

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PROFRAC HOLDING CORPORATION
and
U.S. WELL SERVICES, LLC,
Petitioners

v.

HALLIBURTON ENERGY SERVICES, INC.,
Patent Owner

Case No. IPR2023-01319
U.S. Patent 7,841,394

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P.O. Box 1450
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Submitted Electronically

**PATENT OWNER'S RESPONSE
UNDER 37 C.F.R. § 42.120**

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1001	U.S. Patent No. 7,841,394
1002	File History of U.S. Patent No. 7,841,394
1003	Declaration of Dr. Michael Nikolaou
1004	Curriculum Vitae of Dr. Michael Nikolaou
1005	WIPO Publication No. 2005/111369 A1 to Crossley ("Crossley")
1006	U.S. Patent No. 7,451,820 to Albers et al. ("Albers")
1007	U.S. Patent No. 4,397,353 to Lacy ("Lacy")
1008	WIPO Publication No. WO2007/024383A2 to Tolman ("Tolman")
1009	U.S. Patent App. Pub. No. 2004/0050550 A1 to Lehman et al. ("Lehman")
1010	S. Dalvi, Fundamentals of Oil & Gas Industry for Beginners (Notion Press 2015) (excerpts)
1011	U.S. Patent App. Pub. No. 2013/0306322 to Sanborn et al.
1012	U.S. Patent No. 9,410,410 to Broussard et al.
1013	U.S. Patent App. Pub. No. 2012/0255734 to Coli et al.
1014	U.S. Patent No. 3,560,053 to Ortloff
1015	U.S. Patent No. 3,664,422 to Bullen
1016	Claim Construction Order
1017	WD Texas Statistics

Patent Owner's Exhibits	
No.	Exhibit Description
2001	U.S. Patent No. 4,077,428 to Weaver (“Weaver”)
2002	Joint Claim Construction Brief
2003	U.S. Patent No. 3,933,205 to Kiel (“Kiel”)
2004	Declaration of Robert A. Durham
2005	Deposition Transcript of Dr. Michael Nikolaou, dated June 6, 2024
2006	Bourgoyne, Adam T., Jr., Keith K. Millheim, Martin E. Chenevert, and F.S. Young, Jr., <i>Applied Drilling Engineering</i> , Society of Petroleum Engineers (1986).
2007	Staff of Royal Dutch / Shell Group of Companies, <i>The Petroleum Handbook</i> , (1983).
2008	Rahman, S. S. and G. V. Chilingarian, <i>Casing design-theory and practice</i> (1995).
2009	Manrique, E.J., J.L. Mogollon, J.A. Linares, and M. Farrera, <i>Basic Nitrogen Compounds in Crude Oils: Effect on Mineral Dissolution during Acid Stimulation Processes</i> , International Symposium on Oilfield Chemistry (1997).
2010	Michael Morton, <i>Unlocking the Earth: A Short History of Hydraulic Fracturing</i> , GEO ExPro, Vol. 10, No. 6, December 2013 (available at https://geoexpro.com/unlocking-the-earth-a-short-history-of-hydraulic-fracturing/) (last accessed July 17, 2023).
2011	Carl T. Montgomery and Michael B. Smith, <i>Hydraulic Fracturing: History of an Enduring Technology</i> , Journal of Petroleum Technology vol. 62 issue 12 (Dec. 2010).
2012	Grieser, B., et al., <i>The Rocket Science Behind Water Frac Design</i> , SPE Production and Operations Symposium, Oklahoma City, OK (March 2003).

2013	Van Domelen, M. S., et al., <i>State-of-the-Art Fracturing in the North Sea</i> , Offshore Technology Conference (1995).
2014	Stephenson, SV, EL Woodall, CD Donaghe, and RE Dant. <i>Fracturing Process Control and Automation: Phase 2</i> , (1993).
2015	L.P. Moore, L.P. and H. Ramakrishnan,, <i>Restimulation: Candidate Selection Methodologies and Treatment Optimization</i> , SPE Annual Technical Conference (2006).
2016	IEEE RP 1017, “IEEE Recommended Practice for Field Testing Electric Submersible Pump Cable” (2004).
2017	Swanson, T. A., et al, <i>The Successful Use of Both Kinetic Hydrate and Paraffin Inhibitors Together in a Deepwater Pipeline with a High Water Cut in the Gulf of Mexico</i> , SPE International Symposium on Oilfield Chemistry (2005).
2018	Chen, Huey J., Gene Kouba, and Seong Lee, <i>Optimizing Corrosion Inhibitor Injection Rate in Flow Lines</i> , CORROSION (2003).
2019	Pizzarelli, S. G., O. E. Gonzalez, P. Justiniano, S. A. Olivares, and J. J. Potma, <i>Results of Thermal Horizontal Completions with Sand Control in Lake Maracaibo, Venezuela: Case Histories of Horizontal Gravel Packs in Bachaquero-01 Reservoir</i> , SPE International Thermal Operations and Heavy Oil Symposium and International Horizontal Well Technology Conference (2002).
2020	Chike, Uchendu, Obadare Awoleke, and Nwoke Linus, <i>Solvent / Acid Blend Provides Economic Single Step Matrix Acidizing Success for Fines and Organic Damage Removal in Sandstone Reservoirs: A Niger - Delta Case Study</i> , SPE Annual Technical Conference and Exhibition (2004).
2021	Conaway, Charles F, <i>The Petroleum Industry: A Nontechnical Guide</i> . Pennwell Books (1999).
2022	Braek, A. M., R. A. Almehaideb, and R. Hughes, <i>Application of Eos to Optimize the Design of an Early Production Scheme of an Onshore Oil Field in Abu Dhabi</i> , Abu Dhabi International Petroleum Exhibition and Conference (1998).

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I. INTRODUCTION

Halliburton Energy Services, Inc. (“Patent Owner”) respectfully submits this Response in accordance with 37 C.F.R. § 42.120, responding to the Petition for *Inter Partes* Review (the “Petition”) filed by ProFrac Holding Corporation and U.S. Well Services, LLC (“Petitioner”) challenging Claims 1-27 (the “challenged claims”) of U.S. Patent No. 7,841,394 (the “’394 Patent”) and the Board’s Decision Granting Institution of *Inter Partes* Review (“ID”).

Petitioner fails to establish a motivation to combine Crossley’s oil and gas production system with Albers’s well stimulation equipment with a reasonable expectation of success due to significant differences between the two oil and gas operations that Petitioner completely ignores. Furthermore, Crossley teaches away from the Petition’s proposed use of Crossley’s simultaneous well-site operations control system to pump the stimulation fluid of Albers because Crossley already has an individual well intervention system that pumps a stimulation fluid.

Petitioner also fails to show that Crossley, Albers, or their combination, teaches (i) “simultaneously flowing: a first stimulation fluid to the first [well / pad / plurality of wells] and not to the second [well / pad / plurality of wells]; and a second stimulation fluid to the second [well / pad / plurality of wells] and not to the first [well / pad / plurality of wells]” or (ii) simultaneously flowing a first stimulation fluid and a second stimulation fluid “wherein the first stimulation fluid

and the second stimulation fluid have different compositions” as required by the challenged claim.

For the reasons set forth more fully below, the Petition should be denied.

II. LEVEL OF ORDINARY SKILL IN THE ART

Patent Owner largely applies Petitioner’s definition of a person of ordinary skill in the art (“POSITA”) with the exclusion of a Bachelor of Science in materials science or metallurgical engineering as relevant degrees. Pet. at 3-4; Ex. 2004 at ¶ 42.

III. CLAIM CONSTRUCTION

The Petition states that it applies the construction of “means for simultaneously flowing” as agreed by the parties and entered by the district court in the parallel litigation. Pet. at 5-6; Ex. 2002 at 3. For purposes of this Response, Patent Owner applies this same construction of “means for simultaneously flowing” and otherwise interprets the claims “in accordance with the ordinary and customary meaning” as understood by a POSITA. 37 C.F.R. § 42.100(b); Ex. 2004 at ¶¶ 43-44.

IV. OVERVIEW OF THE ’394 PATENT

A. Patent Specification and Claims

The background of the ’394 Patent explains that “[t]he servicing and stimulation of wells can require a series of coordinated operations that begin with the supply by truck of equipment, supplies, fuel, and chemicals to the wellhead.”

Id. at 1:24-27. “The equipment is then set up and made ready with proppant and chemicals.” *Id.* at 1:27-28. “After completion of the well services, equipment must be broken down and made ready for transport to the next pad for service.” *Id.* at 1:28-30. The ’394 Patent explains that “[t]his movement of equipment and supplies has environmental impacts, and the exposure of mobile equipment to adverse weather conditions can jeopardize well treatment operations and worker safety.” *Id.* at 1:35-38. To address these concerns, the ’394 Patent relates to “methods and apparatuses for simultaneously treating multiple wells from a centralized location and simultaneously connecting multiple wells to a single manifold, so as to conserve labor, infrastructure, and environmental impact.” *Id.* at 1:7-11.

The ’394 Patent discloses systems for centralized well operations that include a well treatment operations factory which manufactures and pumps a well stimulation fluid, a first connection between a first location (*e.g.*, a well, pad, or plurality of pads) and the factory, and a second connection between a second location (*e.g.*, a well, pad, or plurality of pads) and the factory. *Id.* at 1:61-66, Cl. 1-27. The systems for centralized well operations also include a means for simultaneously flowing a first stimulation fluid to the first location and a second stimulation fluid to the second location. *Id.* at 1:66-2:3. The ’394 Patent discloses that the stimulation fluids can be “any combination of proppant, fracturing fluid, gelling agent, friction reducer, and acid.” *Id.* at 2:3-5. The majority of the claims

require that the first stimulation fluid and the second stimulation fluid have different compositions. *Id.* at Cl. 1-26.

B. Priority Date

U.S. Patent Application No. 11/291,496 (the “’496 Application”) leading to the ’394 Patent was filed on December 1, 2005. The Petition acknowledges that “Patent Owner represented during the prosecution underlying the ’394 Patent that it is entitled to a priority date of August 5, 2005,” and the Petition does not dispute this priority date. Pet. at 3.

C. Prosecution History

The ’496 Application was filed with 39 claims, with claims 1, 5, 11, 34, and 35 being independent. Ex. 1002 at 18-24. The Examiner issued an Office Action on May 3, 2007, with a restriction requirement that required election between the method claims (claims 1-10), system claims (11-33), and apparatus claims (34-39). *Id.* at 143-146. Applicant’s representative had provisionally elected the system claims (11-33), and in the Office Action, the Examiner rejected claims 11-33 under several different grounds, including rejections under 35 U.S.C. §§ 102 and 103 over U.S. Patent No. 4,305,463 to Zakiewicz (“Zakiewicz”) and U.S. Patent No. 5,515,920 to Luk (“Luk”). *Id.* at 147-149. In a response dated July 26, 2007, Applicant argued against these rejections without amending the claims. *Id.* at 159-164.

