

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

PILOT INTELLECTUAL PROPERTY, LLC,
Patent Owner.

Case IPR2024-00385
Patent 8,505,332 B1

PATENT OWNER'S RESPONSE

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EXHIBIT LIST

Exhibit	Description
2001	Declaration of Trevor Bors (May 13, 2024)
2002	<i>Curriculum Vitae</i> of Trevor Bors
2003	U.S. Patent No. 4,529,411 (“Goddin”)
2004	Table of Similarities (demonstrating similarities between Goddin ‘411 Patent Fig. 11 and Three-Column Ryan/Holmes Process)
2005	GPA Engineering Data Book (12th Ed. 2006, FPS version) (Pages 1-300 of 821) (replaced by Ex. 2025 (Part 1 of 3), Ex. 2026 (Part 2 of 3), and Ex. 2027 (Part 3 of 3))
2006	U.S. Patent No. 4,318,723 (“Cryogenic Distillative Separation of Acid Gases from Methane”)
2007	U.S. Patent No. 4,462,814 (“Distillative Separations of Gas Mixtures Containing Methane, Carbon Dioxide and Other Components”)
2008	Holmes AS, Ryan JM, Price BC, Styring RE. Process Improves Acid Gas Separation. <i>Hydrocarbon Processing</i> 1982; 61:131–136
2009	Hannah Kent-Webb PhD, Best Practices for Biological Sample Storage and Management. <i>Biocompare</i> . (Oct. 2022)
2010	Vortex Expansion Devices for High Temperature Cryogenics. Proceedings of the 26 th Intersociety Energy Convention Engineering Conference (1991)
2011	Penflex Engineering Bulletin #113 (including table from The American Society of Materials “ASM Specialty Handbook: Stainless Steels,” published in 1994)

2012	Hydrate Formation in Chevron Mabee Unit for NGL Recovery and CO ₂ Purification for EOR (Submitted to Gas Processors Association 2017)
2013	Canada Patent No. 294,939 (Prosecution File History – including Re-examination)
2014	Proposed Discovery Requests (including annotated Ex. 2012 Figure 3, specifically identifying four particular streams)
2015	Claim Chart_’332 Patent Claims 1-4 6-7_Secondary Considerations_Copying
2016	United States Patent No. 4,753,666 (“Pastor”)
2017	Naomi Baker e-mail “Memo to file. conversation with Allen Hein, Chevron” (2012-02-12) (highlighted) (“He [Chevron’s Allen Hein] told me [Pilot’s Naomi Baker] that they were building a plant identical to their Rangeley (CO) plant”)
2018	Notice Letter from Pilot Energy Solutions to Chevron (August 15, 2013)
2019	Response Letter from Chevron to Pilot Energy Solutions (August 29, 2013) (attaching Pastor ‘666 Patent)
2020	<i>Pilot Energy Solutions, LLC et al. v. Chevron U.S.A. Inc. et al.</i> , Case No. 4:23-cv-02505-AHB, in the U.S. District Court for the Southern District of Texas, Houston Division, Order on Defendants’ Motion to Dismiss (Granting in Part, Denying in Part) (Doc. 41)
2021	<i>Pilot Energy Solutions, LLC et al. v. Chevron U.S.A. Inc. et al.</i> , Case No. 4:23-cv-02505-AHB, in the U.S. District Court for the Southern District of Texas, Houston Division, Agreed Joint Motion to Stay Pending Final Written Decision in Inter Partes Review Proceedings (Doc. 42)
2022	OSHA § 1910.119(d)(3)(i)(B) (requiring “Piping and instrument diagrams (P&ID’s)” for Process safety management of highly hazardous chemicals) (highlighted)

2023	Chevron Mabee Plant Air Permit Application – Texas Commission for Environmental Quality (“TCEQ”) (November 5, 2012)
2024	Transcript (Full) of Deposition of David A. Rockstraw (October 18, 2024)
2025	GPA Engineering Data Book (12th Ed. 2006, FPS version) (Sections 1-15) (Part 1 of 3) (replacing Ex. 2005)
2026	GPA Engineering Data Book (12th Ed. 2006, FPS version) (Sections 16-23) (Part 2 of 3) (replacing Ex. 2005)
2027	GPA Engineering Data Book (12th Ed. 2006, FPS version) (Sections 24-26) (Part 3 of 3) (replacing Ex. 2005)
2028	Declaration of Trevor Bors (November 22, 2024)
2029	Declaration of Eric Prim (November 22, 2024)
2030	Holloman Job No. 3228 New Construction – Description: Plant (Propane) Estimated Start Date: 8/13/01
2031	Exxon Means project development – sketches and notes
2032	Exxon Means project development – HYSYS process simulation (August 9, 2001)
2033	Exxon Means GCF Processing Plant Preliminary Piping and Instrumentation Diagram (“P&ID”) 50 MM Case (August 9, 2001)
2034	Exxon Means project development – Equipment needed (August 16, 2021)
2035	Exxon Means - Material Balance of Gas Available for Processing (January 5, 2002)
2036	Exxon Means Optimization (November 17, 2002)

2037	Exxon Means Processing Proposal (December 17, 2002) (“The optimized results from the means processing proposal have yielded results that are a little unexpected. Optimization of the system has demonstrated that the best economics are found with an inlet flow of 50 MMSCFD with relatively low propane recovery. Small increases in the propane recovery rate result in major increases in the capital cost.”)
2038	Exxon Means GCF Operations Initial Proposal (January 25, 2003) (“If the operations of the GCF are coupled with the proposed NGL recovery plant, savings will be realized through the synergy of operating both facilities.”)
2039	Exxon Means Processing Proposal (January 30, 2003)
2040	Exxon Means Processing Proposal (March 27, 2003) (“The optimized results from the means processing proposal have yielded results that are a little unexpected. Optimization of the system has demonstrated that the best economics are found with an inlet flow of 50 MMSCFD with relatively low propane recovery. Small increases in the propane recovery rate result in major increases in the capital cost.”)
2041	Exxon Means San Andres Unit - Means Field - Hydrocarbon Gas Production Forecast (June 2003)
2042	Exxon Means NGL Recovery Proposal e-mail (July 16, 2003)
2043	Exxon Means Processing Information (July 21, 2003) (“The original plant was intended to be a <u>high recovery</u> 60MMSCFD plant that was estimated to cost \$12MM to \$15MM. Next the plant size was reduced to 25MMSCFD, also with <u>high propane recovery</u> . The 25MM option was estimated to cost around \$5MM. The current case is designed for 50MMSCFD with <u>low (25%) propane recovery</u> and is estimated to cost around \$7MM.”) (emphasis added)
2044	Exxon Means project development – Process Flow Diagram (“PFD”) Front Page (July 21, 2003) HYSYS process simulation (July 21, 2003)

2045	Exxon Means project development – All Equipment List (notes reducing Costs from \$7,461,160 to \$5,152,492)
2046	Exxon Means Optimization (November 17, 2002 Optimization Corrected for Presentation (August 30, 2003)
2047	U.S. Provisional Application No. 60/938,726, filed May 18, 2007 ('322 Patent Provisional Application)
2048	NGL Recovery in CO2 Floods, Options and Reasons, Eric Prim & Naomi Baker, Midland CO2 Conference (December 2011) (available at https://www.co2conference.net/wp-content/uploads/2012/12/1.4-EricPrim_NGL_Recovery_Options_in_CO2_Floods_2011-CO2FloodingConf.pdf)
2049	NGL Recovery in CO2 Floods, Options and Reasons, Eric Prim & Naomi Baker, 6th Annual Wyoming CO2 Conference, Casper, Wyoming (July 11-12, 2012)
2050	Rangely Weber Sand Unit Case History, Rory Clark – Reservoir Engineer, Chevron North America E&P, 6th Annual Wyoming CO2 Conference, Casper, Wyoming (July 12, 2012)
2051	New Process Recovers NGLs From CO2, Naomi Baker, The American Oil & Gas Reporter (February 2013)
2052	Summary of Charts Demonstrating that Pilot's CO2Flex [®] Plants Perform the Steps of the Challenged '332 Patent Claims 1-4, 6-7 ("coextensive" – "essentially the claimed invention")
2053	Monell 20 Chart Demonstrating One-to One Correspondence between Challenged '332 Patent Claims 1-4, 6-7 and Monell 20 CO2Flex [®] Plant as Shown in Process Flow Diagram
2054	Monell 20 NGL Recovery Plant, Piping and Instrumentation Diagram (April 9, 2007 – Revised per PHA Review)

2055	Monell 20 CO2Flex [®] Plant, Process Flow Diagram, NGL Fractionation System (November 11, 2024)
2056	HYSYS Chemical Process Simulation, Monell 20, (May 3, 2007 [regenerated November 11, 2024])
2057	Goldsmith - Golden Hammer Chart Demonstrating One-to One Correspondence between Challenged '332 Patent Claims 1-4, 6-7 and Goldsmith - Golden Hammer CO2Flex [®] Plant as Shown in Process Flow Diagram
2058	Goldsmith Processing Plant, Process Flow Diagram, Project No. 5100928 (March 13, 2012 – Final Design)
2059	Mobile Analytical Labs, Inc., Goldsmith Feed Gas Analysis Gas Extended Analysis (2012-10-12), and Gas Analysis Report (2018-01-11)
2060	Pantechs Laboratories, Goldsmith Feed Gas Analysis C6+ Gas-Vapor Fractional Analysis (2017-01-08)
2061	Weyburn Chart Demonstrating One-to One Correspondence between Challenged '332 Patent Claims 1-4, 6-7 and Weyburn 20 CO2Flex [®] Plant as Shown in Process Flow Diagram
2062	Weyburn NGL Recovery Plant, Process Flow Diagram and Material Balance (April 23, 2012 – Approved)
2063	Bureau Veritas Laboratories, Weyburn Plant Gas Analysis, Extended Gas Analysis (2020-12-15)
2064	Wellman Chart Demonstrating One-to One Correspondence between Challenged '332 Patent Claims 1-4, 6-7 and Wellman CO2Flex [®] Plant as Shown in Process Flow Diagram
2065	Wellman CO2Flex [®] Plant, Process Flow Diagram (February 19, 2015 – Final as Built)
2066	Wellman CO2Flex [®] Plant, Corrected Stream Table

2067	Pantechs Laboratories, Wellman Plant Gas Analysis, C6+ Gas-Vapor Fractional Analysis (2018-01-17)
2068	Pantechs Laboratories, Wellman Plant, Extended Crude Oil Fractional Analysis (2017-01-04)
2069	Monell 120 Chart Demonstrating One-to One Correspondence between Challenged '332 Patent Claims 1-4, 6-7 and Monell 20 CO2Flex® Plant as Shown in Process Flow Diagram
2070	Monell 120 CO2Flex® Plant, Process Flow Diagram, Project No. 14154 (July 31, 2015 – Issued Final)
2071	American Mobile Research, Inc., Monell Plant Extended Hydrocarbon Gas and Liquid Analysis (2016-08-31)
2072	Financials
2073	Maintenance Fee Record for U.S. Patent No. 4,753,666 (“Pastor”) (“Patent expired on 06/28/1992 due to non-payment of [first – 3.5Year] maintenance fee”)
2074	Google Earth Images – Chevron Mabee CO2 Recycle Facility (02/21/2013) (before addition of NGL Recovery Plant) https://earth.google.com/web/@32.21102082,-102.2292088,884.43526729a,580.57327589d,35y,-0.00009674h,26.71434883t,0r/data=ChYqEAgBEgoyMDEzLTAYLTIXGABCAggBOgMKATBCAggASg0I_____ARAA
2075	Google Earth Images – Chevron Mabee CO2 Recycle Facility (10/4/2014) (after addition of NGL Recovery Plant) https://earth.google.com/web/@32.21102082,-102.2292088,884.43526729a,580.57327589d,35y,-0.00009674h,26.71434883t,0r/data=ChYqEAgBEgoyMDE0LTExwLTA0GABCAggBOgMKATBCAggASg0I_____ARAA
2076	Comparison of Pilot Monell 20 CO2Flex® Plant to Chevron Mabee NGL Recovery Plant

2077	E-mail from Julie K. Huff, Chevron Facilities Engineer – CO2 Injection Projects, to three other Chevron personnel (Shintaku/Hein/Acero) and three Pilot personnel (Prim/Baker/Holloman), regarding plan for flights to visit Pilot’s Monell 20 CO2Flex® plant in Wyoming (November 11, 2008) (“[T]rip confirmed ... to visit the Anadarko/[Pilot] Monell CO2 recovery plant. Purpose of trip, understand the [Pilot] process for CO2 removed and Q&A with Anadarko Operations.”)
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I. INTRODUCTION

When Eric Prim initially came up with the idea that ultimately became the ‘332 Patent CO2Flex[®] process, he was trying to bridge the gap between two existing technologies, which were the Ryan/Holmes process and the Mechanical Refrigeration Unit (“MRU”). Prim succeeded in bridging this gap, developing an invention that provided a middle ground between the Cadillac Ryan/Holmes process and the budget MRU process.

Finding this middle ground, and meeting the long felt but unmet need for this solution, has led to tremendous commercial success through the building of six CO2Flex[®] NGL Recovery plants so far within the first ten years of operations.

The CO2Flex[®] plants have produced a total combined revenue of over \$330 million, and over \$245 million in operating profits, through the end of 2023. For the four plants still in operation today, the total annual revenue for 2023 was approximately \$23 million, and around \$16 million in operating profits. Based on the expected remaining life of the reservoirs for these four plants continuing to operate, projections estimate an additional combined revenue of \$427 million, and \$295 million in operating profits.

The past and projected future numbers combine to a total revenue of around \$760 million, and \$540 million in operating profits.

