of claim 2 would have been obvious over the combined disclosures of Aycaguer, Soldati, and Ryan.

H. Grounds 5 and 6

Petitioner submits that claims 1–4, 6, and 7 are unpatentable over Aycaguer in view of Soldati and Arand (Ground 5) and that claim 2 is unpatentable over Aycaguer in view of Soldati, Ryan, and Arand (Ground 6). Pet. 3.

Petitioner identifies where it contends that Aycaguer in view of Soldati, Anand, and Ryan teach or suggest every limitation of claims 1–4, 6,

and 7. *See* Pet. 84–90.

Patent Owner does not address Petitioner’s arguments with respect to these grounds, apart from the arguments addressed above. *See* Prelim. Resp. 64 (“Ground 5 suffers from the same defects as Grounds 1–4”); *see also id.* at 65 (“The addition of Arand to the combinations asserted in Grounds 3 and 4 does nothing to overcome the defects of Grounds 3 and 4.”).

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of claims 1–4, 6, and 7 would have been obvious over the combined disclosures of Aycaguer, Soldati, Ryan, and Arand and that claim 2 would have been obvious over Aycaguer in view of Soldati, Ryan, and Arand.

V. CONCLUSION

After considering the evidence and arguments presented in the Petition, Preliminary Response, Reply, and Sur-reply, we determine that the information presented shows a reasonable likelihood that Petitioner would prevail in establishing that claims 1–4, 6, and 7 are unpatentable.

VI. ORDER

Accordingly, it is

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review is instituted for claims 1–4, 6, and 7 of the ’332 patent on the unpatentability grounds asserted in the Petition; and

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

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