The Examiner issued a Final Office Action on October 16, 2007, that maintained the prior rejections over Zakiewicz and Luk. *Id.* at 221-227. Applicant filed a request for continued examination on January 9, 2008, with a response that amended independent claim 11 and added independent claims 40 and 41. *Id.* at 232-240. The Examiner issued an Office Action on August 21, 2008, that maintained the prior rejections over Zakiewicz and Luk. *Id.* at 403-409. In a response dated December 17, 2008, Applicant amended independent claim 11 as follows:

11. (Currently Amended) A system for centralized well operations comprising:
a well treatment operations factory which manufactures and pumps a well stimulation fluid;
a first connection between a first well location and the well operations factory;
a second connection between a second well location and the well operations factory; and
means for simultaneously flowing:
a first stimulation fluid [[only]] to the first well location and not to the second well location; and
a second stimulation fluid [[only]] to the second well location and not to the first well location.

Id. at 508-511. The response made similar amendments to independent claims 40 and 41 and added new independent claim 43. *Id.* at 516-517.

The Examiner issued a Final Office Action on March 11, 2009, that rejected the pending claims under several different grounds, including rejections under 35 U.S.C. § 112 and 35 U.S.C. §§ 102 and 103 over Tolman. *Id.* at 544-556. In a

response dated May 6, 2009, Applicant argued that Tolman does not qualify as prior art and further that Tolman does not disclose a well treatment operations factory which manufactures a well stimulation fluid. *Id.* at 617-638.

The Examiner issued another Office Action on May 19, 2009, that rejected the pending claims under 35 U.S.C. § 102 over U.S. Patent No. 6,644,844 to Neal (“Neal”). *Id.* at 662-667. On July 21, 2009, Applicant’s representative conducted an interview with the Examiner during which Applicant proposed further amending claim 11 to include the limitation wherein the first and second fluids are fluids having different compositions. *Id.* at 691-692. On August 12, 2009, Applicant filed a response that amended independent claims 11 and 40-41, and 43 to include “wherein the first stimulation fluid and the second stimulation fluid have different compositions,” cancelled independent claim 33, and added independent claim 44. *Id.* at 695-709.

The Examiner issued a Final Office action on May 13, 2010, that rejected the pending claims under several different grounds, including rejections under 35 U.S.C. §§ 102 and 103 over the prior publication of Albers (US 2006/0243437). *Id.* at 850-59. Applicant filed a request for continued examination on August 10, 2010, with a response that amended the claims to replace “well location” with well, pad, or plurality of wells and argued that Albers does not disclose at least two wells. *Id.* at 897-910.

On October 14, 2010, the Examiner issued a notice of allowance, withdrawing the rejections over Albers and allowing all pending claims 11-32 and 40-44. *Id.* at 952-56. In the notice of allowance, the Examiner noted there were several references that teach a system for centralized well operations, including U.S. Patent No. 4,077,428 by Weaver (“Weaver”), but none of the references disclose, teach, or suggest the combination of limitations that provide for the claimed system. *Id.* at 955-56. The Examiner also noted that the prior art fails to teach or suggest “simultaneous flowing of a first and second stimulation fluid having different compositions” as well as “simultaneous flowing of stimulations fluids having different compositions to each of the wells.” *Id.* The ’496 Application issued as the ’394 Patent on November 30, 2010, including claims 1-27 with claims 1, 24, 25, 26, and 27 being independent. *See generally id.*

V. OVERVIEW OF PRINCIPAL CITED REFERENCES

A. Crossley

International Patent Publication WO2005/111369 to Crossley *et al.* is entitled “System and Vessel for Supporting Offshore Fields.” Ex. 1005. Crossley was filed on February 23, 2005 and published on November 24, 2005. *Id.*

Crossley “generally relate[s] to a system for supporting a plurality of hydrocarbon-bearing wells, including systems for providing **production**

operations in multiple-well-site, offshore fields.”¹ *Id.* at [0002]. Each well-site has one or more wells. *Id.* at [0008]. For example, in Figure 1 below, “the three fields 10, 20, 30 are being produced through three separate subsea well-sites” 110, 120, 130, and each well-site “has a plurality of wells 112, 122, 132 clustered together.” *Id.* at [0043].

Crossley’s system “comprises a floating vessel [150] that is relocatable from a first subsea well-site to a second subsea well-site.” *Id.* at Abstract, [0008], [0018]. “The system also comprises two separate systems: (1) **an operations control system** for providing subsea well-site operations such as power and communications” (annotated in blue in Figure 1 below), “and (2) **an intervention system** for conducting intervention services to an individual subsea well such as workover services and maintenance services” (annotated in red in Figure 1 below). *Id.*

¹ Emphasis added throughout unless otherwise indicated.

delivery of hydraulic fluid to selected subsea equipment, the delivery of low voltage electrical power for control equipment, and the delivery of electrical power for high power production equipment.” *Id.*

Specifically with respect to Figure 1, Crossley discloses that “[t]he operations control system 180 preferably employs two control links”—first, “a surface vessel control link 182 that extends from the relocatable vessel 150, downward to one of the collection manifolds, e.g., manifold 115,” and second, “an inter well-site controls network 184 that connects the subsea well-sites 110, 120, 130 together.” *Id.* at [0049]. With respect to “the delivery of chemicals to selected flowlines,” Crossley teaches that “[c]ontrol operations may further include the injection of chemicals such as **hydrate, paraffin, or wax inhibitors** into flow lines.” *Id.* at [0048]. Crossley refers to such chemicals as “production chemicals.” *Id.* at [0009]. Figure 4 of Crossley provides “an illustrative integrated line as may be used to transmit control features for the system.” *Id.* at [0015]. “Lines 428 and 428’ are preserved for the delivery of chemicals, such as hydrate inhibition fluids.” *Id.* at [0050]. “Chemicals may be delivered from the lines 428, 428’ and then through the manifold 115 for treatment of flow lines, valves, and even the wellbores as appropriate.” *Id.*

Unlike Crossley’s operations control system that simultaneously provides control operations to two separate wells or well-sites, Crossley’s intervention

system (red) is “for conducting intervention services to an **individual** well.” *Id.* at [0020]; *see also id.* at Abstract, [0010], [0025], [0026], [0030], [0037], [0038], [0056], [0061], Cl. 1 (disclosing intervention services for only one “an individual well” at a time). As shown in Figure 1, “the well intervention system 170 operates through the use of a workover riser 172 and an ROV system 508.” *Id.* at [0054]. “The riser 172 extends from the relocatable vessel 150, downward through the ocean to the wellhead of an individual well.” *Id.* at [0056]. “[T]he riser 172 may be disconnected from the wellhead of well 112, and reconnected to the wellhead of any other well in that subsea well-site 110,” or “[a]lternatively, the vessel 150 may be relocated to a second subsea well-site, e.g., site 120, where the workover riser 172 may be connected to a production or injection well in that second well-site, e.g., well 122.” *Id.*

“The intervention services include at least one of workover services and maintenance services.” *Id.* at [0010]. As used in Crossley, “‘workover’ refers to both major and minor well interventions.” *Id.* at [0037]. “Major interventions are those that require the pulling of tubing from the well” whereas “[m]inor interventions, on the other hand, do not require the pulling of tubing.” *Id.* One example of a minor intervention provided in Crossley is “**the injection of acid or other treating fluids.**” *Id.* As used in Crossley, “‘[m]aintenance’ refers to the maintaining of equipment at the mudline or the wellhead platform, including

equipment associated with the wellhead, the collection manifold, and any subsea fluid separators.” *Id.*

B. Albers

U.S. Patent No. 7,451,820 to Albers *et al.* is entitled “Method For Fracture Stimulating Well Bores.” Ex. 1006. Albers was filed on April 29, 2005 and issued on November 18, 2008. *Id.*

Albers is directed to “a method for fracture stimulating well bores using gaseous nitrogen and/or liquid carbon dioxide combined with substantially dehydrated proppant.” *Id.* at Abstract, 1:65-67. As shown in Figure 1, Albers discloses “conventional” equipment used to manufacture and pump a fracturing fluid into a wellbore, including “[a] conventional blender unit (1),” “[a] conventional sand trailer (4),” “a conventional high-pressure pump (5),” “a conventional sand intensifier unit (7),” and “[a] first nitrogen/carbon dioxide storage tank and pump (10).” *Id.* at 3:56-4:4. This equipment is attached to “a manifold connection ... which is in turn connected to a first wellhead conduit (13) that extends directly to the wellhead.” *Id.* at 4:8-11. “A second nitrogen/carbon dioxide storage tank and pump (14) is shown extending directly to the wellhead via a second wellhead conduit (13a), bypassing the sand intensifier unit (7) altogether.” *Id.* at 4:11-14.

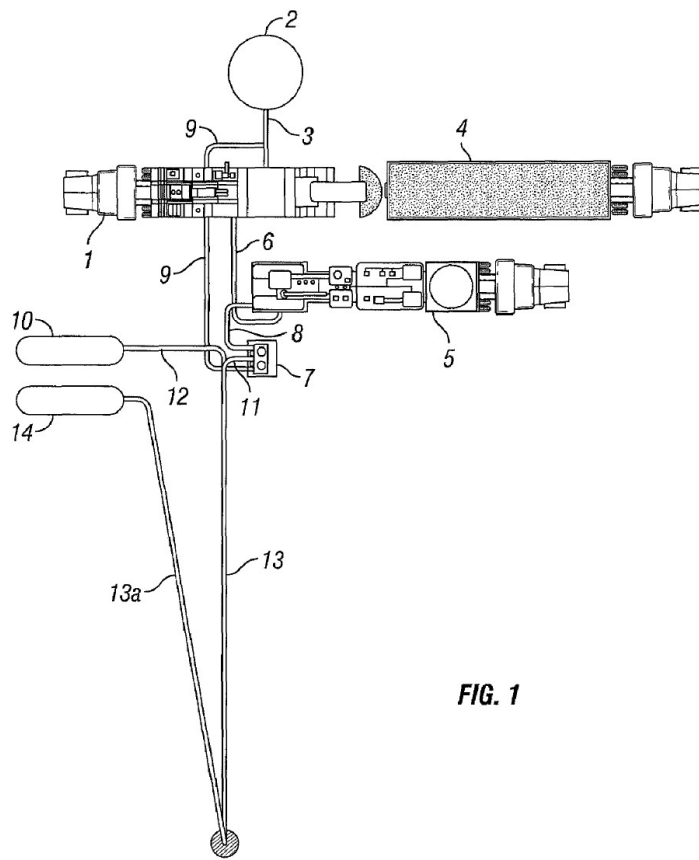


FIG. 1

This conventional equipment in Albers is used to combine partially dehydrated or “wet” proppant with nitrogen/carbon dioxide and deliver it to a wellhead at a rate and pressure sufficient to fracture stimulate the formation. *See, e.g., id.* at 2:25-27, 2:58-67, Cl. 1. Albers discloses two alternative procedures for delivering the wet proppant to **a single wellhead overtime**: (1) a “step” procedure and (2) a “ramp” procedure. *Id.* at 6:50-7:25. In the “step” procedure, “a measured of amount of proppant is introduced into the formation, followed by an increased amount, followed by a further increased amount, and so on until the proper proppant concentration is attained.” *Id.* at 6:52-56, FIGS. 5-6. In the “ramp”

procedure, “an initially small, but steadily and constantly increasing amount of proppant is introduced into the formation until the proper concentration is attained.” *Id.* at 7:3-7, FIGS. 7-8.