All six of the obviousness grounds asserted in the Petition rely upon the basic assertion that the Ryan/Holmes process renders obvious the challenged claims of the Prim ‘332 Patent. The Ryan/Holmes process was used in about 12 gas processing plants in the US over 30 years ago, including several in West Texas.

Petitioners’ assertion that the Ryan/Holmes process renders obvious the ‘332 Patent CO2Flex® process is in effect an assertion that POSITAs roamed the oil fields of West Texas and beyond in the shadows of those Ryan/Holmes plants for over two decades failing to act on an obvious process through which they could have generated over three-quarter of a billion dollars in revenue, and over half a billion dollars in operating profits from plants built in their first ten years of operations.

II. OVERVIEW OF THE PRIM ‘332 PATENT PROCESS

The Prim ‘332 Patent describes a process whereby fluids produced from an Enhanced Oil Recovery (“EOR”) field “the hydrocarbon feed stream” (EX1001, 1:38) are first separated into a liquid stream, the “heavy hydrocarbon rich stream” (*id.* 1:39), and a vapor stream, the “carbon dioxide recycle stream” (*id.* 1:40). The liquid stream contains oil (heavy hydrocarbon), and the vapor stream includes carbon dioxide, methane, ethane, NGL’s, hydrogen sulfide, helium, and nitrogen, that is, everything included at *id.* 2:61-65 except for the heavy hydrocarbon removed in the above separation. This stream is then processed using a distillation separation

to produce an overhead stream which contains virtually all of the methane, virtually all of the ethane, most of the CO₂, over 90% of the H₂S, and about 30% of the C₃+ liquids. The bottom product consists of soluble amounts of methane and ethane, less than 10% of the H₂S and about 70% of the C₃+ liquids. The recovery level of the C₃+ liquids is dependent upon the economic decision process described in Method 400 of EX1001 8:48 to 10:21. Because this stream contains H₂S as well as CO₂ it is referred to as the “sour NGL rich stream” and is further processed to remove the H₂S and CO₂. This sour NGL rich stream is then treated to separate the sweet NGL rich stream from the acid gas stream. The sweet NGL rich stream consists of C₃-C₈ hydrocarbons. (EX2028 ¶31.)

The purpose of this process as the title “Natural Gas Liquid Recovery Process” would imply is to make a marketable NGL stream that is suitable for sale. It is not to separate a methane stream for use as fuel or for sale, and it is not to make ethane, either as a single component or as part of the natural gas liquids stream. (EX2028 ¶32.)

Prior to May 18, 2007 (the priority date) a POSITA would have had limited choices for a process to recover natural gas liquids from an EOR project. Although other options may have been available at the time, the most common were a Mechanical Refrigeration Unit (MRU) or the Ryan/Holmes process. Although an MRU is a widely accepted method to separate hydrocarbons based on their relative

boiling points, separations involving CO₂ are much more difficult. The use of an MRU is relatively simple and quite inexpensive to build, but the recovery of natural gas liquids is limited to C₄+. Another known process available at the time would have been the Ryan/Holmes process, which is described extensively below. (EX2028 ¶33.)

The main deciding factor for a POSITA in the decision of which type of facility to build would have been the economics. The economics would have been based on the forecasted revenues from the sale of product, less operating cost and less an allowance for the recovery of the initial capital cost. When considering the forecasted revenues not only would the volume of product been important, but also the price of the product. A POSITA would have known that the local price of products can vary significantly based on the presence of infrastructure and availability of capacity and market. For example, some areas may not have access to a pipeline capable of transporting ethane. Since ethane has a very high vapor pressure, it is impractical to move by truck or rail. Other areas may have pipeline constraints which make the transportation cost of methane higher than the value of the product, making the recovery of methane uneconomic. Incidentally, a low price of methane in an area can be a further benefit to a plant which does not recover methane since purchased fuel can be a significant part of the operating expense. (EX2028 ¶34.)

The Prim ‘332 Patent invention provides a middle ground for the POSITA to consider. If the potential revenue stream for the plant is insufficient to support the higher capital cost of a Ryan/Holmes facility, but the POSITA wanted to recover more products than an MRU is capable of, the Prim invention could be considered. (EX2028 ¶36.))

III. SUMMARY OF THE ‘332 PATENT PROSECUTION

In response to the Examiner’s rejections, amendments were made to the ‘332 Patent claims specifically to distinguish the claimed invention from the Ryan/Holmes process, including the negative limitations suggested by the Examiner to specify that the ‘332 Patent process does not use cryogenic conditions, membranes, or CO2 recovery solvents. (EX2028 ¶¶43-49.)

As confirmed by the Examiner in the reasons for allowance set forth in the Notice of Allowability, these amendments distinguished the ‘332 Patent process from the Ryan/Holmes cryogenic distillation process, and led to the issuance of the challenged claims. (EX2028 ¶¶43-49.)

IV. LEVEL OF ORDINARY SKILL IN THE ART

Petitioners assert 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,” and that “[a]dditional work experience can substitute for educational or research experience, and vice versa. (Petition, 8 (citing EX1002, ¶¶26-29).)

Patent Owner agrees with Petitioners’ assertions regarding the level of ordinary skill in the art.

V. CLAIM CONSTRUCTION UNDER 37 C.F.R. §42.104(B)(3)

While Petitioners assert that “explicit construction” of terms in this matter is “unnecessary because it is not dispositive,” relying on an assertion that “the art teaches the claims under any reasonable construction,”¹ it is clear that the Petition necessarily relies upon critically flawed proposed interpretations of at least two particular claim terms in support of the obviousness grounds, which are the “cryogenic conditions” and “CO₂ recovery solvents” terms in challenged independent Claim 1, upon which each of the challenged dependent Claims 2-4, 6, and 7 depend.

¹ (Petition, 8.)

A. Cryogenic Conditions

Challenged Claim 1 of the Prim '332 Patent includes the negative limitations suggested by the Examiner during prosecution to distinguish the claimed invention from the prior art Goddin cryogenic distillation process, including the requirement that the “hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream” in the Prim process “are not subjected to cryogenic conditions.” (*See supra*, Section III(B).)

The Goddin patent, just like the Ryan/Holmes patents and journal articles, repeatedly refer to their process as “cryogenic distillation” and “cryogenic fractionation,” or “cryogenic distillative fractionation.” (*See, e.g.*, EX2003, EX1010, EX2006, EX2008.)

The term cryogenic does not have a universal definition, and is often different depending on the context and the industry. (EX2028 ¶52.) At the outset of the related federal court proceeding, the Patent Owner Plaintiff proposed a general definition of the term in response to Petitioners/Defendants’ Motion to Dismiss asserting that cryogenic conditions included temperatures as warm as 5.7°F. (EX1011, 12.)

Patent Owner/Plaintiff’s response asserted that cryogenic conditions were colder than 5.7°F, using an EPA website reference describing cryogenic conditions as -130°F (-90°C) or less. (EX1011, 12, n2.) This reference is related to the storage of gases which have been liquified such as air, argon, carbon monoxide, ethylene,

fluorine, helium, hydrogen, methane, nitrogen, and oxygen. (EX2028 ¶52.) Patent Owner/Plaintiff cited a second reference, from the American Institute of Chemical Engineers, which defines cryogenic liquid as a refrigerated liquid gas having a boiling point below -130°F (-90°C) at atmospheric pressure. (NFPA 30). (EX1011, 12, n2.)

Petitioners provide a definition of cryogenic from the National Institute of Standards and Technology of -150°C (-238°F), again related to the liquification of permanent gases. (EX1017, 1.)

Each of the definitions offered at the outset of the related federal court litigation, which had not, and still has not reached even the beginning of the claim construction process, and Petitioners' EX1017 definition, generally relate to the liquification of gases, rather than providing a definition applicable to the oil and gas industry, and in particular the gas processing industry, which is the field of the Prim '332 Patent process.

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." (EX2028 ¶58.) The Twelfth Edition (2004), at 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.

(EX2025, Page 20.)

The GPA, in addition to publishing the Engineering Data Book, also sponsors an annual technical convention and publishes technical papers such as EX1010 “Pilot Tests Prove Ryan/Holmes Cryogenic Acid Gas/Hydrocarbon Separations.” The “Hydrate Formation in Chevron Mabee Unit for NGL Recovery and CO₂ Purification for EOR,” which was submitted to the Gas Processors Association conference 2017, also lists the 1998 edition of the GPSA Engineering Data Book as a reference. (EX2012.) The GPA (and GPSA) Engineering Data Book is also referenced in EX1022, 1:30, and was acknowledged in the reference (21) of EX1005 as being presented at the 61st Annual Gas Processors Association Convention. EX1007 reference 3 is also a GPA publication from 1983. (EX2028 ¶¶59.)

Because the Prim ‘332 Patent process at issue in this case is related to the oil and gas industry, and in particular the field of gas processing, Patent Owner proposes that the term be construed as set forth in the GPS “Engineering Data Book” definition of “below minus 50°F.” (EX2028 ¶¶60-61.)

B. Carbon Dioxide Recovery Solvents

Challenged Claim 1 of the Prim '332 Patent includes additional negative limitations suggested by the Examiner during prosecution to distinguish the claimed invention from the prior art Goddin cryogenic distillation process, including the requirement that the “hydrocarbon feed stream, the carbon dioxide recycle stream, and the sour NGL rich stream” in the Prim process “are not subjected to ... carbon dioxide recovery solvents.” (*See supra*, Section III(B).)

Patent Owner proposes that this “carbon dioxide recovery solvents” term be construed according to its plain and ordinary meaning: “solvents used for recovery of carbon dioxide.”

Petitioners propose that this “carbon dioxide recovery solvents” be construed to be limited to “carbon dioxide solvents,” which Petitioners refer to as “solvents having CO₂ affinity” (Petition, 35). But these words in the claim were chosen specifically with the intention of not limiting the solvents to carbon dioxide solvents. Had Prim intended the exclusion to include only solvents with an affinity to CO₂, the patent would have used the term “carbon dioxide solvents.” (EX2028 ¶66.)

With this in mind, the additives in the Ryan/Holmes process, and the Soldati process, are used extensively to allow the separation of CO₂ from the hydrocarbons. This separation is accomplished by relying on the solubility of the hydrocarbons into the additive. Additives, also referred to as agents, liquid hydrocarbon streams,

recycled hydrocarbon stream, absorbent oil, stream 10 and stream 32 (in Soldati), recirculating hydrocarbon, lean oil, among others, amounts to the use of carbon dioxide recovery solvents. The use of these carbon dioxide recovery solvents is mentioned by one of the terms above in Exhibits 1005, 1006, 1007, and 1010, but never in EX1002. (EX2028 ¶70.)

VI. OVERVIEW OF THE PRIOR ART

A. The Ryan/Holmes Process

A POSITA, having reviewed the article by Aycaguer (EX1005) which specifically mentions the Ryan/Holmes process by name at 305,² and its footnote references 21 (EX2008) and 22 (EX1007), would have realized that all three describe the Ryan/Holmes process. Further to the Aycaguer article, a POSITA may have reviewed the Soldati patent EX1006 which also mentions the Ryan/Holmes process by name at 1:21-25.³ Soldati also provides a concise description of Ryan/Holmes at 1:25-53, and goes on to provide a detailed description complete with the results of process simulations in 8:49 to 13:20. Suffice it to say that any

² “The separation of CO₂ from hydrocarbons and H₂S can be achieved by using the Ryan/Holmes process.” (EX1005, Page 6.)

³ “A fractionation process of the known art is described hereinafter from the teachings of A. S. Holmes and J. M. Ryan.” (EX1006, Page 6, 1:21-25)

reference to Aycaguer or Soldati is really a reference to Ryan/Holmes. (EX2028 ¶68.)

Ryan and Holmes authored several journal articles describing their cryogenic distillation process that were published in the early 1980's, and were issued several U.S. patents for their process. Petitioners included two of the Ryan/Holmes journal articles in the Petition, Exhibits 1007 and 1010. Patent Owner adds in this Response an additional Ryan/Holmes journal article as EX2008. Patent Owner also includes two of the Ryan/Holmes patents, as Exhibits 2006 and 2007. (EX2028 ¶74.)

Petitioners rely upon one of the Ryan/Holmes journal articles as the primary basis for each of the six obviousness Grounds asserted in the Petition. Petitioners incorporate Ryan's 1984 Chemical Engineering Progress article (EX1007 ("Ryan")) into the Aycaguer (EX1005) reference, by asserting that Aycaguer's citing of the Ryan article (at footnote 22) "evidences a POSITA's knowledge at the relevant time" (Petition, 35). Aycaguer, and by incorporation Ryan, is the primary reference for each of the six obviousness Grounds asserted in the Petition. Grounds 4 and 6 explicitly add Ryan to the combination of references for those Grounds. (EX2028 ¶75.)

In both of these 1982 journal articles authored by Ryan and Holmes, they refer to their distillation processes as being "cryogenic." (EX1010, entitled "Pilot Tests Prove Ryan/Holmes Cryogenic Acid Gas/Hydrocarbon Separations" (emphasis

added); EX2008, subtitled “Ryan/Holmes cryogenic processes overcome roadblocks to distillation of C₁-CO₂, C₂-CO₂ and CO₂-H₂S systems” (emphasis added)). (EX2028 ¶77.)

At pages 35-36 of the Petition, Petitioners rely upon two particular quotes from the Ryan/Holmes journal articles that reference non-cryogenic temperatures for particular proposed configurations of the Ryan/Holmes process, referencing operating temperatures as warm as “-30 to -40°F” (EX1010, 81), and “-35°F” (*id.*, 83). Upon a closer review of these Ryan/Holmes journal article descriptions of the process, the non-cryogenic (warmer than -50°F) conditions referenced are particular proposed configurations of the Ryan/Holmes process in which these warmer conditions were accomplished by increasing the flow of the CO₂ recovery solvents (“NGL-based additives”). *See* EX1010, 83 (“By increasing the volume of recycle additive to the column, the overhead temperature can be raised to -35°F.”). (EX2028 ¶79.)