C. Lehman

U.S. Patent Pub. No. 2004/0050550 to Lehman *et al.* is entitled “Re-use Recovered Treating Fluid.” Ex. 1009. Lehman was filed on September 16, 2002 and published on March 18, 2004. *Id.*

Lehman is directed to “treating fluid production and subterranean formation treatment methods as well as compositions for treating fluids, all of which relate to reuse of at least part of a prior treating fluid.” *Id.* at Abstract, [0018]. One method includes “treating a subterranean formation intersected by a well, comprising performing a treatment on a well using a treating fluid residual recovered from a prior treatment, wherein using a treating fluid residual recovered from a prior treatment includes conditioning the recovered treating fluid residual.” *Id.* at [0020].

VI. PETITIONER HAS NOT ESTABLISHED THE CHALLENGED CLAIMS ARE OBVIOUS

A. Legal Requirements of a Petition Asserting Obviousness

Petitioner bears the burden of proving a proposition of unpatentability by a preponderance of the evidence on the grounds asserted in the Petition. 35 U.S.C. § 314(e). The grounds asserted must be described with “particularity” in the petition. 35 U.S.C. § 312(a)(3); *Intelligent Bio-Systems, Inc. v. Illumina Cambridge*

Ltd., 821 F.3d 1359, 1369 (Fed. Cir. 2016) (“It is of the utmost importance that petitioners ... adhere to the requirement that the initial petition identify ‘with particularity’ the ‘evidence that supports the grounds for the challenge to each claim.’” (quoting 35 U.S.C. § 312(a)(3))). Specifically, the Petition “must specify where each element of the claim is found in the prior art patents or printed publications relied upon.” 37 C.F.R. § 42.104(b)(4). Petitioner must therefore show that “the structural features of [the challenged claims] were **known prior art elements.**” *K/S HIMPP v. Hear-Wear Technologies, LLC*, 751 F. 3d 1362, 1365-66 (Fed. Cir. 2014); *Personal Web Techs., LLC v. Apple*, 848 F.3d 987, 991 (Fed. Cir. 2017).

Under 35 U.S.C. § 103, Petitioner must prove that the claimed subject matter would have been obvious to a POSITA at the time of the invention. In considering obviousness, the Board must determine the scope and content of the prior art and differences between the prior art and the claims and the level of ordinary skill in the pertinent art. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966).

A claim limitation must be proven to be in the prior art; it cannot be proven by conclusory testimony unsupported by concrete evidence. *See Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363-66 (Fed. Cir. 2016) (reversing the Board’s obviousness determination, which relied on “common sense,” because the petitioner’s expert declaration lacked “evidence and a reasoned explanation”).

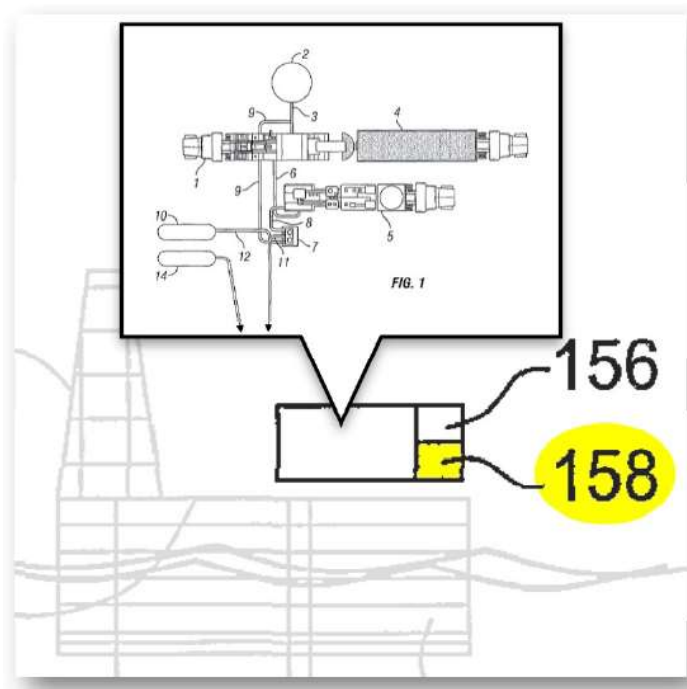
Petitioner must offer “a sufficient explanation of how the references may be combined, from the perspective of one with ordinary skill in the art, to arrive at the claimed invention, and **why the proffered combination accounts for all the features of each claim.**” *Dominion Dealer Sols., LLC v. AutoAlert, Inc.*, IPR2013-00223, Paper 9 at 19 (P.T.A.B. Aug. 15, 2013); *see also Arendi*, 832 F.3d at 1362 (“[O]ur cases repeatedly warn that references to ‘common sense’—whether to supply a motivation to combine or a missing limitation—cannot be used as a wholesale substitute for reasoned analysis and evidentiary support . . .”).

“[A] clear, evidence-supported account of the contemplated workings of the combination is a prerequisite” to concluding “that a relevant skilled artisan would have been motivated to make the combination and reasonably expect success in doing so.” *Personal Web Techs. LLC v.* 848 F.3d at 994. Moreover, “[o]bviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor.” *Para-Ordnance Mfg., Inc. v. SGS Importers Int'l, Inc.*, 73 F.3d 1085, 1087 (Fed. Cir. 1995); *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

B. All Grounds Fail as to All Claims Because the Petition Does Not Provide a Sufficient Motivation to Combine Crossley and Albers With a Reasonable Expectation of Success.

Petitioner and its expert Dr. Nikolaou were unable to find a single reference that discloses each limitation of any claims of the '394 Patent, *see* Ex. 2005 at

69:21-70:2, and thus rely on the combination of Crossley and Albers. In Petitioner's proposed combination, "Albers's fracture-stimulation equipment ... would have been **implemented on** Crossley's 'vessel 150'... and in conjunction with the 'control delivery system 158'" as depicted in the below annotated high-level figure from the Petition and Dr. Nikolaou's declaration:



Pet. at 12; Ex. 1003 at ¶ 48. During his deposition, Dr. Nikolaou confirmed that the combination of Albers and Crossley relies on Albers's equipment to be the well treatment operations factory that manufactures the first and second stimulation fluids as required by the claims of the '394 Patent. Ex. 2005 at 72:7-15, 156:14-19. In particular, the Petition proposes to implement Albers's fracture-stimulation equipment on Crossley's vessel and combine it with Crossley's operations control system. *See, e.g.,* Pet. at 18-20.

The Petition's proposed combination of Crossley and Albers fails because, as both experts agree, Crossley and Albers relate to two different oil and gas operations (*i.e.*, production versus well stimulation), and the Petition fails to provide a sufficient rationale for why a POSITA would have been motivated to include Albers's **fracture-stimulation** equipment on Crossley's **production** vessel with a reasonable expectation of success.³

³ In his deposition, Dr. Nikolaou made a passing remark that the above figure from his declaration somehow shows "replacing an element of the Crossley configuration using the Albers equipment." Ex. 2005 at 84:18-85:12. However, neither the Petition nor Dr. Nikolaou make this assertion or explain what element on Crossley is supposedly being replaced. Moreover, such a combination would fail because it would change the principle of operation of Crossley's system from a production system to a well stimulation (*i.e.*, fracturing) system and further render Crossley's system inoperable for its intended purpose as a production vessel. *See* MPEP § 2143.01(VI) (citing *In re Ratti*, 270 F.2d 810, 813 (CCPA 1959)); MPEP § 2143.01(V) (citing *In re Gordon*, 733 F.2d 900 (Fed. Cir. 1984)); *infra* § VI.B.1.

1. Crossley and Albers Relate to Two Different Oil and Gas Operations

Both experts agree there are four main steps in oil and gas production: (1) drilling, (2) casing, (3) fracture stimulation, and (4) oil and gas production. Ex. 2004 at § IX; Ex. 1003 at § IV; Ex. 2005 at 24:5-14 (drilling), 29:18-21 (casing), 33:9-13 (stimulation or fracturing), 48:22-49:2 (oil and gas production). Unlike the other three steps, Dr. Nikolaou remarkably did not include a discussion of oil and gas production in his declaration “[b]ecause production wasn’t central in this discussion,” Ex. 2005 at 49:11-12, even though he conceded in his deposition that the primary reference he relies on, Crossley, exclusively relates to production operations, *see, e.g.*, Ex. 2005 at 62:4-7.

Both experts also agree that Albers relates exclusively to **fracture stimulation** operations. Ex. 2004 at ¶ 104; Ex. 2005 at 65:8-12 (Albers’s “main concern is how you do stimulation regardless of the particular configuration onshore or offshore.”), 65:16-17 (“[T]he focus is on stimulation.”), 66:8-9 (Albers “does not directly addressing drilling operations per se.”), 66:10-14 (“Q:And Albers does not related to production operations; is that right? A:Not directly....”); *see also, e.g.*, Ex. 1006 at Title, Abstract, 1:65-67. Both experts further agree that Crossley relates exclusively to **production** operations. Ex. 2004 at ¶ 102; *see, e.g.*, Ex. 2005 at 62:4-7 (“Q:These disclosures relate to production operations; is that fair? A:The Crossley patent, you mean? Q:Yes. A:Yes.”), 62:9-11 (“Q:Does

Crossley[’s] system perform well-stimulation? A:No.”), 62:21-63:1 (“Crossley focuses on essential unit that oversees production operations.”), 63:12-16 (“Drilling operations are indeed not the focus of Crossley.”); *see also, e.g.*, Ex. 1005 at Title, Abstract, [0002], [0044].

Dr. Durham explains that fracture stimulation of hydrocarbon bearing formations is a technique that has been used to increase or speed up oil and gas production for nearly as long as oil and gas production has existed. Ex. 2004 at ¶ 63. Fracture stimulation involves pumping a fluid (typically water but sometimes also foam or gas) containing chemicals and proppant into a hydrocarbon bearing formation as sufficient pressure to crack (fracture) the formation’s rock. *Id.* at ¶¶ 66, 71. The proppant enters the fractures and keeps them open to allow oil and gas to flow from the fractures into the wellbore and then to the surface during subsequent oil and gas production operations. *Id.* at ¶ 73. At the time of the ’394 Patent, fracture stimulation required higher volumes of fracturing fluid, higher pressures, and higher horsepower pumps than in the past due largely to the advent and expansions of horizontal wells. *Id.* at ¶ 65.

Dr. Durham explains that oil and gas production involves the flow of significant volumes of a three-phase fluid (*e.g.*, oil/water, gas, and solids) from the hydrocarbon bearing formation into wells and to the surface, and then to separation and storage facilities. *Id.* at ¶¶ 74, 79-80. Wells are commonly overpressured such

that the fluid flows to the surface without any assistance. *Id.* at ¶ 75. In other instances, artificial lift operations, such as electric submersible pumps, are required to produce the fluid. *Id.* at ¶¶ 76-78. Both experts agree that the production of oil and gas from a well can last at least a decade. *Id.* at ¶ 74; Ex. 2005 at 95:8-10. They also agree that reservoir stimulation techniques (such as acidizing and fracture stimulation) may also be required to maintain or enhance the production of oil and gas over the life of the well as is disclosed in Crossley's intervention system. Ex. 2004 at § IX.C.4; Ex. 2005 at 162:19-163:13, 164:5-12, 165:7-9.

Both experts further agree that fracture-stimulation operations, such as those in Albers, and production operations, such as those in Crossley, happen sequentially. Ex. 2004 at ¶¶ 74, 102; Ex. 2005 at 66:12-14 (Stimulation "is something that you do before production to stimulate the well."), 92:19-93:1 ("Production will follow stimulation."); *see also* Ex. 1008 at FIG. 3. They yet further agree that equipment used in fracture-stimulation operations is removed from the well before production operations begin. Ex. 2004 at ¶¶ 74, 102; Ex. 2005 at 95:11-17 (If fracture stimulation equipment is "not needed or anticipated to be needed soon, there's no reason that equipment would stay there."), 96:3-6 ("If the equipment is not needed, there may be an incentive not to use it anymore, and move it someplace else where it can be more useful."); *see also* Ex. 1008 at FIG. 3

(Step 320 “Move Stimulation Equipment,” Step 322 (“Provide Production Tubing”), Step 324 “Produce Hydrocarbons”)).

Both experts still further agree that fracture-stimulation operations and production operations differ with respect to at least: (1) equipment, (2) pressures, (3) fluid types, and (4) fluid volumes. With respect to equipment, Dr. Durham explains entirely different equipment is used for fracture-stimulation operations as compared to production operations. *See, e.g.*, Ex. 2004 at ¶ 74. For example, fracture-stimulation operations require multiple high-pressure pumps, a blender or hydration unit, storage tanks, and a manifold at the surface while production operations require trees, collection and separation equipment, and lower pressure pumps. *Id.* at ¶¶ 67-71, 74-80. Dr. Nikolaou agreed in his deposition that “[t]here is equipment in fracturing that would have ... no serious use for production operations. For example, pumps that pressurize ... the fracturing fluid into the well are not going to be needed for production.” Ex. 2005 at 50:21-51:8. He further described the differences in pumps for these two operations as: “a different pump for a different job, different configuration, different function and all that.” *Id.* at 51:13-19. Dr. Nikolaou further admitted he would **not** consider using the same manifold (whether same piece or same design) for both simulation operations and production operations to be “the best use of equipment.” *Id.* at 214:16-215:12.

With respect to pressure, Dr. Durham explains that a significant amount of pumping horsepower (about 8,800 to 12,400 hhp) would be required to generate pressure sufficient to fracture the formation (around 6,000 to 15,000 psi). Ex. 2004 at ¶ 65; *see also* Ex. 1006 at 5:8-11 (disclosing stimulation fluid pumped at “pressure of ... up to a design maximum of 70,000 kPa,” or about 10,000 psi). Dr. Durham further explains that the horsepower and pressure required for production operations are significantly lower. Ex. 2004 at ¶¶ 77, 81. Dr. Nikolaou agreed during his deposition, testifying that lower horsepower pumps are typically needed for production as compared to stimulation operations and that “[f]racture stimulation fluids are pumped at pressure high enough to fracture the rock” and “[t]here would be no such need when you pump these [production] chemicals to the production line.” Ex. 2005 at 55:17-56:12, 147:17-148:4.

With respect to fluid types, Dr. Durham explains that fracture stimulation involves pumping liquids (*e.g.*, water, foam, or gas) and proppant (*e.g.*, sand) into the formation. Ex. 2004 at ¶ 66; *see also* Ex. 1006 at 1:6-51. Dr. Nikolaou gave a similar description in his deposition. Ex. 2005 at 34:19-35:1 (“[I]t’s water with other things. The other things may be chemical additives, may be sand which is the proppant that will keep the fractures open.”). In contrast, during production operations, production chemicals, such as hydrate, paraffin, and wax inhibitors, may be injected to aid in the flow of fluids from the formation to the surface by

preventing the buildup of solids. Ex. 2004 at ¶ 81; Ex. 2005 at 162:4-8; Ex. 1005 at [0009], [0033]. Dr. Nikolaou further testified in his deposition that production chemicals, such as hydrate, paraffin, and wax inhibitors, are not used in fracture-stimulation operations. Ex. 2005 at 147:12-16.

With respect to fluid volumes, Dr. Durham explains that, at the time of the '394 Patent, fracture-stimulation operations would have required introducing about 2,000 – 2,500 gal/ft of stimulation fluid into the well whereas production operations would have used very small volumes of production chemicals by comparison. Ex. 2004 at ¶¶ 65, 81. Dr. Nikolaou agreed in his deposition that “the volume of ... the production-related injection would definitely be lower than the volume of the stimulation fluid in the well” because the stimulation fluid must fill the entire well to fracture the formation while production chemicals, such as inhibitors, would not fill the well. Ex. 2005 at 152:18-153:19.

With respect to fluid rates, Dr. Durham explains that, at the time of the '394 Patent stimulation fluids were pumped at rates on the order of barrels per minute while production chemicals were pumped at rates on the order of quarts or barrels per day. Ex. 2004 at ¶¶ 81, 109; *see also* Ex. 1006 at 5:8-11 (disclosing stimulation fluid pumped at “a rate ... of 1 to 2 m³/min,” or about 264-528 gal/min or about 6.3 to 12.5 bbl/min). Dr. Nikolaou admitted in his deposition that fluid rates for stimulation and production operations “could be different,” but he did not consider

these differences when proposing a combination that would involve pumping Albers's stimulation fluids through Crossley's production system. Ex. 2005 at 150:20-151:15, 153:14-16 ("A:Now, at what rates those would be pumped? That's another question that I have to look at more carefully.").

2. *The Petition Fails to Establish a Motivation to Combine Albers's Fracture-Stimulation Equipment with Crossley's Production System*

The Petition fails to provide a sufficient reason a POSITA would have been motivated to combine Albers's **fracture-stimulation** equipment with Crossley's **production** system, each of which relate to a very different operation as discussed above. First, as Dr. Durham explains, the Petition's analogous art argument that Crossley and Albers are both directed to "oil well operations" is an overgeneralization that does not account for the distinct phases of oil well operations, each with its own concerns, equipment, and service providers, as discussed above. Ex. 2004 at ¶¶ 106-109. Furthermore, while the Petition suggests that Crossley and Albers are directed to "the need to efficiently conduct drilling operations," Dr. Nikolaou conceded in his deposition (and Dr. Durham agrees) that neither Crossley nor Albers has anything to do with drilling operations. Pet. 13; Ex. 2005 at 63:12-16 ("Drilling operations are indeed not the focus of Crossley."), 66:8-9 (Albers "does not directly addressing drilling operations per se."); Ex. 2004 at ¶¶ 101-104. The '394 Patent is directed to well stimulation, not drilling

operations. Ex. 2004 at ¶ 105; *see, e.g.*, Ex. 1001 at 1:42-43 (“In general, one aspect of the invention features a method of stimulating multiple wells from a central location.”).

Second, the Petition’s assertion that Albers’s **fracture-stimulation** equipment and Crossley’s **production** system “each perform[] the same function it has been known to perform” when combined does not explain **why** a POSITA would have been motivated to combine them. Pet. at 14. If this rationale was sufficient, nearly any two things would be obvious to combine. While the Petition asserts that “a POSITA would have been motivated” to combine Crossley and Albers “based on the benefits Albers discloses,” Pet. at 15, Albers does not disclose any benefits applicable to the **production** operations to which Crossley relates, Ex. 2004 at ¶ 110. As Dr. Nikolaou testified in his deposition, Albers does not involve production operations. Ex. 2005 at 66:10-14; *see also* Ex. 2004 at ¶ 104.

Moreover, as the Petition states, “the increasing the production from a well was achievable through proper well stimulation and was a sought-after result in the industry” for decades. Pet. at 16 (citing Ex. Ex. 1007 from the 1980s). This well-known concept reflected in both Albers and Lacy, however, does not explain why a POSITA would have been motivated to implement Albers’s fracture-stimulation equipment on Crossley’s production vessel, as asserted in the Petition’s proposed

combination. Ex. 2004 at ¶ 111. None of the references cited to support the Petition’s motivation to combine argument—Albers, Lacy, and Tolman—teach the combination of fracture-stimulation equipment with a production system. *See* Pet. at 15-17; Ex. 2004 at ¶¶ 111-112; Ex. 2005 at 90:4-7 (Lacy “is just another reference that explains the technology for hydraulic fracturing was fairly well developed and known already at that date.”), 91:16-21 (“Q:Is it fair to say that Tolman is directed to stimulation treatment and not production operations? A:Yes...”).

In fact, Tolman teaches away from doing so because it teaches that, “[i]f the planned stimulation treatments for the wells are complete, then the equipment associated with the stimulation treatments may be **rigged-down and moved off the surface pad** 102, as shown in block 320” for FIG. 3, before “run[ning] production tubing in each of the wells, as shown in block 322” and utilizing the wells “to produce hydrocarbons, as shown in block 324.” Ex. 1008 at [0040], FIG. 3 (Step 320 “Move Stimulation Equipment,” Step 322 (“Provide Production Tubing”), Step 324 “Produce Hydrocarbons”)); Ex. 2004 at ¶ 112; *see also* Ex. 2005 at 91:21-92:18. A POSITA similarly would have understood Albers’s disclosure that its “conventional” fracture-stimulation equipment is included on trucks and trailers to be for the purposes of moving the equipment around. *See* Ex. 2005 at 69:5-14 (Doing so was “quite common”). Indeed, Dr. Nikolaou testified in

his deposition that, if fracture-stimulation equipment is “not needed or anticipated to be needed soon, there’s no reason that equipment would stay there” on an offshore vessel during production operations and that, “[i]f the equipment is not needed, there may be an incentive not to use it anymore, and move it someplace else where it can be more useful.” Ex. 2005 at 95:11-17, 96:3-6. And despite the fact that it is costly to keep fracturing equipment unused at the well-site during production operations that can last a decade or more, Dr. Nikolaou admitted “[t]hat’s not something [he] looked into in very much detail for this declaration.” Ex. 2005 at 44:7-9.

Third, Albers’s teaches that its fracture-stimulation methods use gaseous nitrogen as a fracturing agent, as opposed to the more common water or foam-based fracturing fluids, and that such methods are particularly suited for treating water-sensitive formations, such as coal bed methane formations. Ex. 1006 at 1:4-61, 5:63-65, Cls. 1 & 13; Ex. 2005 at 86:5-87:4. The Petition has not established that a POSITA would have understood water-sensitive formations to exist offshore in December 2005 such that Albers’s fracture-stimulation equipment and techniques would have been suitable for use with Crossley’s offshore operations. Dr. Nikolaou did not even consider this when preparing his declaration, as he conceded in his deposition that he “would have to look up” whether the industry

was stimulating coal bed methane formations or other water sensitive formations offshore as of December 2005. Ex. 2005 at 88:3-7.

Accordingly, the Petition fails to establish that a POSITA would have been motivated to combine Albers's fracture-stimulation equipment with Crossley's production system as proposed in the Petition, and therefore, the Crossley/Albers combination does not render obvious claims 1-27 of the '394 Patent.

3. *The Petition Fails to Establish a Reasonable Expectation of Success in Combining Albers's Fracture-Stimulation Equipment with Crossley's Operations Control System*

“An obviousness determination requires finding that a POSITA would have been motivated to combine or modify the teachings in the prior art **and would have had a reasonable expectation of success in doing so.**” *Endo Pharm., Inc. v. Actavis LLC*, 922 F.3d 1365, 1373 (Fed. Cir. 2019). Motivation to combine and reasonable expectation of success are “two different legal concepts.” *Intelligent BioSystems, Inc. v. Illumina Cambridge, Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016). The absence of either is sufficient to establish nonobviousness. *See id.* at 1367-68.