While these Ryan/Holmes 1982 journal articles described their proposed configurations to operate at non-cryogenic conditions by increasing the flow of CO₂ recovery solvents (“NGL-based additives”), by 1984 Ryan and Holmes were teaching away from this configuration by promoting their new four-column process, and criticizing their old increased additives three-column process. (EX2028 ¶80.)

Four-column scheme

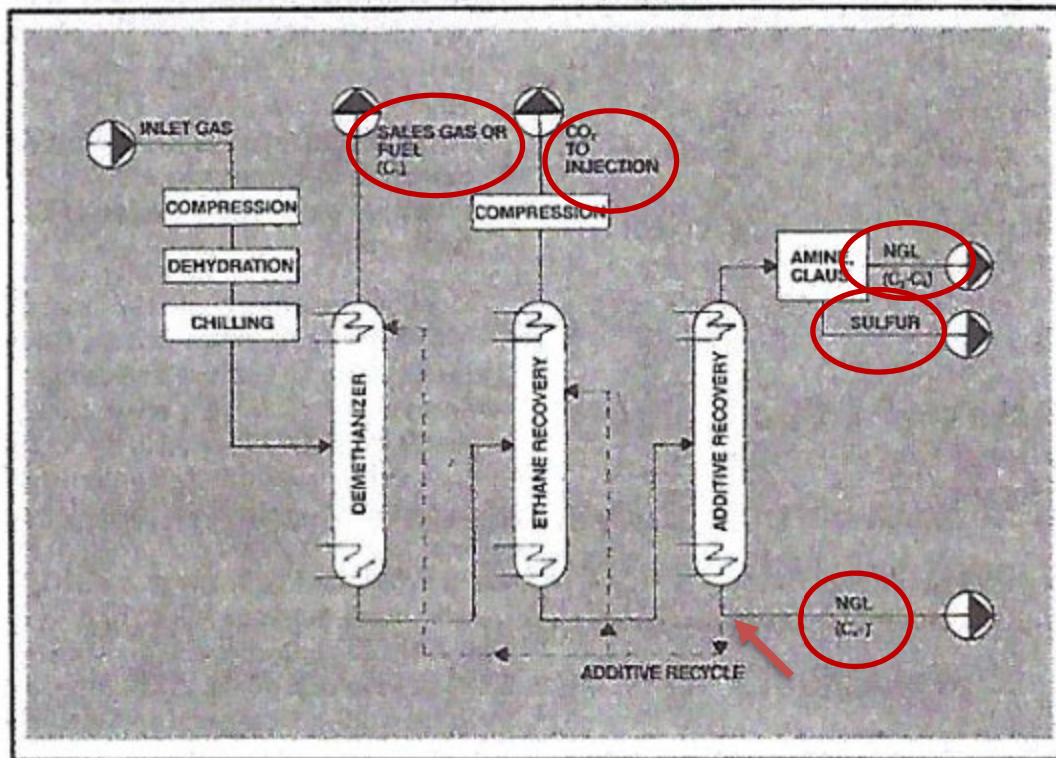
The major objectives which lead to the development of the four-column arrangement were to lower the energy consumption and capital cost of the overall processing scheme. After some study it became apparent that reducing the flow of additive and producing the CO₂ product as a liquid-column bottoms stream would help accomplish these objectives. If a liquid CO₂ product bottoms stream were to be produced, it would have to be from a column into which no additive was fed. Figure 3 shows the resulting four-column flow schematic.

(EX1007, 84 (emphasis added).)

In other words, although the Ryan/Holmes process back in 1982 may have included a proposed non-cryogenic configuration for the Ryan/Holmes cryogenic distillation process, within a few short years in 1984 Ryan and Holmes were teaching away from that particular proposed configuration. (EX2028 ¶81.)

The Ryan/Holmes process shown in Figure 2 of EX1007 describes the 3 column Ryan/Holmes process. (EX2028 ¶82.)

Figure 2. Three-column Ryan/Holmes process.



Note the 5 individual outputs from the process.

- Sales gas or fuel (C1) [methane]
- NGL (C2-C3) [ethane-propane] and (C4+) [butane-plus]
- Sulfur
- CO2 to Injection

From EX1007 page 54, Ryan states that “The role of the additive recovery column is to remove lighter NGL’s to prevent them from being recycled. Butane-plus is produced from the bottom of the column providing the net heavier NGL make and recovered additive to be recycled to the first two columns.” The “net heavier NGL make” in this sentence refers to “NGL (C4+)” shown in the bottom right corner

of Figure 2. It is important to note that the “lighter NGL’s” refer to the circle in the top right corner of Figure 2, and specifically mention the presence of ethane (C2). In his testimony, Rockstraw states that “a POSITA would understand that ‘natural gas liquids’” is a term that includes C3-C8 hydrocarbons” (see Institution Decision page 27). This statement is misleading since all the Ryan/Holmes exhibits (and exhibits which reference Ryan/Holmes) include references to C2 in the NGL. (EX2028 ¶83.)

Rockstraw testified in his deposition that “the ethane appears in a separate NGL stream that the author refers to as a light NGL stream.” (EX2024, 77:16-17). This is consistent with the “NGL (C2-C3)” shown in figures 2 and 3 of EX1007. (EX2028 ¶84.)

The article goes on to say that “H₂S, if present in the plant feed, will be produced in the overhead of the additive recovery column.” It will be shown in the Soldati description of the Ryan/Holmes process that 100% of the H₂S contained in the inlet is produced in the overhead of the additive column. Also, the next sentence in the article (Ex 1007, 54) states that “The sour NGL’s of the overhead are processed by conventional amine treatment to produce sweet NGL product.” Figure 2 and this direct quote from Ryan clearly show an external step after the additive recovery column is required to produce a sweet NGL rich stream, the NGL (C2-C3). Rockstraw, in his Declaration Section 75 states that the additive recovery column is

where “the stream is separated into a sweet NGL stream with the C₄₊ hydrocarbons and a sour NGL stream with C₂-C₃ hydrocarbons,” and then goes on to say that “[t]he sour NGL stream is then sweetened,” which contradicts his assertion in Section 149 of his Declaration that the Soldati “column 21 sweetens this C3-C8 hydrocarbon stream.” This is also contrary to the Rockstraw testimony where he contends that the sweet NGL rich stream is produced from the bottom of the additive recovery column (Soldati’s stream 28) as shown on page 42 of the Board’s Institution Decision. It will be discussed later, but stream 28 (the additive recovery column bottom stream) mentioned in Rockstraw’s testimony is mischaracterized as an NGL stream since it is over 99% additive which is continuously recycled to other parts of the plant. Less than 1% of stream 28 is included in the “NGL C₄₊” stream shown in the bottom right corner of Figure 2 shown with a red arrow. (EX2028 ¶85.)

Figure 3 from EX1007 describes an alternative (four-column) embodiment of the Ryan/Holmes process. (EX2028 ¶89.)

A detailed description of the Ryan/Holmes Four-Column process, complete with simulated component throughputs is included in the Soldati (EX 1006) Prior Art discussion. (EX2028 ¶90.)

B. Aycaguer (EX1005)

Reducing Carbon Dioxide Emissions with Enhanced Oil Recovery Projects: A Life Cycle Assessment Approach (“Aycaguer”) is an article published in the Energy & Fuel journal, managed by the American Chemical Society. (EX1005.)

Aycaguer in EX1005 at 305 describes the “associated gas for separation of the different components” as “water, hydrogen sulfide – H₂S, CO₂, CH₄, natural gas liquids.” It is important to note that the description does NOT include C₂H₆ (ethane). The absence of ethane in the list of components would lead a POSITA to know that the ethane is included in the “natural gas liquids.” The presence of ethane in the NGL is a critical difference between the Prim ‘332 Patent and the process described in Aycaguer. (EX2028 ¶97.)

During his deposition, Rockstraw testified that that the natural gas liquids stream described above “will contain some of the ethane that’s in the feed stream.” (EX2024, 49:5-6) When asked during deposition whether “a POSITA reading Aycaguer would have understood, and at the very least found it obvious that the hydrocarbon feed stream of Aycaguer includes C₂ through C₈” he testified that “Yes, a POSITA would recognize that the hydrocarbon feed stream of Aycaguer includes C₂ through C₈.” (EX2024, 57:16-21.) (EX2028 ¶98.)

In contrast, the Prim ‘332 Patent refers to the inlet prior to the initial separator at 2:63-65 as “carbon dioxide, methane ethane, NGLs, heavy hydrocarbons,

hydrogen sulfides, helium, nitrogen, water,” specifically mentioning ethane and NGLs and further defining NGLs as C3-C8 hydrocarbons at 3:5-7. (EX2028 ¶100.)

Aycaguer introduces the presence of “additives” into the discussion. Looking into the references cited in Aycaguer would introduce EX1007 (“Ryan”), which will be discussed later. (EX1005, 305, footnotes 21 (1982) and 22 (1984) are journal articles authored by Ryan and Holmes, describing the Ryan/Holmes process.) (EX2028 ¶102.)

Aycaguer also introduces the use of amine for sweetening the NGL (EX1005, 305). Aycaguer states that “to separate H₂S from the natural gas liquids, we used a nonselective chemical absorption amine” which is in agreement with Ryan EX1007 Figures 2 and 3, Holmes EX2008 Fig. 6, and Holmes EX1010 Fig. 6. (EX2028 ¶103.)

C. Soldati (EX1006)

Soldati describes a fractionation process for high acid gas streams. The patent at 1:14-19 states that “the purpose of the process according to the present invention is to separate a fraction formed of ethane, propane and heavier hydrocarbons, a fraction formed essentially of acid gases, and a fraction formed essentially of methane,” contrary to the Rockstraw description in section 68 where it is stated that “Soldati discloses methods of processing oil and natural gas streams to remove CO₂ and H₂S.” (EX2028 ¶107.)

Soldati incorporates four distillations to complete the separation described above, and makes use of carbon dioxide recovery solvents referred to as the “liquid hydrocarbon stream” shown in Figures 1, 3, and 4 as streams 10 and 32. (EX2028 ¶108.)

The Soldati patent refers to a “known art” described as “the teachings of A.S. Holmes and J.M. Ryan.” (EX1006, 1:21-25.) Soldati describes his innovation as an improvement over the Ryan/Holmes process by incorporating “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.” (EX1006, 1:54-58 (emphasis added).)

Although this EX1006 is the Soldati patent, the Rockstraw Declaration focuses most of the discussion referencing the prior art Ryan/Holmes process. All of the component throughput data used in the Declaration refer to Table III, which is the data for Example 2, Ryan/Holmes Fig 4. (EX1006, 8:49-10-23, 11:1-13-7.)

During deposition, when asked “if you change your statement to saying stream 12 includes propane and higher hydrocarbons, C3 through C8 and you change that to say ethane and higher hydrocarbons, C2 through C8, would that statement be correct?” Rockstraw testified “that statement would be correct.” (EX2024, 94:24 – 95:6) Later, Rockstraw testified that “roughly three-quarters of the ethane in the feed

stream comes out in stream 12, so it would've been more accurate to refer to it as ethane and higher hydrocarbons.” (EX2024, 98:19-21.)

In section 71, Rockstraw describes column 21 as “where the hydrogen sulfide and carbon dioxide are removed.” Although it is true that these components are included in stream 27, this stream is made up of 94.54% hydrocarbons. It would be more accurate to describe stream 27 as a sour NGL rich stream, which is further processed as described in Aycaguer (Ex 1005) using “a nonselective chemical absorption amine process.” (EX1005, 305.) (EX2028 ¶114.)

Rockstraw mischaracterizes column 21 as if its purpose is to remove the hydrogen sulfide and carbon dioxide, while in reality the purpose and function of column 21 is to separate the C4 butane and heavier hydrocarbons from the lighter hydrocarbons (C2 ethane and C3 propane), which is always the function of the fourth column in the Ryan/Holmes process. The C4+ heavier hydrocarbons are produced as a bottom product for recycling as the “liquid hydrocarbon stream” (aka “additives”), while the C2-C3 lighter hydrocarbons are produced as an overhead product. (EX2028 ¶115.)

The C2-C3 overhead stream is a sour NGL stream, meaning it contains some hydrogen sulfide and carbon dioxide acid gasses, which are further processed to produce sweet NGL product, by removing the hydrogen sulfide and carbon dioxide acid gasses. This sleight of hand mischaracterization by Rockstraw is purposeful,

done in order to support Rockstraw’s later opinion for Grounds 3 and 5, regarding challenged Claim 4, which specifies that the sweet NGL rich stream comprises “no more than 1 molar percent ethane.” (EX2028 ¶116.)

Rockstraw purposefully incorrectly reverses the overhead and bottom products of column 21, intentionally mischaracterizing the stream 28 bottom product as the sweet NGL rich stream. (EX1002, ¶177.) The stream 28 bottom product is used for recycling as the “liquid hydrocarbon stream” (aka “additives”), while the overhead product is the sour NGL stream produced for sale, containing about 50% ethane. See Soldati Table III components, showing the sour NGL stream 27 as about 50/50 ethane/propane. (EX2028 ¶121.)

TABLE III

COMPONENT THROUGHPUT KMOLS/H	STREAM		
	94	57	27
NITROGEN	—	16.44	—
HYDROGEN SULPHIDE	—	—	0.03
CARBON DIOXIDE	—	1.20	3.65
METHANE	—	57.46	—
ETHANE	—	—	32.57
PROPANE	1.20	0.03	30.51
N-BUTANE	108.25	0.65	0.67
N-PENTANE	32.52	0.05	—
HEXANE	8.03	—	—
THROUGHUT KMOLS/H	150.00	75.83	67.43
PHASE	L	V	L
TEMPERATURE °C.	−20.0	−35.0	5.5
PRESSURE ATA	41.5	40.5	18.5

EX1006, Table III (annotated to highlight the ethane/propane components in the overhead stream 27 of the fourth column). Ryan and Holmes refer to this stream 27, the overhead stream of the fourth column of their four-column Ryan/Holmes process, as the “sour NGL” stream, which is further processed “to produce sweet NGL product.”⁴ (EX2028 ¶121.)