Dr. Nikolaou's declaration concludes that “[a] POSITA could therefore have made the Crossley/Albers combination without undue experimentation and with a reasonable expectation of success” because “each perform[] the same function it has been known to perform (gas and oil production and well-stimulation

techniques) and yielding not more than what one would expect from such an arrangement (centralized well operations including simultaneous and optimized well-stimulation techniques).”⁴ Ex. 1003 at ¶ 58. This is the only mention of a

⁴ Paragraph 58 of Dr. Nikolaou’s declaration cites International Patent Publication WO2007/024383 by Tolman (Ex. 1008) for support as allegedly “disclosing the same technique in the prior art.” However, the Petition’s reliance on Tolman should be disregarded because Tolman does not qualify as prior art to the ’394 Patent, and the Petition does not establish that it does. Tolman was filed on July 24, 2006 and published on March 1, 2007, *see* Ex. 1008—both after the ’394 Patent’s December 2, 2005 filing date. Thus, Tolman does not qualify as prior art under pre-AIA 35 U.S.C. §§ 102(a) or 102(b). Tolman also claims priority to a U.S. provisional application filed on August 19, 2005. However, the Petition has not met their burden to establish that Tolman is entitled to that priority claim. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378-81 (Fed. Cir. 2015). And even if it did, that date is insufficient to qualify Tolman as prior art under pre-AIA 35 U.S.C. § 102(e). As Patent Owner explained during prosecution of the ’394 Patent, Tolman does not qualify as prior art under pre-AIA 35 U.S.C. § 102(e) because the invention of the subject matter claimed in the ’394 Patent pre-

reasonable expectation of success in Dr. Nikolaou's declaration, and the Petition cites only to this paragraph to support the existence of a reasonable expectation of success. Pet. at 15.

As Dr. Durham explains, however, Crossley's operations control system (including its pumps, pipelines, valves, and manifold) would perform a **different** function in the Petition's proposed combination of Crossley and Albers because it would be used for fracture-stimulation techniques in the proposed combination as opposed to production operations as it is in Crossley. Ex. 2004 at ¶ 115. As Dr. Durham further explains, there are several critical considerations for whether there is a reasonable expectation of success in using Crossley's production system to perform Albers's fracture-stimulation techniques. *Id.* at ¶ 116. These include, for example, (i) whether the equipment in Crossley's operations control system could withstand the pressures required to fracture a formation, (ii) whether the flowlines in Crossley's operations control system are large enough to carry the volumes and rates required for fracturing fluids, and (iii) whether the power generated by Crossley's production system would be sufficient to power the high horsepower

dates Tolman's August 19, 2005 effective date. *See* Ex. 1002 at 632-658; *see also supra* § IV.B.

pumps and other equipment required for fracturing operations in addition to Crossley's existing equipment. *Id.*

Dr. Nikolaou did not address any of these considerations in his declaration. *See, e.g.*, Ex. 2005 at 78:15-22 (“Q:You haven’t provided any evidence in your declaration that Crossley’s pumps or other equipment could withstand pressures of up to 10,000 PSI; have you? A:I don’t believe I discussed that issue at all what pressure these pumps would be suitable for.”), 79:1-10 (“Q:[Y]ou didn’t provide any evidence in your declaration that Crossley’s fluid delivery lines can support the high volume and rates required for stimulation fluids; did you? A:Regarding the volumes of these fluids, I didn’t discuss that either. ... The fluid rates, no, I didn’t discuss that.”), 134:10-21 (“Q:What diameter would a POSITA have understood line 420 to have? A:I haven’t thought about that.”).

Moreover, Dr. Nikolaou conceded in his deposition that he does not know: (i) the range of pressures required to fracture (*id.* at 38:18-39:6), (ii) the injection rate of fracturing fluids (*id.* at 41:1-10), or (iii) the horsepower of fracturing pumps (*id.* at 41:14-20). Dr. Nikolaou admitted that he would have to look up each of these or “Google it basically.” *Id.* at 38:18-39:6, 41:7-10, 42:9-17. Dr. Nikolaou similarly admitted that he would have to “research” whether production chemicals, such as those used in Crossley, would ever be used in a higher volume and rate

than fracturing fluids because it “is not something [he] looked into in preparing [his] declaration.” *Id.* at 58:11-21.

Without knowing these fundamental aspects of fracture-stimulation operations, it is impossible that Dr. Nikolaou could have considered whether a POSITA would have had a reasonable expectation that Crossley’s operations control system designed for production operations could be used for more demanding fracture-stimulation operations as proposed. Therefore, the Petition, and its sole reliance Dr. Nikolaou’s ill-founded opinion, fails to meet the burden of establishing a reasonable expectation of success.

Furthermore, as Dr. Durham explains, a POSITA would not have had a reasonable expectation of success in using Crossley’s production system to perform Albers’s fracture-stimulation techniques when accounting for the above-mentioned considerations. First, at the time of the ’394 Patent, equipment used in offshore production operations was typically subjected to pressure on the order of hundreds of pounds per square inch. Ex. 2004 at ¶ 119. In contrast, at the time of the ’394 Patent, fracturing fluids were typically pumped at pressures of up to about 10,000 psi in order to fracture the formation. *Id.*; *see also* Ex. 1006 at 5:8-11 (disclosing stimulation fluid pumped at “pressure of ... up to a design maximum of 70,000 kPa,” or about 10,000 psi); Ex. 2004 at ¶ 65. A POSITA would have had no reason to believe that the equipment in Crossley’s operations control system would

be capable of withstanding the pressures required for fracture-stimulation as disclosed in Albers. *Id.* at ¶ 121.

Second, as discussed above, at the time of the '394 Patent, the fluid volumes and rates used in production operations, such as Crossley, were orders of magnitude different as compared fluid volumes and rates used in fracture-stimulation operations, such as Albers (*e.g.*, quarts to barrels per day v. barrels per minute). *See supra* at VI.B.1. Given this difference, a POSITA would have had no reason to expect the production chemical flowlines in Crossley's operations control system upon which Dr. Nikolaou relies (*see* Ex. 1005 at Fig. 4) to be capable of delivering a fracture-stimulation fluid at the required volumes and rates to fracture the formation. Ex. 2004 at ¶¶ 120-122.

Third, the power consumption for fracturing pumps alone would have been about 3,000 horsepower at the time of the '394 Patent and the fracture-stimulation equipment disclosed in Albers would have required further power. *Id.* at ¶ 123. The Petition has not established that a POSITA would have reasonably expected that Crossley's size-limited power delivery system would be capable of generating sufficient power to operate Albers's fracture-stimulation equipment in addition to Crossley's existing equipment. *Id.*

Because of the significant differences between production operations and fracture-stimulation operations, a POSITA would not have had a reasonable

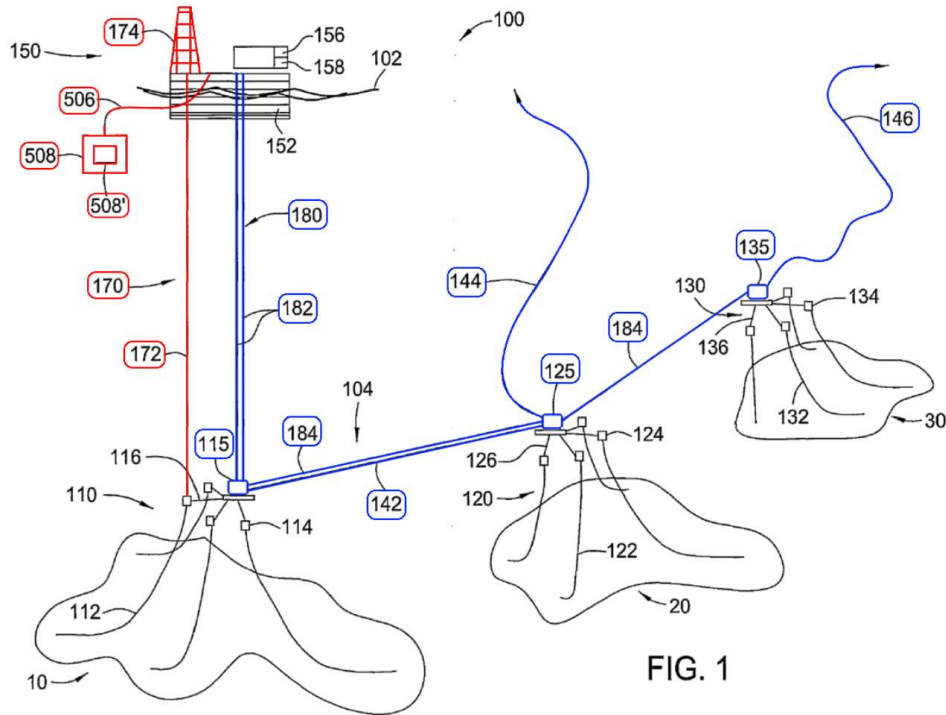
expectation of success in combining Albers's fracture-stimulation equipment with Crossley's operations control system as proposed in the Petition, and therefore, the Crossley/Albers combination does not render obvious claims 1-27 of the '394 Patent. *Id.* at ¶ 124.

C. All Grounds Fail as to All Claims Because Crossley Teaches Away From Introducing Albers's Stimulation Fluid Using Crossley's Operations Control System as the Petition Proposes.

Even if a POSITA was motivated to incorporate Albers's fracture-stimulating equipment on Crossley's vessel as proposed in the Petition, the Petition fails to establish that a POSITA would have been motivated to simultaneously flow Albers's well stimulation fluids to the wells, pads, and plurality of pads to multiple wells through Crossley's operations control system. Crossley actually teaches away from doing so.

1. *The Petition Should Not Have Ignored Crossley's Intervention System*

A prior art reference must be considered in its entirety, i.e., **as a whole**, including portions that would lead away from the claimed invention. *W.L. Gore & Assoc.*, 721 F.2d at 1551. As described above, *see supra* § V.A., Crossley's vessel contains an intervention system (annotated in red in Figure 1 below) that is completely separate from its operations control system (annotated in blue in Figure 1 below):



Ex. 1005 at FIG. 1 (annotated); Ex. 2004 at ¶ 125; Ex. 2005 at 175:18-176:5 (Dr. Nikolaou agreeing this annotated figure is accurate.). The intervention system and operations control system are used for different purposes. Ex. 2004 at ¶ 125.

Crossley discloses that its **operations control system** is used for “control operations,” which may include “the injection of chemicals such as hydrate, paraffin, or wax inhibitors into flow lines” and may also “include pumps and other electrically or hydraulically actuated equipment.” Ex. 1005 at [0048]; Ex. 1003 at ¶ 66. Crossley refers to these chemicals as “**production chemicals**.” Ex. 1005 at [0009]. As Dr. Durham explains (and Dr. Nikolaou agrees), oil and gas extracted from subterranean formations contain hydrate, paraffin, and wax, and as the temperature of the oil and gas decreases, hydrate, paraffin, and wax can solidify

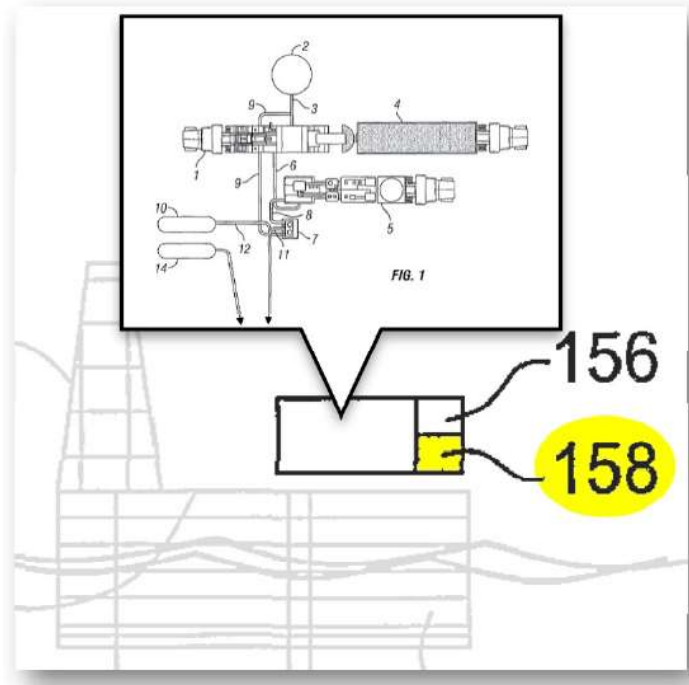
and build up on production equipment and in the wellbore (e.g., on the production tubing). Ex. 2004 at ¶ 126; Ex. 2005 at 146:5-147:5. Hydrate, paraffin, or wax inhibitors are therefore pumped or injected into producing well in order to prevent build up and ensure smooth flow of oil and gas through the wellbore and equipment. Ex. 2004 at ¶ 126; Ex. 2005 at 147:6-12.

Crossley's **intervention system**, on the other hand, is used for, among other things, interventions such as "the injection of **acid or other treating fluids**." Ex. 1005 at [0037]. It is common that a production well will need to be re-stimulated as part of ongoing maintenance efforts to continue the production of oil and gas. Ex. 2004 at ¶¶ 81-83, 129; Ex. 2005 at 159:21-160:7, 162:19-163:13. One such stimulation technique is acid fracturing in which an acid is pumped into a formation causing it to degrade the formation's rock. Ex. 2004 at ¶ 85; Ex. 2005 at 164:5-165:6. Another such stimulation technique that may be used during production operations is hydraulic fracturing in which a fluid (typically water) containing chemicals and proppant is pumped into the formation at high pressures to create fractures with the formation's rock. Ex. 2004 at ¶¶ 86, 130; Ex. 2005 at 165:7-14. Albers's fracture-stimulation technique is another type of reservoir stimulation that uses carbon dioxide and nitrogen. Ex. 2004 at ¶¶ 86, 130; Ex. 2005 at 168:10-14. A POSITA would have understood Crossley's teaching of "the injection of acid or other treating fluids" for intervention during production

operations to be acid fracturing and other reservoir stimulation techniques, such as hydraulic fracturing and Albers's fracture-stimulation technique. Ex. 2004 at ¶ 129.

The Petition relies entirely on Crossley's operations control system. More specifically, the Petition relies on Crossley's operations control system as "a first connection between a first well and the well operations factory" and "a second connection between a second well and the well operations factory." Pet. at 23-26. The Petition also relies on Crossley's operations control system in combination with Albers's "fracture-stimulating equipment (and associated dynamic fluid manufacturing and optimized oil well-stimulation fluid techniques)" for the "well treatment operations factory which manufactures and pumps a well stimulation fluid" and the "means for simultaneously flowing" Albers's well stimulation fluid. Pet. at 11-17, 20-23, 27-33.

The Petition completely ignores Crossley's intervention system in its analysis. *See, e.g.*, Pet. at 7 (noting "Crossley's system describes a vessel 150 comprising two systems," but only discussing the "operations control system 180" and not even mentioning the intervention system). Indeed, the "annotated Figure 1 of Crossley with an excerpt of Figure 1 of Albers superimposed" included in the Petition (Pet. at 12) to depict the proposed combination completely blurs Crossley's intervention system on the left side of Crossley's vessel, making it clear the Petition and its proposed combination ignore it:



Dr. Nikolaou also confirmed this during his deposition. He acknowledged that Crossley describes the operations control system and the intervention system as two separate systems and that he relied on the operations control system. Ex. 2005 at 169:13-170:1, 171:17-172:4. He also agreed that acid as referenced in Crossley is used in acid fracturing for reservoir stimulations. *Id.* at 176:9-177:3, 177:12-178:2. Yet he conceded that he “ha[s]n’t thought about” whether “a POSITA [would] have understood that Crossley’s intervention system would be used for reservoir stimulation” and that he “ha[s] not considered” “why Crossley does not describe the intervention system as applying to multiple wells ... at the time.” *Id.* at 177:4-11, 179:4-10. These admissions demonstrate that Dr. Nikolaou failed to consider Crossley **as a whole** when forming his opinions. See *W.L. Gore & Assoc.*, 721 F.2d at 1551.

Indeed, as discussed further below, it is Crossley’s intervention system, and not the operations control system, that a POSITA would have understood to flow the types of fluids that are the subject of the ’394 Patent claims, *i.e.*, “injection of **acid or other treating fluids.**” Ex. 1005 at [0037]; Ex. 2004 at ¶ 129. As the Petition acknowledges, the ’394 Patent describes that the well treatment fluid or stimulation fluid flowed to the wells during “[s]**timulation and treatment** processes” can be “any combination of proppant, fracturing fluid, gelling agent, fraction reducer, and **acid.**” *See* Ex. 1001 at 1:15-2:57, cl. 21-22; Pet. at 4, 21; *see also* Ex. 1001 at 1:15-17 (“In the production of oil and gas in the field, it is often required to **stimulate and treat** several well locations within a designated amount of time.”). Despite the clear relevance of Crossley’s intervention system to the ’394 Patent’s claims, Petitioner failed to consider Crossley in its entirety by omitting the intervention system from its Petition.

2. Crossley Teaches Away from the Petitioner’s Proposed Combination with Albers

The ID acknowledged that “Crossley does teach that the intervention system can be used for the injection of treating fluids.” ID at 13. However, the ID argued that Crossley “also teaches that the control delivery system can be used for the treatment of the wellbore.” *Id.* (citing Ex. 1005 at [0050] (“Chemicals may be delivered from the lines 428, 428' and then through the manifold 115 for *treatment* of flow lines, valves, and even the wellbores as appropriate.”) (emphasis in

original)). As Dr. Durham explains, however, “treating” and “treatment” are generic terms commonly used in the oil and gas industry to refer to the introduction of chemicals or fluids into a wellbore for any number of purposes. Ex. 2004 at ¶ 132. As Dr. Durham further explains, a POSITA reading Crossley would have readily understood different treatments to have different purposes based on the chemicals or fluids being used. *Id.*

As explained above, a POSITA would have recognized that the production chemicals introduced by Crossley’s operations control system have a completely different purpose (*i.e.*, preventing buildup during oil and gas production) than the acid and other treating fluids of Crossley’s intervention system (*i.e.*, reservoir stimulation to prolong oil and gas production). *Id.*; Ex. 2005 at 147:12-16 (“Q:These production chemicals such as hydrate paraffin wax inhibitors, they are not used in stimulation operations; are they? A:No.”), 176:13-177:3 (“A:Yes, acid is used in acid fracturing. That’s correct. Q:Which is a reservoir stimulation process, correct? A:Correct.”). Furthermore, a POSITA would have understood Albers’s fracture-stimulation fluid to serve the same purpose as the fluid used by Crossley’s intervention system and not by Crossley’s operations control system. Ex. 2004 at ¶ 132; Ex. 2005 at 164:5-12, 168:10-14 (Dr. Nikolaou identifying both “acid fracturing” and “the fracture stimulation that’s disclosed in Albers” as “reservoir stimulation”). Like the acids and other treating fluids that are injected by

Crossley's intervention system, the purpose of Albers's fluids is to stimulate fractures in order to enhance oil and gas wells. Ex. 1006 at 2:58-67 ("The present invention essentially comprises a method of fracture stimulating a formation in a subterranean well bore, the method including the steps of ... pumping the dehydrated slurry with gaseous nitrogen into the well bore at a pump rate and pressure sufficient to fracture stimulate the formation."); Ex. 2004 at ¶ 104; Ex. 2005 at 65:8-12 (Albers's "main concern is how you do stimulation regardless of the particular configuration onshore or offshore."), 65:16-17 ("[T]he focus is on stimulation.").

Thus, even if Albers's fracture-stimulating equipment was included on Crossley's vessel as proposed in the Petition, a POSITA would have been led to introduce a well stimulation fluid manufactured by Albers's fracture-stimulating equipment to the wells, pads, and plurality of wells shown in Crossley using Crossley's intervention system, because Crossley's intervention system is already used to introduce a fluid having the same purpose. Ex. 2004 at ¶ 136. As a result, a POSITA would have been led in a direction divergent from the path that was taken by Patent Owner in the '394 Patent—namely, **simultaneous** flow of two different stimulation fluids to two different wells, pads, or plurality of wells—because Crossley's intervention system is used "for conducting intervention services to an **individual** well." Ex. 1005 at [0020]; *see also id.* at Abstract, [0010], [0025],

[0026], [0030], [0037], [0038], [0056], [0061], Cl. 1 (disclosing intervention services for only one “an individual well” at a time); Ex. 2004 at ¶¶ 133-136.

The Petition fails to account for Crossley’s intervention system or provide any reason a POSITA would have been motivated to use Crossley’s operations control system instead of Crossley’s intervention system, which is already designed to introduce the exact type of fluid manufactured by Albers’s fracture-stimulating equipment. Indeed, as discussed above, Crossley’s operations control system is used to inject “production chemicals,” such as “hydrate, paraffin, or wax inhibitors,” which serve an entirely different purpose than the acid or other treating fluids of Crossley and the well stimulation fluid of Albers. Ex. 1005 at [0009], [0049]. A POSITA would have naturally followed the path already set out in Crossley—namely, using the intervention system to introduce a well stimulation fluid separately to each individual well, which does not meet the limitation of the ’394 Patent’s claims. Ex. 2004 at ¶¶ 133-136. This is also consistent with how the same fluid is introduced to the well in Albers. *Id.*

While Crossley discloses an operations control system that can provide “well-site operations simultaneously to each of the first well-site and a second well-site,” **the system in Crossley that would be used to provide stimulation fluids (*i.e.*, the intervention system) only provides stimulation fluids to wells on an individual basis.** See Ex. 1005 at Abstract, [0010], [0020], [0025], [0026],

[0030], [0037], [0038], [0056], [0061], Cl. 1 (disclosing intervention services for only one “an individual well” at a time); Ex. 2004 at ¶ 133. This type of activity does not meet the claim limitations of the ’394 Patent.

Because Crossley teaches away from using its operations control system to simultaneously flow well stimulation fluids made by Albers’s fracture-stimulation equipment, the Petition fails to establish that the combination of Crossley/Albers renders obvious the claims of the ’394 Patent.