Rockstraw presents a similar mischaracterization to support Rockstraw’s opinion for Grounds 3 and 5, regarding challenged Claim 7, which specifies that the sour NGL rich stream comprises “no more than 5 molar percent ethane.” Rockstraw purposefully incorrectly presents the stream 12 bottom product of column 8 (the first column of the four-column Ryan/Holmes process) as the sour NGL rich stream. (EX1002, ¶189.) Rockstraw attempts to disguise the fact that the stream 12 bottom product of column 8 is subsequently fed into the “additive recovery” column 21, which produces the sour NGL rich stream as the stream 27 overhead product, containing about 50% ethane and 50% propane. (EX1006, Fig. 4, Table III.) And as Ryan and Holmes themselves specifically refer to the overhead product of the fourth column as the “sour NGL” stream, which is further processed “to produce sweet NGL product.”⁵ (EX2028 ¶122.)

⁴ (EX1007, 54.)

⁵ (EX1007, 54.)

Table IV of Soldati shows the typical recoveries of the Soldati process compared to the Ryan/Holmes process.

TABLE IV		
	Example 2 (comparative)	Example 1
Ethane recovery %	78.5	94.1
Propane and higher hydrocarbon recovery (Mol %)	94.2	94.5
Carbon dioxide recovery %	99.6	99.9
Recirculating hydrocarbons Ton/h (stream 32)	93.8	17.2
Absorbed power kW	6150	5350
Steam required for reboilers 10 ⁶ kCal/h	18.8	5.3
	(P _{sat} = 6 ATA)	(P _{sat} = 4 ATA)

A review of stream 6 and stream 44 of Table III shows that the inlet stream (the carbon dioxide recycle stream) contains 57.59 kMol/hr of methane, and the purified carbon dioxide stream contains 0.0 kMol/hr of methane. This means that the purified carbon dioxide recycle stream contains 0.0% of the methane contained in the carbon dioxide recycle stream. In contrast, purified carbon dioxide recycle stream in Prim '332 contains 100% of the methane contained in the carbon dioxide recycle stream. (EX2028 ¶125.)

The Soldati process and the Ryan/Holmes process described in the Soldati patent both require 4 distillation columns, both use carbon dioxide recovery solvents, both produce a separate methane stream, both produce an NGL stream which contains essentially all of the ethane from the carbon dioxide recycle stream, and

produce a purified carbon dioxide stream which is over 99% carbon dioxide. In contrast, the Prim '332 Patent process makes no attempt to separate methane from the purified carbon dioxide stream. (EX2028 ¶131.)

D. Ryan (EX1007)

CO₂ Recovery by the Ryan/Holmes Process (“Ryan”) is an article published in the Chemical Engineering Progress journal, managed by the American Institute of Chemical Engineers. As described above in Section VI(A), this EX1007 article is Ryan/Holmes in 1984 promoting their new four-column process over their prior 1982 three-column process.

E. Arand (EX1004)

The Arand patent describes “Processing produced fluids of high-pressure gas condensate reservoirs.” Within the patent at 4:55-56, it states: “natural gas liquid (for example, C₂-C₆ or C₂-C₈, or the like)” and at 5:32-33 “natural gas liquids fraction comprising C₂ to as high as, for example C₈.” Then at 5:46-49, states: “As used herein, the term ‘natural gas liquids components’ will be used to refer to any or all of C₂ through about C₈ hydrocarbons or higher.” Arand also refers to ethane as among the “condensable hydrocarbons, that is, those that can ordinarily be collected and stored in liquid form.” 1:19-21 Furthermore, Arand table 1B (11:15-39) shows a stream labeled “NGL” which contains 33.76% ethane (calculated as 281.60 moles ethane / 834.14 moles total = 0.3376). (EX2028 ¶146.)

As stated by Rockstraw, Arand at 5:44-45 (which is between two of the above references) does refer to natural gas liquids as C3-C8, however, the reference is used to describe an approach to making an economic decision about further processing of the gas. The full quote at 5:41-46 “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.” (EX2028 ¶147.)

F. Composition of the NGL Stream

The composition of the NGL Stream is of paramount importance for understanding that the processes described in Aycaguer, Ryan/Holmes, and Soldati are significantly different than the process of Prim ‘332 patent. (EX2028 ¶156.)

Aycaguer describes an NGL stream which contains ethane (C2). The references (21) and (22), which are included as Exhibits 1007 (Figure 2) and 2008 (Table 2) confirm the presence of C2 in the NGL stream. The claim by Rockstraw that the NGL stream described in Aycaguer is a C3-C8 stream is misleading. (EX2028 ¶159.) As discussed in Section B above, Rockstraw confirmed that the NGL stream in Aycaguer contains C2-C8.

In Section C above, Soldati describes a process which makes an NGL product shown in Fig.4 as stream 27 which contains C2-C4 as shown in Table III. Table IV

from Soldati also shown in Section C describes the recovery of ethane (C2) at 94.1%, again confirming that the NGL stream contains ethane (C2). (EX2028 ¶166.)

As discussed above in Section VI(E), Arand (EX1004) makes 4 references to the composition of the NGL stream. Three of these references mention NGL as C2-C8, including the last reference at 5:47 which says “herein, the term “natural gas liquids components” will be used to refer to any or all of C2 through about C8.”

The most significant evidence that Arand describes the NGL stream as C2-C8 is the component throughput shown in Table IB which shows 281.60 Mol/hr of ethane in the NGL stream.

Ryan EX1007 Figures 2 and 3 both show an NGL (C2-C3), Holmes EX1010 at 78 describes “recovery of ethane and higher hydrocarbons as a product,” Goddin EX2003 Fig. 11 shows a C2-C3 Mix, and Holmes ‘723 EX2006 Fig. 5 shows an ethane plus fraction. (EX2028 ¶169.)

The only Exhibit presented which describes NGL as a C3-C8 mixture is Prim ‘332, and that is because Prim only recovers a C3-C8 product. To refer to NGLs as C2-C8 in Prim would have been misleading to the reader. (EX2028 ¶170.)

G. The Prim ‘332 Process Provides an Additional Choice

As described above in EX2028 ¶¶32-36, the Prim process opened up new opportunities for the processing of an EOR recycle hydrocarbon feed stream. Before

the priority date there was no “middle ground” to choose from. The only choices were to individually recover methane, ethane, and NGL for sale, and produce a substantially pure CO₂ product for reinjection into the reservoir using a Ryan/Holmes process, or produce a C₄+ product for sale and reinject everything else using an MRU. (EX2028 ¶171.)

The Pastor process (EX2016) described in Section VIII(A) of this Response proposes an alternative method of NGL recovery primarily focused on maintaining the minimum miscibility pressure of the injected fluid. Recovery of NGLs is not the primary driver of this method, leaving all of the propane and a significant portion of the butane in the injection fluid. (EX2028 ¶172.)

Prim provided a middle ground where additional NGLs could be captured and sold based on the economics of the plant. Variable recoveries and capital investment described in the method 400 provided a roadmap to the best possible economics for the situation. (EX2028 ¶173.)

H. Component Destinations

A simple way to demonstrate the significant difference between Ryan/Holmes and Prim is to look at where the individual components of the inlet stream end up. In the table below, PCO₂RS refers to the Purified carbon dioxide recycle stream which is injected into the reservoir. (EX2028 ¶174.)

Component	Ryan/Holmes (Aycaguer, Soldati)	Prim '332
Methane (C1)	Separate sales stream	Included in PCO2RS
Ethane (C2)	Included in C2-C4 sales stream	Included in PCO2RS
Carbon Dioxide (CO2)	Separate 99.1% pure stream for injection	Included in PCO2RS
Hydrogen Sulfide (H2S)	Separate stream converted to sulfur (100% of the H2S in the Plant inlet)	90% of the H2S in the Plant inlet Included in PCO2RS, 10% included in the Acid Gas stream
Propane (C3)	Included in C2-C3 sales stream	80% to 10% in PCO2RS, remainder in the NGL Rich Stream
Butane and heavier (C4+)	Included in C4+ sales stream	NGL Rich Stream

As shown above, Prim does not recover a methane stream for sale, leaves all or substantially all of the ethane in the PCO2RS, leaves about 90% of the H2S in the PCO2RS, and only recovers economically viable amounts of propane. (EX2028 ¶175.)

VII. THE RYAN/HOLMES PROCESS “TEACHES AWAY” FROM THE PRIM ‘332 PATENT PROCESS

Ryan/Holmes is a cryogenic distillation process developed in the late 1970’s and early 80’s to improve the process of separating methane and ethane from carbon dioxide recycle streams in enhanced oil recovery (“EOR”) operations. 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. (EX2028 ¶180.)

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.” (EX1001, 4:55-60.) (EX2028 ¶181.)

The purpose, process, and result of implementation of the Ryan/Holmes process is to separate methane and ethane from carbon dioxide recycle streams, using additives and extensive processing equipment, to produce methane and ethane for sales. 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. This innovative process leaves all (or almost all) of the methane and ethane in the carbon dioxide recycle streams, to produce NGLs, having little to no methane and ethane, while using significantly less process

equipment and energy, and thereby recovers NGLs with significantly less costs. (EX2028 ¶182.)

Considering that the Prim ‘332 process conserves costs by “disregarding the recovery” of methane and ethane from the carbon dioxide recycle stream, it would make no sense for a POSITA to use the Ryan/Holmes methane/ethane recovery process as a starting point to modify it or combine with other teachings to develop the Prim ‘332 Patent process. The Ryan/Holmes process focus on recovery of methane and ethane would lead a POSITA in a direction divergent from the path that was taken by Prim to develop the ‘332 Patent process. The Ryan/Holmes process and the Prim ‘332 Patent process go in opposite directions for recovering salable components of carbon dioxide recycle streams. (EX2028 ¶183.)

The Ryan/Holmes process thereby “teaches away” from the Prim ‘332 Patent process. A POSITA would not be motivated to modify or combine the Ryan/Holmes process with other teachings to develop the Prim ‘332 Patent process. The Ryan/Holmes process therefore cannot be the basis for an obviousness finding as asserted by Petitioners in each of their six obviousness grounds. (EX2028 ¶184.)

VIII. SECONDARY CONSIDERATION EVIDENCE OF NON-OBVIOUSNESS

Even where the teachings of the prior art “point in the direction of” the claimed subject matter, objective evidence of nonobviousness may lead to a

conclusion that the challenged claims would not have been obvious. *In re Piasecki*, 745 F.2d 1468, 1474–75 (Fed. Cir. 1984). Objective evidence of nonobviousness “may often be the most probative and cogent evidence in the record” and “may often establish that an invention appearing to have been obvious in light of the prior art was not.” *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (citation omitted).

Patent Owner contends that nonobviousness is supported by evidence of long felt but unmet need, skepticism of experts, failure of others, unexpected results, industry praise, commercial success of Patent Owner’s process, and copying of the patented process by Petitioner Chevron.

Nexus

To be accorded substantial weight, the evidence of the secondary considerations must include a showing of nexus. *In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988).

There is a rebuttable presumption of nexus when the patentee shows that the asserted objective evidence is tied to a specific product and that product is the invention disclosed and claimed in the patent. *WBIP, LLC v. Kohler Co.*, 829 F.3d

1317, 1329 (Fed. Cir. 2016); *SightSound Techs., LLC v. Apple, Inc.*, 809 F.3d 1307, 1319 (Fed. Cir. 2015) (“If a product both embodies the claimed features and is coextensive with the claims at issue, a nexus is presumed.”); *see also Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 723 F.3d 1363, 1372 (Fed. Cir. 2013) (there is a “presumption of a nexus” when a product is “coextensive” with a patent claim).

The presumption of nexus can be rebutted by showing that commercial success or other alleged secondary evidence was due to extraneous factors, other than the patented invention, such as unclaimed features or improvements in marketing. *WBIP*, 829 F.3d at 1329. “However, a patent challenger cannot successfully rebut the presumption with argument alone—it must present evidence.” *Id.*

Patent Owner contends that it is entitled to the rebuttable presumption of nexus, by showing that the asserted objective evidence is tied to a specific process, which is Patent Owner’s CO2Flex[®] process that is the invention disclosed and claimed in the challenged claims of the ‘332 Patent.

A. Long Felt but Unmet Need

Petitioner Chevron itself recognized the long felt need to develop a more economical alternative to the Ryan/Holmes and Mechanical Refrigeration Unit technologies for processing carbon dioxide recycle streams in enhanced oil recovery (“EOR”) operations. In Chevron’s Pastor ‘666 Patent, filed in 1986, Chevron

described the need for development of a process that “treats CO₂ injection gas in an economical manner from both a capital investment and operating expense perspective.” (EX2016, 2:41-44.) Chevron further described the need “to create a process that produces both acceptable CO₂ injection gas and saleable liquid [NGL] products.”⁶ (*Id.* 2:39-41.)

Chevron described the disadvantages of the Ryan/Holmes process as having “several inherent disadvantages,” including being:

extremely expensive from both a capital and operating perspective since it is necessary to provide multiple distillation columns and massive refrigeration capacity to cool the entire inlet gas stream to -40° F. or colder. For example, in the example labeled “Table II” in U.S. Pat. No. 4,318,723, the feed temperature is reduced to -65° F. This also results in the need to use exotic materials of construction for the process equipment.

Further, the process produces sour, high vapor pressure liquid streams that must be subjected to additional processing before sale. Further, the ultimate value of the liquid products is offset by the need to purchase additional CO₂ as a result of the lost gas volume, i.e., there is significant shrinkage associated with the process.

(*Id.* 1:68 to 2:16.)

Chevron also described the “inherent disadvantages” of the Mechanical Refrigeration Unit process, which it referred to as “a ‘Straight Refrigeration’ process for separating hydrocarbons from CO₂.”

⁶ Pastor described the “readily marketable liquid product” produced in his ‘666 Patent process as an “NGL ... product.” (*Id.* Abstract; 2:68 to 3:1-3.)

Initially, as with the [Ryan/Holmes] processes described ... above ..., the inlet gas stream must be cooled to -40° F. or colder for recovery of C3+, requiring extremely high refrigeration capacity. Further, the liquid stream produced by this process would require further treatment before sale since it will have a high vapor pressure (approximately 40 psia RVP) as well as unacceptable CO2 and H2S concentrations. Finally, a large portion of the C4+ would go overhead and be unnecessarily wasted since no rectification section is provided on the column.

(*Id.* 2:17-34.)

But when Chevron addressed these problems, and the need for a solution, it failed to come up with the Prim ‘332 Patent process, which recovers an economical amount of C3 Propane. Chevron’s solution to these problems was to focus on Pastor’s asserted need to create an “acceptable CO2 injection gas,” to the detriment of the “saleable liquid [NGL] products.” The Pastor ‘666 Patent solution was to forego recovery of C3 propane for the NGL product, leaving “substantially all”⁷ of the C3 propane in the CO2 injection gas (*id.* 3:55-57), in order to address what the patent describes as “miscibility problems” (*id.* 1:41-42).⁸

The need for a solution focusing on the economic recovery of NGLs from the CO2 recycle stream, rather than being distracted by asserted “miscibility problems,” continued beyond Chevron’s 1986 patent, for two decades up to the point when Prim

⁷ See also *id.* 5:28-33 (“essentially all” of the C3 propane remains in the CO2 injection gas).

⁸ Prim provides his understanding of the “miscibility problems” in his Declaration, referring to the Pastor ‘666 Patent as “fixated” on the issue, while “the ‘332 Patent process didn’t think it was a concern.” (EX2029, ¶¶48-50.)

came up with his solution, resolving this long felt but unmet need. There were about twelve Ryan/Holmes processing plants built around twenty years before Prim came up with his ‘332 Patent CO2Flex[®] process, but none have been built since then,⁹ while Pilot has built so far six CO2Flex[®] plants in its first ten years of operations.

B. Failure of Others (including Petitioner Chevron)

Chevron touted the asserted advantages of its Pastor ‘666 Patent process by running computer simulations of the process on its Rangely, Colorado petroleum reservoir, comparing its advantages to the Ryan/Holmes process with its “several inherent disadvantages.” (EX2016, 1:68 to 2:16; 6:13-62.) Chevron has repeatedly asserted to Pilot that Chevron built a Pastor ‘666 NGL recovery plant at its Rangely CO2 facility. (EX2029 ¶¶47, 88.) Chevron’s July 2012 industry conference presentation on the history of the Rangely Unit shows 1987-91 as the time-frame for when it added the NGL recovery plant at the facility. (EX2050, Page 17 (“NGL construction”).)

By at least June of 1992, Chevron apparently had recognized its Pastor ‘666 process as a failure, letting the patent expire by not paying the first maintenance fee that was due June 29, 1992 at the four-year anniversary of the issuance of the patent.

⁹ Tomlinson, Enhancing Oil Recovery, Oilfield Technology, n.10 (December 2015) (“Ryan Holmes technology was used on about 12 gas processing plants in the US over 20 years ago, before depressed gas prices restricted installation of new facilities.”)

(EX2073.) At the July 2012 industry conference where Chevron presented the history of the Rangely Unit, including the addition of the Pastor ‘666 NGL Recovery Plant, Chevron’s Reservoir Engineer presenter expressed his disappointment with the NGL recoveries they were producing using the Pastor ‘666 process, wishing that they instead could get the recoveries of the Prim ‘332 Patent CO2Flex® process. (EX2029 ¶47 (stating to Eric Prim: “wow, I sure wish we could get your recoveries at our Rangely NGL plant.”).)

Chevron further conceded its Pastor ‘666 process as a failure when it added the NGL Recovery Plant to its Mabee CO2 Recycle Facility, choosing to copy the ‘332 Patent CO2Flex® process rather than building another Rangely Pastor ‘666 Plant at Mabee. See Section VIII(G) below, “Copying (by Petitioner Chevron).”

C. Skepticism of Experts

Prim describes in his Declaration the initial skepticism he faced when trying to find a CO2 recycle facility that would join with him to build a “proof of concept” gas processing plant. (EX2029 ¶¶28-34.) Prim describes the proposals to Exxon to build a “proof of concept” plant at its Means facility, the same place which had sparked his idea from the beginning. Prim presented various proposals to Exxon that spanned over the time period from late 2001 to July 2003, trying to convince Exxon to accept his proposals. Despite his best efforts, Exxon was skeptical of the proposed process and rejected his proposals.

Skepticism of the proposed process from potential partners to build a “proof of concept” plant continued from the initial efforts with Exxon Means in 2001-2003, then eventually turned to acceptance in 2006. Prim was fortunate to find another candidate for the technology at the Anadarko Monell field in Sweetwater County, Wyoming. Prim was able to reach a joint venture agreement with Anadarko Petroleum in 2006 to build a “proof of concept” natural gas liquids recovery plant at Anadarko’s Monell Unit. (EX2029 ¶¶35-37.)

The initial skepticism and rejection of Prim’s proposals turned to acceptance, and then eventually led to industry praise from those including one of Petitioner Chevron’s industry expert reservoir engineers.

D. Unexpected results

Prim describes in his Declaration the unexpected results he achieved in the development of his invention. (EX2029 ¶¶30-33.)

Evidence of “unexpected results” is found among the various proposals that Prim presented to Exxon trying to convince them to join with him to build a “proof of concept” plant. The July 21, 2003 proposal describes the history of the proposals, reflecting the continued improvements in Prim’s development of the process, including some “unexpected results” encountered along the way.

The July 21, 2003 proposal states as follows:

Over the past two years, the Means processing proposal has undergone many modifications. The original plant was intended to be a high recovery

60MMSCFD plant that was estimated to cost \$12MM to \$15MM. Next the plant size was reduced to 25 MMSCFD, also with high propane recovery. The 25MM option was estimated to cost around \$5MM. The current case is designed for 60MMSCFD with low (25%) propane recovery and is estimated to cost around \$7MM. The advantage of this case is that it will provide higher recovery at lower gas flows, but will still operate with gas flow rates as high as 50MM of 60MM.

EX2043 (emphasis added).

This passage is referring to the first two proposals (not found in Prim files), in which the original plant, and the modified plant design, both were intended to recover a high amount of propane. The plan then shifted with modifications (improvements) to “low (25%) propane recovery.” This improvement was referred to in two of the proposals (found in Prim’s files), on December 17, 2002 (EX2037) and March 27, 2003 (EX2040), which state as follows:

The optimized results from the means processing proposal have yielded results that are a little unexpected. Optimization of the system has demonstrated that the best economics are found with an inlet flow of 50 MMSCFD with relatively low propane recovery. Small increases in the propane recovery rate result in major increases in the capital cost.

(emphasis added).

This description of the development of the process shows that Prim was continuing to develop his ideas into what he had hoped would be a working process, and in that development he discovered “unexpected results.”

E. Industry Acclaim/Praise

Initial skepticism turned to acceptance, industry praise, and commercial success. Among the industry praise Prim received includes a compliment from Chevron's reservoir engineer who was presenting a history of Chevron's Rangely, Colorado CO2 recycle facility at the same "CO2 Conference" where Prim was presenting an introduction of the CO2Flex[®] process to the CO2 flood industry.

Prim describes in his Declaration the praise following his July 2012 presentation of the CO2Flex[®] process at the 6th Annual Wyoming CO2 Conference in Casper, Wyoming. (EX2029 ¶¶42-47.) Prim presented the EX2049 PowerPoint presentation. In these PowerPoint slides, Prim demonstrates the differences between the four most common NGL recovery schemes. These Recovery options included Ryan/Holmes, Membrane/Amine, the '332 Patent CO2Flex[®] process, and Refrigeration. (EX2049, 11-18.) This is the customary way that Pilot introduced its CO2Flex[®] process to the industry, specifically distinguishing the '332 Patent process from the Ryan/Holmes process, showing how CO2Flex[®] is different and better than the Ryan/Holmes process.

Chevron was also presenting a case history of their Rangely CO2 recycle plant. EX2050 is the PowerPoint presentation that Chevron reservoir engineer Rory Clark presented at the Conference, describing the history of Chevron's Rangely, Colorado facility.

After Prim had finished his presentation on NGL recovery, the Chevron presenter approached Prim to talk about the presentation. He made the statement: “wow, I sure wish we could get your recoveries at our Rangely NGL plant.” As Chevron has repeatedly told Pilot, the Rangely facility utilizes the Pastor ‘666 Patent process (EX2016.). According to the Pastor ‘666 Patent, this process recovers no propane, 20% of the i-C4, 55% of the n-C4 and essentially all of the C5+. In contrast, the ‘332 Patent process typically recovers around 25% of the propane, 70% of the i-C4, 90% of the n-C4, and essentially all of the C5+. (EX2029 ¶47.) Therefore, to Chevron’s point, the differences in recovery are substantial and impressive, thus deserving of the praise from Chevron’s Rangely reservoir engineer.

Considering that imitation often is said to be the sincerest form of flattery, one should also consider Chevron’s copying of the ‘332 Patent CO2Flex[®] process as itself a form of industry praise. See Section VIII(G) below, “Copying (by Petitioner Chevron).”

F. Commercial Success (by Patent Owner)

Since the successful building and operation of the Monell 20 “proof of concept” CO2Flex[®] plant, a total of five additional CO2Flex[®] plants have been built, which are:

- 2) Mentone “Mini Plant” – 2011 (EX2029 ¶41);
- 3) Goldsmith – 2012 (¶¶56-59);

- 4) Weyburn – 2013 (§§60-62);
- 5) Wellman – 2015 (§§63-64); and
- 6) Monell 120/160 – 2016/2021 (§§65-66).

Of these six total CO2Flex[®] plants, all but Mentone have generated substantial revenue and operating profits. And four are still in operation today (all but Monell 20 and Mentone), generating substantial revenue and operating profits that are expected to continue for around five more years for Wellman, ten for Goldsmith, and around twenty more years for Weyburn and Monell 160, based on the expected remaining life of the reservoirs. Prim describes in his Declaration the building and operation of each of these plants at the paragraphs cited above, citing to the financial records and projections for each plant, as set forth in the financials EX2072.

The first page of EX2072 summarizes the financial numbers for each plant, including the total revenues and operating profits through the end of 2023, the annual numbers for 2023, and the projected numbers through the expected remaining life of the reservoirs.

The CO2Flex[®] plants have produced a total combined revenue of over \$330 million, and over \$245 million in operating profits, through the end of 2023. For the four plants still in operation today, the total annual revenue for 2023 was approximately \$23 million, and around \$16 million in operating profits. Based on the expected remaining life of the reservoirs for these four plants continuing to

operate, projections estimate an additional combined revenue of \$427 million, and \$295 million in operating profits.

The past and projected future combines to a total revenue of around \$760 million, and \$540 million in operating profits.

G. Rebuttable Presumption of Nexus

Patent Owner is entitled to the rebuttable presumption of a nexus between the objective evidence of nonobviousness and the challenged claims of the ‘332 Patent because the evidence is tied to a specific process, Pilot’s CO2Flex[®] process, and that process is the invention disclosed and claimed in the challenged claims of the patent. The CO2Flex[®] process embodies the claimed features and is coextensive with the claims at issue.

Exhibits 2053 (Monell 20), 2057 (Goldsmith), 2061 (Weyburn), 2064 (Wellman), and 2069 (Monell 120) are charts demonstrating one-to-one correspondence between the Challenged ‘332 Patent Claims 1-4, 6-7 and each of these five CO2Flex[®] plants, which confirm that the CO2Flex[®] plants are “coextensive” (essentially the claimed invention). (EX2029 ¶69.)

EX2052 is a summary of those charts, demonstrating the near perfect correspondence between each of the elements of the patent claims and these five CO2Flex[®] plants, with a relatively small number of exceptions for a few of the claim elements and some of the CO2Flex[®] plants, which are:

- i) One of the five CO2Flex[®] plants (Weyburn) does not use solvents for dehydrating the CO2 recycle stream as recited in Claim 2 [2.2]. Weyburn uses a regenerative scrubber and molecular sieves for the dehydration step, which are not solvents.
- ii) One of the five CO2Flex[®] plants (Wellman) does not use an Inlet Heat Exchanger as recited in Claim 3. And Monell 120 did not use an Inlet Heat Exchanger until the plant was expanded to be able to process 160 MMSCFD in 2021 (expansion from Monell 120 to Monell 160), at which time an Inlet Heat Exchanger was installed.
- iii) One of the five CO2Flex[®] plants (Weyburn) operates with slightly more than 1 molar percent C2 ethane in the “Sweet NGL Rich Stream,” which is over the “no more than 1 molar percent ethane” limit recited in Claim 4.
- iv) Three of the five CO2Flex[®] plants (Weyburn, Wellman, and Monell 120/160) operate with more than 5 molar percent carbon dioxide in the “Sour NGL Rich Stream,” which is over the “no more than 5 molar percent carbon dioxide” limit recited in Claim 7.

These relatively small number of variances from a few of the elements of dependent claims for a few of the five CO2Flex[®] plants confirm that these plants are performing the steps of the claimed ‘332 Patent process, and the CO2Flex[®] plants process is essentially the claimed invention. (EX2029 ¶¶70-71.)