D. All Grounds Further Fail as to All Claims Because the Crossley/Albers Combination Does Not Disclose or Render Obvious Each Element of Independent Claims 1 and 24-27.

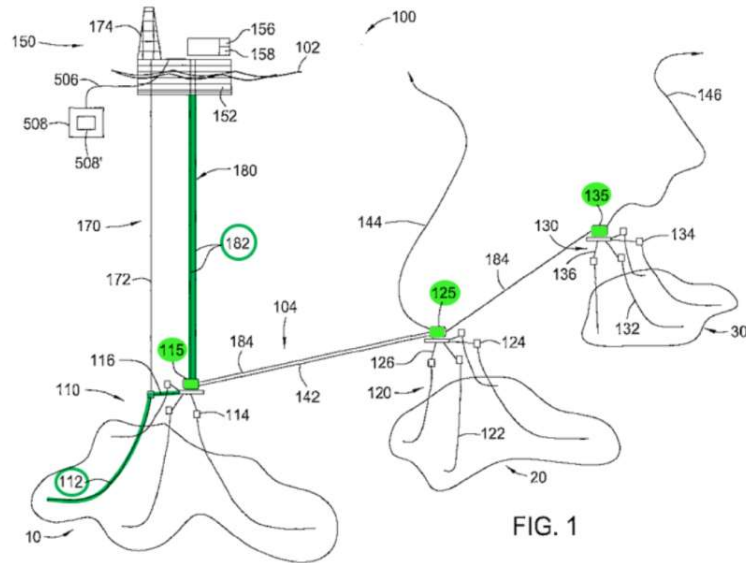
The Petition relies on Crossley’s “operations control system” for the vast majority of the limitations in independent claims 1 and 24-27, but states that “Crossley does not expressly disclose ‘*manufactur[ing] a well stimulation fluid.*’” *See* Pet. at 21, 57-61. For that limitation, the Petition proposes to modify Crossley’s vessel to include Albers’s fracture-stimulating equipment shown in Figure 1, *see id.* at 11-12, and then to pump Albers’s well stimulation fluid through the fluid distribution lines in Crossley’s operations control system that are used to inject “chemicals such as hydrate, paraffin, or wax inhibitors,” *see id.* at 7, 20, 27-33. Even if it would have been obvious to combine the teachings of Crossley and Albers as proposed in the Petition, *see* Pet. at 11-17, the Petition fails to show how

the Crossley/Albers combination discloses or suggests the limitations required by independent claims 1 and 24-27.

1. *Claim Limitations 1[D], 24[D], 25[D], 26[D], and 27[D]: “means for simultaneously flowing: a first stimulation fluid to the first [well / pad / plurality of wells] and not to the second [well / pad / plurality of wells]; and a second stimulation fluid to the second [well / pad / plurality of wells] and not to the first [well / pad / plurality of wells]”*

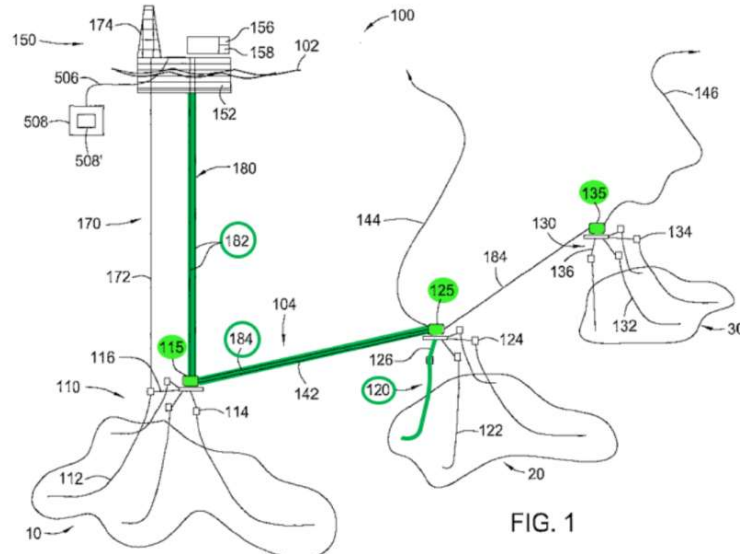
The Petition fails to establish that the Crossley/Albers combination discloses or suggests a means for **simultaneously flowing**: (1) a first stimulation fluid to the first well / pad / plurality of wells **and not to** the second well / pad / plurality of wells, and (2) a second stimulation fluid to the second well / pad / plurality of wells **and not to** the first well / pad / plurality of wells, as required by independent claims 1 and 24-27. Ex. 2004 at § XI.D.1, 24-27. The Petition relies on the same connection 182 in Crossley (shown in green in the below annotated figures from the Petition) as part of the means for flowing both “a first stimulation fluid” and “a second stimulation fluid” from the vessel 150 to a first well, pad, or plurality of wells and a second well, pad, or plurality of wells, respectively:

Petition's Path For First Stimulation Fluid



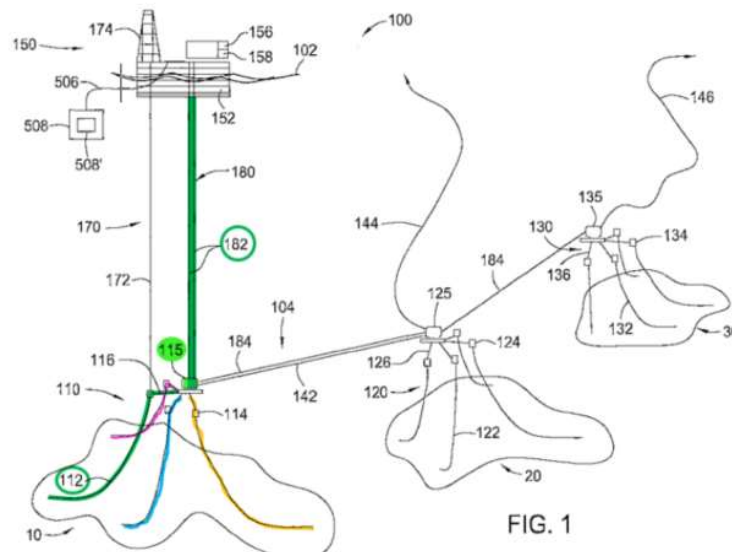
Pet. at 29-30 (“Crossley/Albers would direct one stimulation fluid flowing from the vessel to well-site 110 and well 112 (‘a first well’) via connection 180 and jumper 116 and associated tree (a ‘first connection’) and through manifold 115.”).

Petition's Paths For Second Stimulation Fluid



Id. at 30-31 (“the vessel would selectively direct a ‘second stimulation fluid’ directed to well-site 120 and well 122 (‘a second well’) via manifolds 115 and 125

and control line 184 and jumper 126 and associated tree (*‘a second connection’*)).⁵



Id. at 31-32 (“Alternatively . . . the ‘*second stimulation fluid*’ would be directed to a ‘*second well*’ at well-site 110”).

The Petition, however, fails to explain how a first fluid traveling from the vessel 150 through connection 182 could flow to well 112 **and not to** a well at well-site 120 such as well 122 (or, alternatively, a second well within well-site 110) **while simultaneously** a second fluid traveling from the vessel 150 through **the same connection 182** could flow to a well at well-site 120 such as well 122 (or, alternatively, a second well within well-site 110) **and not to** well 112. When

⁵ The annotated figure in the Petition highlights an unlabeled well at well-site 120 as the second well; however, the Petition text maps well 122 as the second well.

asked in his deposition whether manifold 115 and manifold 125 would each get the fluid that flows down line 182, Dr. Nikolaou testified that “**somehow** that fluid would have to flow down 182 along with whatever other fluids are needed to be passed down to 115 and 125. And then **a decision would be made or a valve would be activated to direct those fluids accordingly**, either ... to each well, the collection number 10 or each well collection number 20.” Ex. 2005 at 122:3-123:14. But Crossley does not disclose any “decision ... made” or any “valve that would be activated” that would result in the claimed fluid flow, and the Petition’s assertion that it would have been obvious to direct fluid flow as claimed is based purely on hindsight.

The Petition relies on Crossley’s disclosures that its operations control system 180 controls the “valve, pump, line or sensor . . . associated with the collection manifold or with an individual well or flowline” and that “[t]he trees of each well—depicted as a box (*e.g.*, 114) on each well—‘have valves for controlling or shutting off fluid.’” Pet. at 24, n.1, 27 (citing Ex. 1005 at [0036], [0044]). The Petition further relies on Crossley’s “surface vessel control link **selectively connectible** with the control module at the first well-site and the control module at a second well-site” and from this disclosure concludes that Crossley’s “manifolds are used to **selectively deliver** fluids from vessel 150.” Pet. at 28 (citing Ex. 1005 at [0028]). Dr. Nikolaou then states that “by **selectively controlling**

Crossley's manifolds . . . Crossley's system would be configured to direct the field-optimizing well-stimulation fluids of Albers to flow using different paths." Pet. at 29. Dr. Nikolaou further states that various configurations of Crossley's manifolds 115, 125, and 135 "would **selectively direct**" Albers's stimulation fluid to various wells. Pet. at 29-32. Finally, Dr. Nikolaou states that fluid distribution lines 428 and 428' "would expressly permit the 'simultaneous' distribution of [Albers'] well-stimulation fluids to a single well or to two different wells—one through 428 and second through 428'."

The Petition and Dr. Nikolaou latch onto and then misinterpret Crossley's "selectively connectible" language and use it to assert that Crossley somehow discloses "selectively deliver[ing]" fluids, "selectively controlling" manifolds, and "selectively direct[ing]" fluids through Crossley's system. Crossley's disclosure of a "surface vessel control link **selectively connectible** with the control module at the first well-site and the control module at a second well-site" simply means that the control link may be connected to a first well-site, a second well-site, or both. Ex. 2004 at ¶ 143; Ex. 2005 at 103:12-17 ("In this sentence it just explains that there's a capability ... for control rather of both si[t]es in the configuration that is discussed there."). Indeed, Crossley states "[t]he terms 'detachable' and 'selectively connectible' may be used interchangeably with the term 'reconnectible.'" Ex. 1005 at [0035]. Crossley's disclosures of "selectively

connectible” upon which the Petition and Dr. Nikolaou rely has nothing to do with controlling how fluids are directed to particular subsea equipment or wellbores located at the first well-site or the second well-site. Ex. 2004 at ¶ 143.

There is no disclosure in Crossley of the simultaneous flowing required by the claims of the ’394 Patent. *Id.* at ¶ 144. The Petition’s explanation for this limitation is based on a hindsight-laden reading of Crossley. At best, Crossley discloses control lines for “valves, gauges, and other subsea equipment” that include “chemical delivery lines to be delivered from the ocean surface, downward to the clustered wells.” Ex. 1005 at [0005]. This disclosure does not amount to **selective** control over manifolds, or more specifically, **selective** control over manifolds that would enable simultaneous flow of one fluid to one well and another fluid to another well. Ex. 2004 at ¶ 144. Petitioner’s analysis jumps to this conclusion using the ’394 Patent as a guide.