Even if Petitioners could somehow rebut the presumption of a nexus, Patent Owner can still prove nexus by showing that the evidence of secondary considerations is the “direct result of the unique characteristics of the claimed invention.” The unique characteristics of the claimed invention, providing a bridge for the gap between the two existing technologies, which were the Ryan/Holmes process and Mechanical Refrigeration Units (“MRUs”), is the alternative solution

that CO2 recycle facilities need, and what led them to implement the CO2Flex[®] process. (EX2029 ¶¶60-61; EX2028 ¶¶33-36, 261-71.)

H. Copying (by Petitioner Chevron)

Prim describes in his Declaration Pilot's proposals for Chevron to use the CO2Flex[®] process at Chevron's Mabee CO2 recycle facility, including Pilot's disclosure of the CO2Flex[®] process through "detailed process simulations that predicted the plant performance over a wide range of possible process conditions at Mabee," Pilot personnel visiting the Mabee field "to select the location of the future plant and the tie-in locations for the CO2 gas connections," and taking Chevron engineers on a visit to the Monell 20 CO2Flex[®] plant in Wyoming for Chevron to "understand" the CO2Flex[®] process. (EX2029 ¶¶72-75.)

Prim further describes how, after Chevron had gone "radio silent" and no longer responded to Pilot's enquiries, he heard from industry contacts in West Texas that Chevron was building an NGL recovery plant at Mabee without Pilot, and eventually discovered that Chevron had copied Pilot's CO2Flex[®] process. (EX2029 ¶¶75-78.)

1. Comparison of Pilot Monell 20 CO2Flex[®] Plant to Chevron Mabee NGL Recovery Plant (EX2076)

Prim describes in his Declaration the comparison of Pilot's Monell 20 CO2Flex[®] Plant to the NGL Recovery Plant that Chevron added to its Mabee CO2

Recycle Facility, confirming that Chevron copied Pilot's CO2Flex[®] process. (EX2029 ¶¶79-91.)

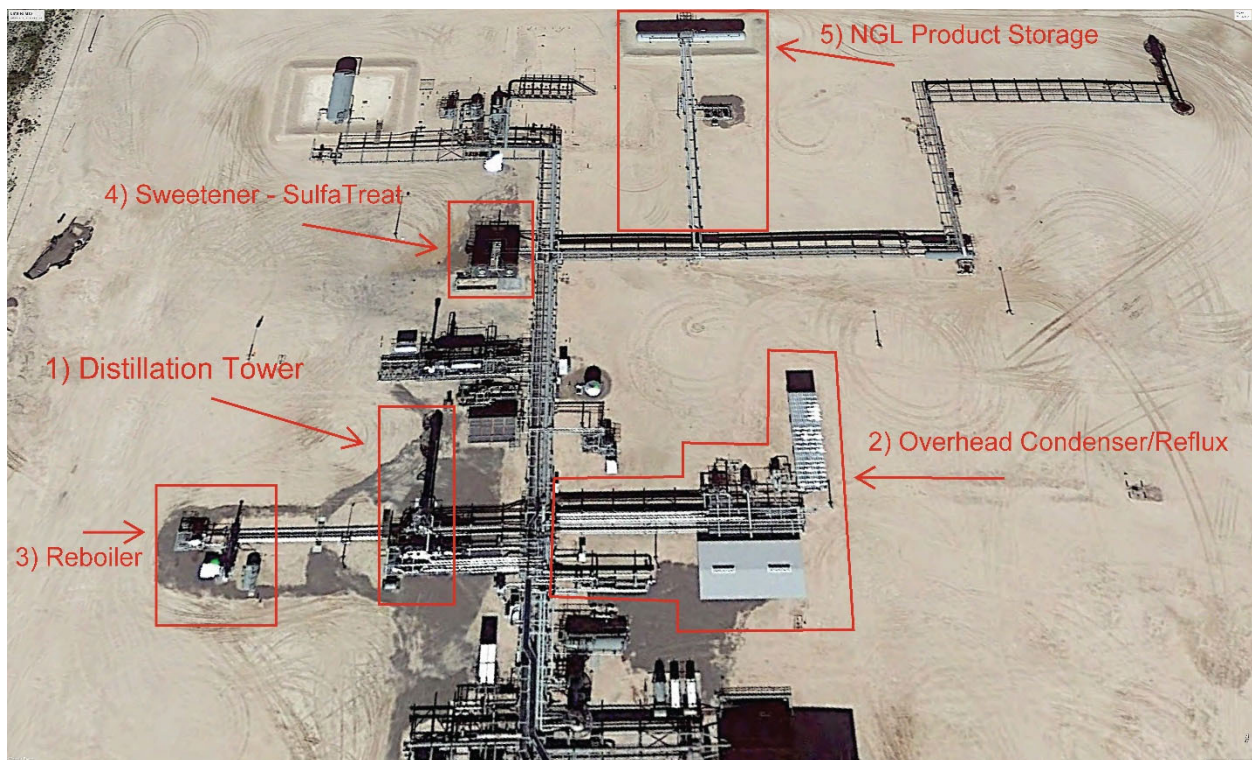
Chevron copied the CO2Flex[®] process that Pilot showed to Chevron personnel on their visit to the Monell 20 CO2Flex[®] Plant in Wyoming (EX2077 (trip planning e-mail)), and based on the drawings and detailed process simulations that Pilot provided to Chevron for implementation of the CO2Flex[®] process at the Mabee field.

EX2076 is a chart that compares Pilot's Monell 20 CO2Flex[®] Plant to the Chevron Mabee NGL Recovery Plant. As summarized in the chart, the Chevron Mabee NGL Recovery Plant includes each of the five main components for performing Pilot's CO2Flex[®] process, each of which are the same as those installed at Pilot's Monell 20 CO2Flex[®] Plant. Those five main components are the Distillation Tower [1], having an Overhead Condenser/Reflux [2] for the overhead stream exiting the top of the Distillation Tower, a Reboiler [3] for reboiling the NGL stream exiting the bottom of the Distillation Tower, a Sweetener [4] for removing the H2S acid gas from the NGL Product, and finally an NGL Product Storage/Sales [5] component (NGL Product storage tank and/or sales pipeline).

Exhibits 2074 and 2075 are Google Earth historical images that show the Chevron Mabee CO2 Recycle Facility both before (02/21/2013) and after (10/4/2014) Chevron added the NGL Recovery Plant to its Mabee CO2 Recycle

Facility. Pages 2 and 3 of EX2075 duplicate the zoomed-in versions of the images. One can compare (overlay) these historical images and see the copy of the CO2Flex[®] process equipment that Chevron installed.

Page 4 of EX2076 is an annotated version of the “after” image, highlighting each of the five main components of the CO2Flex[®] process that Chevron added to build their NGL Recovery Plant.



EX2075, Google Earth Image – Chevron Mabee CO2 Recycle Facility (10/4/2014) (after addition of NGL Recovery Plant) (Annotated to show equipment added for NGL Recovery Plant).

Chevron added to their Mabee CO2 Recycle Facility a Distillation Tower [1] having an Overhead Condenser/Reflux [2] for the overhead stream exiting the top of the Distillation Tower, a Reboiler [3] for reboiling the NGL stream exiting the bottom

of the Distillation Tower, a Sweetener [4] (SulfaTreat towers) for removing the H₂S acid gas from the NGL Product, and finally an NGL Product Storage/Sales [5] component (NGL Product storage tank).

In addition to the Google Earth historical images, one can see Chevron's addition of the five main components of the Pilot CO₂Flex[®] process by reviewing the Figures in the Hydrate Formation Paper (EX2012). Figure 3 in the Hydrate Formation Paper is a block flow diagram for Chevron's Mabee NGL Recovery Plant, which shows a block for each of the five main components of Pilot's CO₂Flex[®] process.

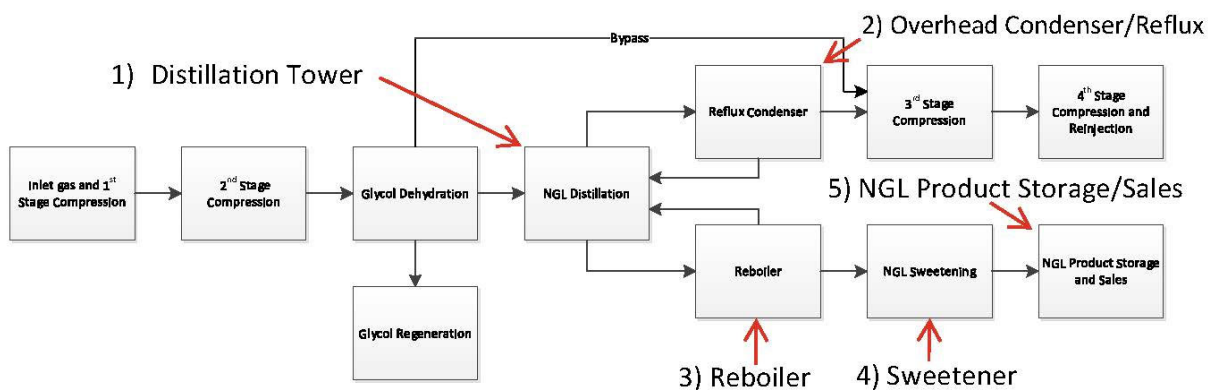


Figure 3: Mabee Gas Plant Block Flow Diagram

EX2012, Page 4, Hydrate Formation Paper, Figure 3 (Annotated to show equipment for adding NGL Recovery Plant to Chevron Mabee CO₂ Recycle Facility).

Figure 1 in the Hydrate Formation Paper is a process flow diagram for the Distillation Tower in Chevron's Mabee NGL Recovery Plant, which shows the Distillation Tower [1], Overhead Condenser/Reflux [2], and the Reboiler [3].

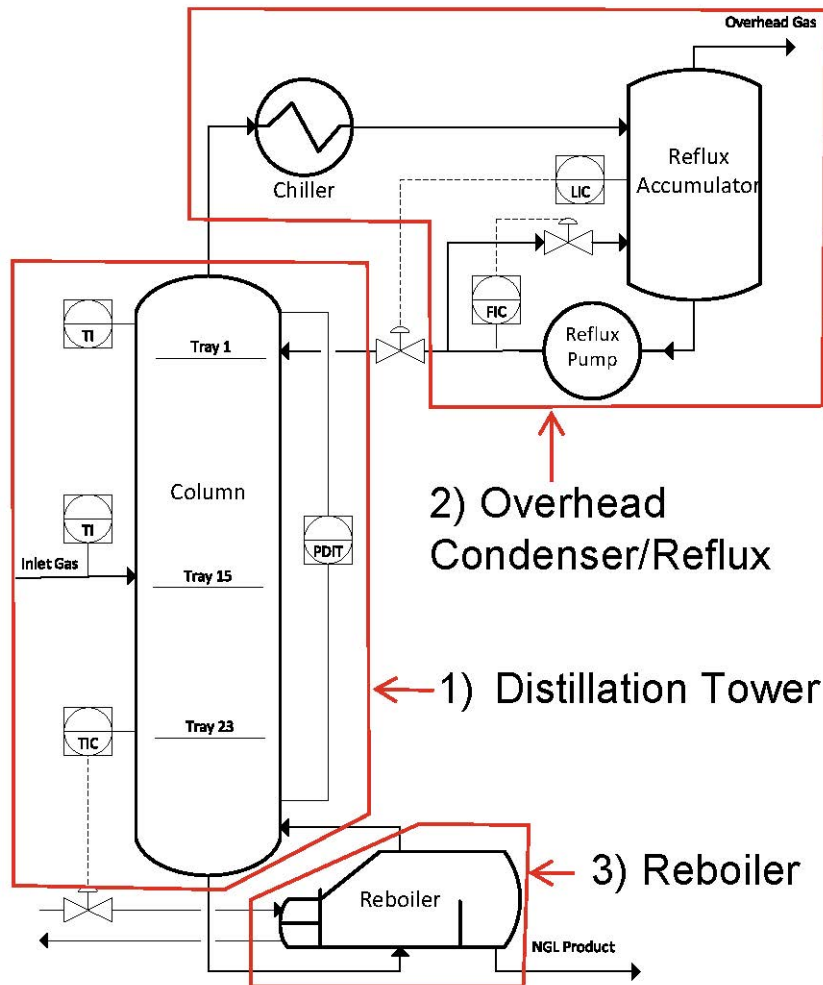
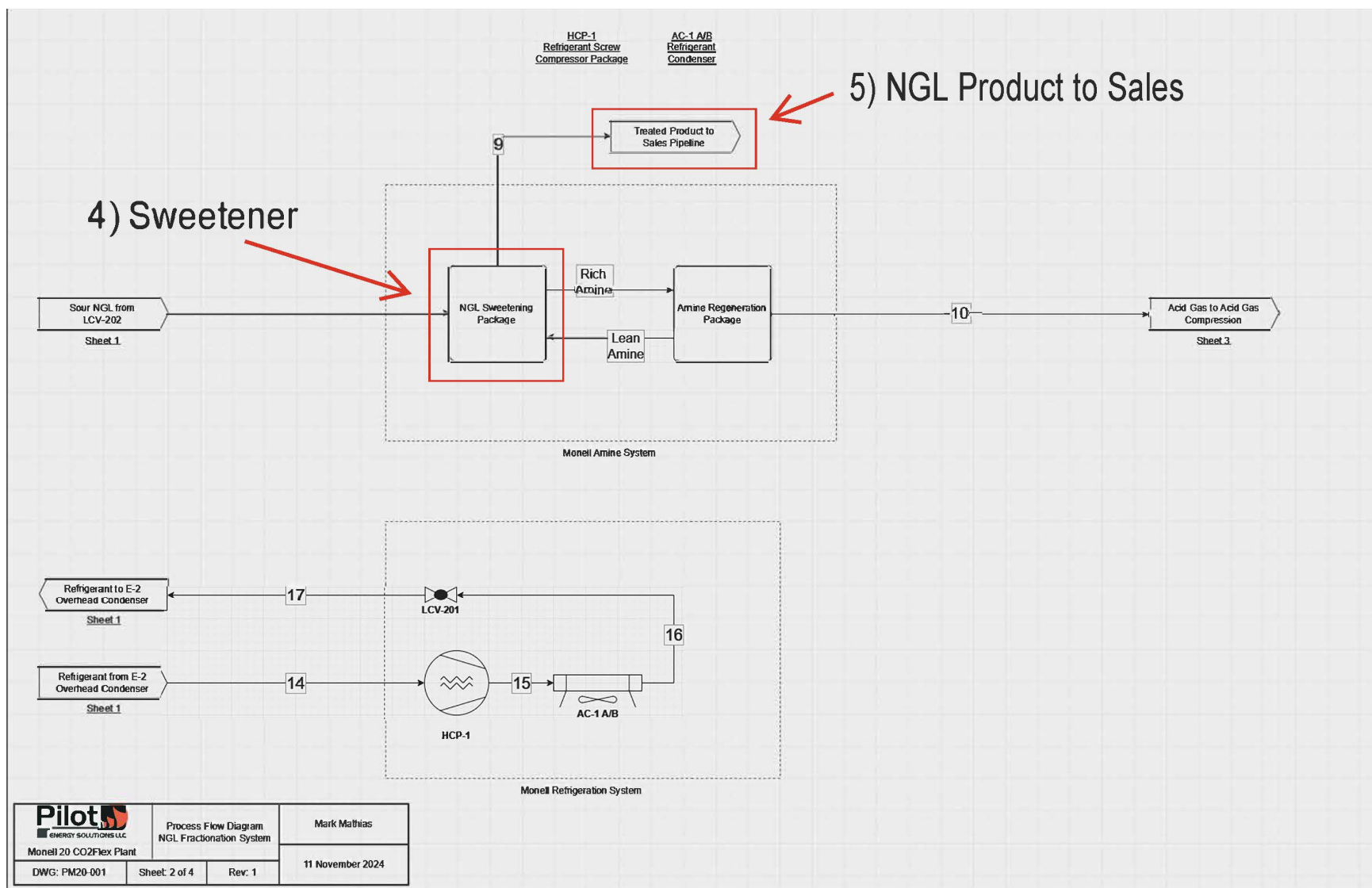


Figure 1: Process Flow Diagram of Distillation Column and Reflux

EX2012, Page 2, Hydrate Formation Paper, Figure 1 (Annotated to show equipment for adding NGL Recovery Plant to Chevron Mabee CO₂ Recycle Facility).

One can compare the Google Earth historical images and the Hydrate Formation Paper Figures 1 and 3 with the process flow diagram for Pilot's Monell 20 CO₂Flex[®] Plant to confirm Chevron's copying of Pilot's CO₂Flex[®] process.



EX2055, Page 2, Monell 20 CO2Flex[®] Plant, Process Flow Diagram, NGL Fractionation System (November 11, 2024) (Annotated to show CO2Flex[®] process equipment matching equipment added to Chevron Mabee CO2 Recycle Facility for adding NGL Recovery Plant).

This EX2055 process flow diagram for the Monell 20 CO2Flex[®] Plant matches the EX2054 Monell 20 Piping and Instrumentation Diagrams (P&IDs) (April 9, 2007 – Revised per PHA Review).

The EX2054 P&IDs, along with the above annotated version of the EX2055 process flow diagrams for the Monell 20 CO2Flex[®] Plant, shows the five main components of the CO2Flex[®] process, each of which correspond with those components that Chevron copied when adding the NGL Recovery Plant to their Mabee CO2 Recycling Facility.

Chevron has repeatedly asserted to Pilot that it did not copy Pilot's CO2Flex[®] process when adding the NGL Recovery Plant to their Mabee CO2 Recycling Facility, because Chevron supposedly built the same Pastor '666 Plant that Chevron had built at their Rangely, Colorado facility in the early 1990s. Chevron is expected to continue this position by asserting that the NGL Recovery Plant it built at Mabee is "architecturally identical" to the Rangely, Colorado plant. Chevron may demonstrate that the Rangely, Colorado plant built in the early 1990s has each of the five main components of the CO2Flex[®] process. But being "architecturally identical" and having each of the components when merely viewed from the outside does not conclude the inquiry. The next question to ask is how the components are configured to operate, mainly, how is the Distillation Tower configured to operate.

Recall that the Pastor ‘666 Patent process differs from Pilot’s CO2Flex[®] process in at least two critical ways. First, the Pastor ‘666 process foregoes the recovery of C3 Propane, leaving essentially all of the C3 Propane in the CO2 recycle stream, so it sends essentially all of the C3 Propane out the top of the Distillation Tower (overhead stream), for the purpose of addressing a “miscibility problem,” which is the focus of the Pastor ‘666 process. On the other hand, the ‘332 Patent CO2Flex[®] process recovers an optimum amount of C3 Propane, leaving some C3 Propane in the CO2 recycle stream, and recovering some C3 Propane in the NGL Product.

Second, the Pastor ‘666 process concentrates the H2S acid gas in the overhead stream, also for the purpose of addressing a “miscibility problem,” which is the focus of the Pastor ‘666 process. (EX2016, 3:12-15.) This means that there is essentially no H2S acid gas in the NGL product (Distillation Tower bottoms stream), so there is no need for processing equipment to remove H2S acid gas from the NGL product (i.e., no Sweetener needed).

With these two critical factors to keep in mind, the EX2012 Hydrate Formation Paper confirms that Chevron did not build a Pastor ‘666 plant at Mabee. Instead, Chevron copied Pilot’s CO2Flex[®] process.

First, the Hydrate Formation Paper discloses the material composition for the NGL Product at Chevron’s Mabee NGL Recovery Plant. A review of the Table 1

stream composition for Chevron's Mabee NGL Product shows a significant amount of C3 Propane in the NGL Product. This C3 Propane in the Chevron Mabee NGL Product means that Chevron configured the Distillation Tower to operate the CO2Flex® process, not the Pastor '666 process. Compare the C3 Propane percentages in the NGL Product for Chevron Mabee (EX2012, Table 1) and the CO2Flex® process (EX2056 Stream Composition) (both having significant amounts of C3 Propane in the NGL Product), with the Pastor '666 process (EX2016, Table I Stream Composition) (essentially no C3 Propane in the NGL Product).

Table 1: Model Validation of Plant Data

	Field	Model
Condenser Temp, F	5.7	5.7
Reboiler Temp, F	260	260
NGL Composition, mol %		
Propane	6.02	5.48
i-Butane	17.11	16.75
n-Butane	41.78	38.39
i-Pentane	14.57	14.20
n-Pentane	9.50	8.96
Hexane +	10.84	10.96

EX2012, Page 4, Hydrate Formation Paper, Table 1
Chevron Mabee NGL Recovery Plant
Stream Composition for NGL Product
(shows significant amount of C3 Propane in the NGL Product)

Composition, mol%	Treated Product
H2S	0.00%
Nitrogen	0.00%
CO2	0.00%
Methane	0.00%
Ethane	0.00%
Propane	29.68%
i-Butane	13.66%
n-Butane	31.66%
i-Pentane	7.28%
n-Pentane	6.24%
n-Hexane	5.20%
n-Octane	6.24%
H2O	0.04%

EX2056, HYSYS Chemical Process Simulation,
Monell 20 (May 3, 2007 [regenerated November 11,
2024])
Stream Composition for NGL Product (excerpted)
(shows significant amount of C3 Propane in the NGL Product)

	Stream Name		
	Feed	Overhead Product	Bottoms Product
Rate	110 MMSCF	107 MMSCF	2620 BPD
H ₂ S (ppmv)	500	514	—
	Mole Percent		
N ₂	3.4	3.5	—
CO ₂	83.9	86.3	—
C ₁	6.6	6.9	—
C ₂	1.4	1.4	—
C ₃	1.1	1.1	0.02
iC ₄	0.5	0.4	3.1
nC ₄	0.7	0.3	16.7
iC ₅	0.4	0.001	16.0
nC ₅	0.6	—	23.3
C ₆	0.6	—	24.4
C ₇₊	0.4	—	16.4

EX2016, Page 6, Pastor '666 Patent at 5:12-27, Table I, Stream Composition for NGL Product (“Bottoms Product”) (showing essentially no C3 Propane in the NGL Product, and essentially all of the C3 Propane from the Feed stream remaining in the CO2 recycle stream (“Overhead Product”).

Second, the Hydrate Formation Paper further confirms Chevron’s copying of the CO2Flex® process by showing the existence of a Sweetener [4] to remove H2S acid gas from the NGL stream. (EX2012, Page 4, Figure 3.) The EX2023 Air Permit Application shows that Chevron uses SulfaTreat towers for this sweetening process. If Chevron had built a Pastor ‘666 plant at Mabee, there would be no need for a Sweetener to remove H2S acid gas from the NGL Product. (EX2016, 3:13-15 (explaining the benefit of the Pastor ‘666 process concentrating the H2S in the overhead, as opposed to allowing H2S in the bottoms stream with the NGL Product, which would mean that “H2S would have to be removed from a liquid product requiring expensive processing equipment.”).)

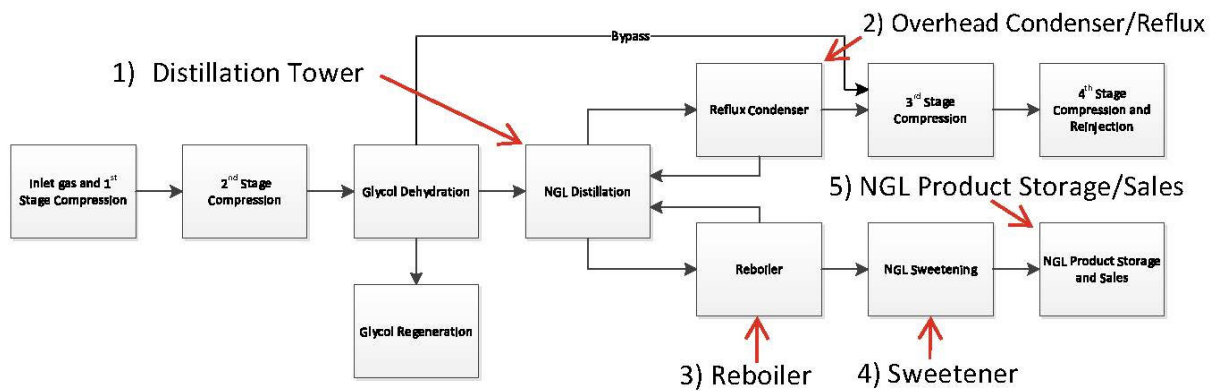


Figure 3: Mabee Gas Plant Block Flow Diagram

EX2012, Page 4, Hydrate Formation Paper, Figure 3 (Annotated to show equipment for adding NGL Recovery Plant to Chevron Mabee CO2 Recycle Facility, including Sweetener [4], which would not be needed if this was a Pastor ‘666 Rangely Plant).

IX. THE BOARD SHOULD NOT CANCEL THE CHALLENGED CLAIMS OF THE '332 PATENT

Prior to going through each of the Petitioners' obviousness Grounds in detail below, it is important to note the portions of the Institution Decision in which the Board accepted the erroneous description provided by Rockstraw in his Declaration (EX1002) that Natural Gas Liquids includes only C3-C8 hydrocarbons. (EX2028 ¶189.)

When asked during deposition whether "a POSITA reading Aycaguer would have understood, and at the very least found it obvious that the hydrocarbon feed stream of Aycaguer includes C2 through C8," Rockstraw testified that "Yes, a POSITA would recognize that the hydrocarbon feed stream of Aycaguer includes C2 through C8." (EX2024, 57:16-21.) Rockstraw further testified that "Aycaguer does not refer to ethane [C2] as a specific component, but he groups it in with natural gas liquids." (EX2024, 48:22-24.) (EX2028 ¶190.)

As shown in detail in Section VI(G) above, all of the references to the NGL streams of the various Exhibits describing the Ryan/Holmes processes all refer to NGL(C2-C3) and NGL(C4+) During the deposition of Rockstraw (77:16-17), he testified that "the ethane appears in a separate NGL stream that the author refers to as a light NGL stream." This is consistent with the "NGL (C2-C3)" shown in figures 2 and 3 of EX1007. (EX2028 ¶191.)

The Institution Decision accepts the composition as C3-C8 on pages 22, 23, 27 (twice), 28, 30 (twice), 31, 32 (twice) 36 (twice), 38, and 40. The clarification of the composition should have a material impact on the conclusion arrived at in the Final Written Decision of the Board. (EX2028 ¶192.)

A. Ground 1: Claim 1 is Not Obvious Over Aycaguer

1. No Motivation to Modify or Combine Aycaguer with Other Teachings

Aycaguer, as presented by Petitioners, describes a three-column Ryan/Holmes process. As described above in Section VII, the Ryan/Holmes process “teaches away” from the Prim ‘332 Patent process. The purpose of the Ryan/Holmes process is to separate methane and ethane from carbon dioxide recycle streams, using additives and extensive processing equipment, to produce methane and ethane for sales. The Prim ‘332 Patent process goes in the opposite direction by “disregarding the recovery” of methane and ethane from the carbon dioxide recycle stream, to recover NGLs “with relatively little process equipment or energy,”¹⁰ by NOT using additives or extensive processing equipment to separate methane and ethane from carbon dioxide recycle streams.

The Ryan/Holmes process and the Prim ‘332 Patent process go in opposite directions for recovering salable components of carbon dioxide recycle streams. The

¹⁰ (EX1001, 4:55-60.)

Ryan/Holmes process thereby “teaches away” from the Prim ‘332 Patent process. A POSITA would not be motivated to modify or combine the Ryan/Holmes process with other teachings to develop the Prim ‘332 Patent process. The Ryan/Holmes process therefore cannot be the basis for an obviousness finding as asserted by Petitioners.

Petitioners make no attempt to meet their burden to show a motivation to modify or combine Aycaguer with other teachings to develop the Prim ‘332 Patent process. While Petitioners at least attempt to present a case for motivation to combine for Grounds 2-6, Petitioners completely neglect to address this required showing for Ground 1.

When discussing obviousness over a single reference (here, Aycaguer), a motivation to modify is legally necessary. *SIBIA Neurosciences, Inc. v. Cadus Pharmaceutical Corp.*, 225 F.3d 1349, 1356 (Fed. Cir. 2000) (“In appropriate circumstances, a single prior art reference can render a claim obvious. However, there must be a showing of a suggestion or motivation to modify the teachings of that reference to the claimed invention in order to support the obviousness conclusion.”). Petitioners fail to attempt, let alone make, this showing. Petitioners’ Ground 1 therefore should be rejected for failure to meet their burden to show a motivation to modify or combine Aycaguer with other teachings to develop the Prim

‘332 Patent process, and because the Aycaguer Ryan/Holmes process “teaches away” from the Prim ‘332 Patent process.

2. Claim 1

a. “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.” [1.6]

Aycaguer, as presented by Petitioners to describe a three-column Ryan/Holmes process, 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. (*See, e.g., supra*, §§V(A, B), VI(B).) Therefore, even if there could somehow be found a motivation to modify Aycaguer or combine it with other teachings, Aycaguer does not render Claim 1 unpatentable as obvious.

B. Ground 2: Claim 1 is Not Obvious Over Aycaguer and Arand

1. No Motivation to Combine Aycaguer and Arand

Petitioners’ Ground 2 suffers from the same defects as Ground 1, including no motivation to modify or combine, because the Petitioners’ asserted Ryan/Holmes process “teaches away” from the Prim ‘332 Patent process. The addition of Arand in a combination with Aycaguer provides nothing to overcome these defects.

Petitioners' Ground 2 combination of Aycaguer and Arand is still nothing more than a Ryan/Holmes process asserted to render obvious the Prim '332 Patent process.

Petitioners in their Ground 2 at least make an attempt to meet their burden to show a motivation to combine, but still fail. Petitioners assert a general motivation to combine Aycaguer and Arand, presenting Aycaguer once again as a three-column Ryan/Holmes process.

Petitioners assert that a POSITA would be motivated to combine Aycaguer and Arand because "because both references relate to methods of natural gas liquid separation." (Petition, 36.) A general motivation to combine two references because they are in the same field is not sufficient. Petitioners must show a motivation to combine to make the Prim '332 Patent process. *See, e.g., William Wesley Carnes, Sr., Inc. v. Seaboard Int'l Inc.*, IPR2019-00133, Paper 10 (PTAB May 8, 2019) at 18 ("[S]tatement of similarity [that 'both references are in the oil and gas exploration and drilling fields'], however, does not constitute an articulated reasoning with rational underpinning as to why a POSITA would combine elements of one reference with another, and why a POSITA would modify the teachings of the references to arrive at the claimed invention.").

Just like Aycaguer's three-column Ryan/Holmes focus on the recovery of methane and ethane teaches away from the Prim '332 Patent process, which disregards the recovery of methane and ethane, Arand's focus of recovery of

methane and ethane teaches away from Prim. Arand describes its invention as “a method for processing a produced fluid stream ... from a ... reservoir to produce a residue [sales] gas stream comprising predominantly methane, [and] also has the flexibility and capability of including ethane ... in the residue [sales] gas stream if desired.” (EX1004, 4:1-9; *see also id.*, 12:27-31 (producing a stream “comprising predominantly methane or methane and ethane”).)

Ground 2 therefore should be rejected for failure to meet their burden to show a motivation to combine Aycaguer and Arand to arrive at the Prim ‘332 Patent process, and because Aycaguer and Arand both “teach away” from the Prim ‘332 Patent process.

2. Claim 1

a. Claim element [1.6].

As explained above for Ground 1, Aycaguer does not teach limitation [1.6].

The addition of Arand does nothing to overcome Aycaguer’s failure to teach limitation [1.6].

Therefore, even if there could somehow be found a motivation to combine Aycaguer and Arand, the combination does not render Claim 1 unpatentable as obvious.

C. Ground 3: Claims 1-4 and 6-7 are Not Obvious Over Aycaguer and Soldati

1. No Motivation to Combine Aycaguer and Soldati

Petitioners' Ground 3 suffers from the same defects as Grounds 1 and 2, including no motivation to modify or combine, because the Petitioners' asserted Ryan/Holmes process "teaches away" from the Prim '332 Patent process. The addition of Soldati, a four-column Ryan/Holmes process, in a combination with Aycaguer's three-column Ryan/Holmes process, provides nothing to overcome these defects. Petitioners' Ground 3 combination of Aycaguer and Soldati is still nothing more than Ryan/Holmes processes asserted to render obvious the Prim '332 Patent process.

Petitioners once again merely assert that a POSITA would be motivated to combine Aycaguer and Soldati because "because both references relate to methods of processing natural gas liquid streams." (Petition, 42.) As stated noted, a general motivation to combine two references because they are in the same field is not sufficient (citing *Carnes* at 18).

Petitioners further assert that a POSITA would be motivated to combine Aycaguer and Soldati because they both describe the use of "a Ryan/Holmes process to process a natural gas stream into natural gas liquids and carbon dioxide." (Petition, 44.) But once again, a general motivation to combine two references because they are in the same field is not sufficient. Petitioners must show a motivation to combine

to make the Prim ‘332 Patent process. While Aycaguer and Soldati both describe the use of a Ryan/Holmes process, and therefore could be combined to develop improvements of the Ryan/Holmes process, neither provide any motivation to use a Ryan/Holmes process to arrive at the Prim ‘332 Patent process. Instead, they both teach away from the Prim ‘332 Patent process.

Ground 3 therefore should be rejected for Petitioners’ failure to meet their burden to show a motivation to combine Aycaguer and Soldati to arrive at the Prim ‘332 Patent process, and because both Aycaguer and Soldati “teach away” from the Prim ‘332 Patent process.

2. Claim 1

a. Claim element [1.6]

As explained above regarding Ground 1, Aycaguer does not teach limitation [1.6]. Soldati, as a four-column Ryan Holmes process, adds nothing to overcome Aycaguer’s failure to teach limitation [1.6].

b. “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.” [1.6]

As explained above regarding Ground 1, Aycaguer. as presented by Petitioners to describe a three-column Ryan/Holmes process, 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.

Soldati suffers from the same defects. As a four-column Ryan/Holmes process, Soldati also subjects the carbon dioxide recycle stream to the same carbon dioxide recovery solvents as Aycaguer, in the process steps in which limitation [1.6] specifically excludes carbon dioxide recovery solvents.

Therefore, even if there could somehow be found a motivation to combine Aycaguer and Soldati, the combination does not render Claim 1 unpatentable as obvious.

3. Claims 2 and 3

Claims 2 and 3 each depend from Claim 1. For the same reasons set forth above that a combination of Aycaguer and Soldati does not render Claim 1 unpatentable as obvious, this combination does render dependent Claims 2 and 3 unpatentable as obvious.

4. Claim 4:

a. “The method of claim 3, 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 depends from Claim 3, which depends from Claim 1. For the same reasons set forth above that a combination of Aycaguer and Soldati does not render

Claim 1 unpatentable as obvious, this combination does not render dependent Claim 4 unpatentable as obvious.

In addition, Claim 4 specifically requires that “the sweet NGL rich stream comprises ... no more than 1 molar percent ethane.”

Considering that both Aycaguer and Soldati are Ryan/Holmes processes that focus on the recovery of ethane, it should be no surprise that the sweet NGL rich streams in both Aycaguer and Soldati comprise more than 1 molar percent ethane. (*See, e.g., supra*, §§VI(B, C).) Therefore, even if there could somehow be found a motivation to combine Aycaguer and Soldati, the combination does not render Claim 4 unpatentable as obvious.

5. Claim 6

Claim 6 depends from Claim 1. For the same reasons set forth above that a combination of Aycaguer and Soldati does not render Claim 1 unpatentable as obvious, this combination cannot render dependent Claim 6 unpatentable as obvious.

6. Claim 7:

a. “The method of claim 6, 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 depends from Claim 6, which depends from Claim 1. For the same reasons set forth above that a combination of Aycaguer and Soldati does not render

Claim 1 unpatentable as obvious, this combination does not render dependent Claim 7 unpatentable as obvious.

In addition, Claim 7 specifically requires that “the sour NGL rich stream comprises ... no more than 5 molar percent ethane.”

Considering that both Aycaguer and Soldati are Ryan/Holmes processes that focus on the recovery of ethane, it should be no surprise that the sour NGL rich streams in both Aycaguer and Soldati comprise more than 5 molar percent ethane. (*See, e.g., supra*, §§VI(B, C).) Therefore, even if there could somehow be found a motivation to combine Aycaguer and Soldati, the combination does not render Claim 7 unpatentable as obvious.

D. Ground 4: Claim 2 is Not Obvious Over Aycaguer, Soldati, and Ryan

1. No Motivation to Combine Aycaguer, Soldati, and Ryan

Petitioners’ Ground 4 suffers from the same defects as Grounds 1, 2, and 3, including no motivation to modify or combine, because the Petitioners’ asserted Ryan/Holmes process “teaches away” from the Prim ‘332 Patent process. The addition of Ryan with Aycaguer, both presented by Petitioners as a three-column Ryan/Holmes process, in a combination with Soldati’s four-column Ryan/Holmes process, provides nothing to overcome these defects. Petitioners’ Ground 4 combination of Aycaguer, Soldati, and Ryan is still nothing more than Ryan/Holmes processes asserted to render obvious the Prim ‘332 Patent process.

Ground 4 therefore should be rejected for Petitioners' failure to meet their burden to show a motivation to combine Aycaguer, Soldati, and Ryan to arrive at the Prim '332 Patent process, because each of these references "teach away" from the Prim '332 Patent process.

2. Claim 2

Claim 2 depends from Claim 1. The addition of Ryan, as an additional cumulative disclosure of the three-column Ryan/Holmes process, adds nothing to overcome the failure of the combination of Aycaguer and Soldati to teach limitation [1.6]. Ryan, as an additional cumulative disclosure of the three-column Ryan/Holmes process, subjects the carbon dioxide recycle stream to the same 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.

For these same reasons that a combination of Aycaguer, Soldati, and Ryan does not render Claim 1 unpatentable as obvious, this combination does not render dependent Claim 2 unpatentable as obvious.

Therefore, even if there somehow could be found a motivation to combine Aycaguer, Soldati, and Ryan, this combination does not render dependent Claim 2 unpatentable as obvious.

E. Grounds 5 and 6: Claims 1-4 and 6-7 Are Not Obvious Over Aycaguer, Soldati, and Arand (Ground 5) and Claim 2 Is Not Obvious Over Aycaguer, Soldati, Ryan, and Arand (Ground 6)

1. No Motivation to Combine the References

Petitioners' Ground 5 suffers from the same defects as Grounds 1-4, including no motivation to modify or combine, because the Petitioners' asserted Ryan/Holmes process "teaches away" from the Prim '332 Patent process. The addition of Arand to the previously presented Grounds, which as described above also teaches away from Prim, provides nothing to overcome these defects. Petitioners' Grounds 5 and 6 combinations are still nothing more than Ryan/Holmes processes asserted to render obvious the Prim '332 Patent process.

Ground 4 therefore should be rejected for Petitioners' failure to meet their burden to show a motivation to combine these references to arrive at the Prim '332 Patent process, because each of these references "teach away" from the Prim '332 Patent process.

2. Grounds 5 and 6 are Duplicative of Grounds 3 and 4, Merely Adding Arand

The addition of Arand to the combinations asserted in Grounds 3 and 4 does nothing to overcome the defects of Grounds 3 and 4. Therefore, for the same reasons set forth above for Grounds 3 and 4, even if there somehow could be found a motivation to combine these references, the combinations asserted in Grounds 5 and 6 do not render unpatentable as obvious Claims 1-4 and 6-7.

X. CONCLUSION

For the reasons and authorities set forth above, Patent Owner respectfully requests that the Board confirm the patentability of all challenged claims because Petitioners failed to meet their burden of proving that any of the challenged Claims 1-4 and 6-7 of the Prim '332 Patent claims are unpatentable by a preponderance of the evidence.

Petitioners failed to meet their burden to show motivation to combine the asserted references to arrive at the challenged claims for the Prim '332 Patent process, because all of the references “teach away” from Prim.

Furthermore, even if Petitioners somehow showed that the teachings of the prior art “point in the direction of” the claimed subject matter, the objective evidence of nonobviousness presented in this Response, especially the incredible commercial success that the claimed invention has achieved, should compel the conclusion that the challenged claims would not have been obvious.

Respectfully submitted this 22nd day of November, 2024.

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CERTIFICATE OF WORD COUNT COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), I hereby certify that this Response to Petition complies with the type-volume limitation of 37 C.F.R. § 42.24(b)(1) because it contains 13,976 words (fewer than the limit of 14,000 words), as determined by the word-processing program used to prepare the paper, excluding the parts of the paper exempted by 37 C.F.R. § 42.24(a)(1) (table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count compliance, appendix of exhibits, and claim listing).

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e), I hereby certify that on November 22, 2024 the foregoing *Patent Owner Pilot Intellectual Property, LLC'S Response* is being served electronically by agreement of the parties, by e-mail to the following counsel of record.

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