Furthermore, with respect to Figure 4, even if Crossley associated the individual fluid distribution lines 428 and 428’ with the manifold valves or some type of structure to control fluid flow, there’s nothing in Crossley that would teach or suggest that distribution line 428 would deliver fluid to one well while distribution line 428’ would simultaneously deliver another fluid to another well. *Id.* at ¶ 145. There is no such teaching of simultaneous flow of different fluids to different wells in Albers either. *Id.* at ¶ 154. Notably, the Petition does not argue

that Crossley, Albers, or that the combined system would be modified to do this, nor does the Petition provide any reasons that would motivate a POSITA to make such modifications. The Petition simply argues that certain configurations would implement the claimed fluid flow without showing that such configurations are disclosed or how or why one would modify the references to teach them. Indeed, when asked in his deposition to identify where Crossley describes a configuration of valves that would be needed to implement the claimed fluid flow, Dr. Nikolaou merely identified Crossley's general disclosures of valves and delivery of fluid to multiple wells. Ex. 2005 at 115:20-117:12 ("Crossley may not use that specific language but he certainly talks about valves and he certainly talks about delivering fluids at various wells using central control"). He further conceded that what control signals would be sent to Crossley's valves to enable the claimed fluid flow "wasn't even the focus of this discussion." Ex. 2005 at 118:6-11.

Indeed, Crossley does not disclose, teach or suggest flow of a first fluid to one well and simultaneous flow a second fluid to another well. Ex. 2004 at ¶ 144. Crossley provides limited disclosure related to the operation of its collection manifolds 115, 125, and 135. For instance, Crossley discloses that control modules may be incorporated into collection manifolds 115, 125, and 135 and used, in relevant part, to direct fluids to subsea equipment; but it omits any specifics as to how such fluids are directed aside from the general disclosure that the collection

manifolds 115, 125, and 135 have an associated “valve or pump.” *See, e.g.*, Ex. 1005 at [0049], [0057]; Ex. 2004 at ¶¶ 145-146. Moreover, Crossley’s disclosure that “the trees 114, 124, 134 of each well have valves for controlling or shutting off fluid flow from the wellbores” makes clear that the valve to each well is either: (1) open to permit fluid from connection 182 to flow to the well, or (2) closed to prevent fluid from connection 182 from flowing to the well. Ex. 1005 at [0044]; Ex. 2004 at ¶ 146. For there to be simultaneous flow to both well 112 and well 122 (or, alternatively, a second well within well-site 110), as proposed in the Petition, then the valves to both well 112 and well 122 must be open and whatever fluid is traveling from vessel 150 through connection 182 would necessarily flow to both wells. *Id.* This does not meet the claim language. And nowhere does Crossley disclose or suggest anything that would.

The Petition next focuses on Crossley’s disclosure of “fluid distribution lines 428, [and] 428” that are “**preserved for the delivery of chemicals**, such as hydrate inhibition fluids,” *see* Pet. at 32-33 (citing Ex. 1005 at [0050]), and relies on the conclusory statement of its expert, Dr. Nikolaou, that “lines 428 and 428’ ... **expressly permit** the ‘*simultaneous*’ distribution of well-stimulation fluids to a single well **or two different wells**—one through 428 and one through 428’.” Ex. 1003 at ¶ 91; Pet. at 33 (citing Ex. 1003 at ¶ 91) (bold emphasis added). But this still does not cure the Petition’s deficiencies. Dr. Nikolaou again fails to provide

any explanation as to how fluid distribution lines 428, 428' “expressly permit” simultaneous distribution to two different wells, as required by independent claims 1 and 24-27; Ex. 2004 at ¶ 148. To the contrary, Crossley discloses, and the Petition even acknowledges, that fluid distribution lines 428, 428' are integrated into a single line 420, as shown in Figure 4:

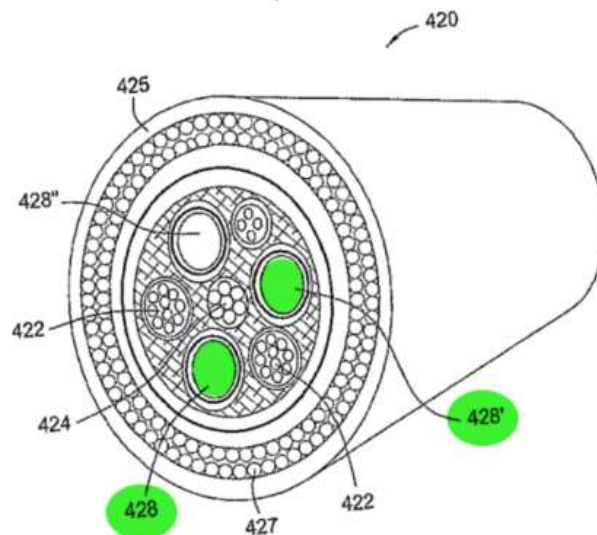


FIG. 4

Pet. at 33 (annotating Ex. 1005 at FIG. 4); Ex. 1005 at [0050].

Neither the Petition nor Dr. Nikolaou provides any explanation as to why a POSITA would have understood it possible that the fluid in line 428 would or could travel to a first well, pad, or plurality of wells and not a second well, pad, or plurality of wells while the fluid in line 428' would simultaneously travel to the second well, pad or plurality of wells and not the first well, pad, or plurality of wells, as required by independent claims 1 and 24-27. To the contrary, Crossley

discloses that “[c]hemicals may be delivered from the lines 428, 428’ and then through the manifold 115 for treatment of flow lines, valves, and even the wellbores as appropriate,” Ex. [1005] at [0050], which a POSITA would have understood to mean that the chemicals in both line 428 and line 428’ travel **together** into manifold 115 and are distributed **together** into any flowlines, valves, or wellbore that are open, Ex. 2004 at ¶ 146. As Dr. Durham explains, based on Crossley’s disclosure that all production fluids are commingled for unitary transport, a POSITA would not have been concerned with simultaneously delivering two different production chemicals to two different wells, pads, or plurality of wells as recited in the challenged claims because those production chemicals are mixed with the production fluids and end up commingled as well. Ex. 2004 at ¶ 149.

The Petitioner’s and its expert’s conclusory assertions, devoid of reasoning or supporting evidence, are insufficient to support an argument of obviousness. *See ActiveVideo Networks v. Verizon*, 694 F. 3d 1312, 1327 (Fed. Cir. 2012) (finding non-obviousness as a matter of law where “[t]he expert failed to explain ... how any specific combination would operate or read on the asserted claims”). As the Federal Circuit noted in *ActiveVideo*, this slipshod approach to obviousness fails because it “is fraught with hindsight bias.” *Id.* That is especially the case here as Petitioner and its expert rely heavily on International Patent Publication

WO2007/024383 by Tolman *et al.* that does not qualify as prior art. *See* Pet. at 28-29 (citing Ex. 1008); Ex. 1003 at ¶ 85 (citing Ex. 1008); *see supra* n.4.

Because Petitioner has failed to offer this necessary explanation to support its obviousness arguments as part of its Petition, and because the Board is limited in this proceeding to the arguments and theories raised in the Petition, the Petition should be denied. *Apple Inc. v. MPH Techs. Oy*, No. 2021-1355, 2022 WL 4103286 (Fed. Cir. Sept. 8, 2022) (nonprecedential) (“We have previously reversed Board decisions that found a motivation to combine where the petitioner presented only threadbare arguments to support its combination”); *see also SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348, 1357 (2018) (“[T]he petitioner’s contentions . . . define the scope of the litigation all the way from institution through to conclusion.”).

2. *Claims 1[E], 24[E], 25[E], and 26[E]: “wherein the first stimulation fluid and the second stimulation fluid have different compositions”*

The Petition’s deficiencies are even more apparent in view of the additional requirement in independent claims 1 and 24-26 that “the first stimulation fluid and the second stimulation fluid have different compositions.” *See* Ex. 2004 at § XI.D.1, 24-26. With respect to this limitation, the ID states that “[t]he Petition does not rely on Albers for teaching a device that prepares two different compositions at the same time,” and that “the Petition relies on Albers for teaching that different

formations, i.e., wells, may require different compositions.” ID at 19. However, Dr. Nikolaou confirmed in his deposition that the combination of Albers and Crossley relies on Albers’s equipment to be the well treatment operations factory that manufactures the first and second stimulation fluids as required by the claims of the ’394 Patent. Ex. 2005 at 72:7-15, 156:14-19. Dr. Nikolaou further testified that it “[m]akes sense” that, in order to simultaneously flow the first and second stimulation fluids, as required by the claims of the ’394 Patent, the first and second stimulation fluids would need to be manufactured simultaneously. Ex. 2005 at 156:20-157:3; *see also* Ex. 2004 at ¶ 151.

Petitioner must offer “a sufficient explanation of how the references may be combined, from the perspective of one with ordinary skill in the art, to arrive at the claimed invention, and why the proffered combination accounts for all the features of each claim.” *Dominion Dealer Sols., LLC v. AutoAlert, Inc.*, IPR2013-00223, Paper 9 at 19 (P.T.A.B. Aug. 15, 2013). However, neither the Petition nor Dr. Nikolaou offer any explanation for how the first and second stimulation fluids having two different compositions would be manufactured simultaneously in the Crossley/Albers combination as Dr. Nikolaou concedes is required to satisfy the claims of the ’394 Patent. As discussed above, *see supra* § V.B, Albers discloses manufacturing a **single** well treatment fluid for a **single** well having a concentration of proppant that changes **over time** using either a “step” procedure

or a “ramp” procedure. Ex. 1006 at 6:50-7:25, FIGS. 1, 5-8; Ex. 2004 at ¶¶ 152-154. While the ID states that “there is no evidence that such a modification or duplication of Albers system to prepare two separate compositions is beyond the skill of one of ordinary skill in the art,” ID at 19, neither the Petition nor Dr. Nikolaou offers any modification of Albers’s fracture-stimulating equipment that would enable the claimed simultaneous flow of two different well stimulation fluids having two different concentrations. Ex. 2004 at ¶ 155. As for duplication of Albers’s fracture-stimulating equipment, Dr. Durham explains that a POSITA would not have had a reasonable expectation of success including Albers’s fracture-stimulation equipment on Crossley’s vessel at all, much less in duplicate, given power constraints. *Id.*

Thus, Albers does not disclose manufacturing two different well stimulation fluids **at the same time** where each has a different composition, such that those two fluids could be **simultaneously** flowed into two different wells, pads, or plurality of wells, as required by independent claims 1 and 24-26, and Petitioners has failed to satisfy its burden of establishing that it would have been obvious to a POSITA to have modified or duplicated Albers’s fracture-stimulating equipment in such a way that meets this claim limitation of the ’394 Patent.

3. *Claim 27[A]: “a well treatment operations factory capable of manufacturing and simultaneously pumping a plurality of well stimulation fluids”*

Unlike the other independent claims, independent claim 27 requires “a well treatment operations factory capable of manufacturing and simultaneously pumping a plurality of well stimulation fluids.” The Petition, however, does not separately address this limitation and instead relies upon the same arguments presented for limitations 1[A], 1[D] and 1[E]. *See* Pet. at 61. As discussed above, the Petition fails to establish that the Crossley/Albers combination discloses or suggests limitations 1[D] and 1[E]. The Petition likewise fails to establish that the Crossley/Albers combination discloses or suggests limitation 27[A] for these same reasons. More specifically, the Petition fails to establish that Albers’s fracture-stimulating equipment is capable of manufacturing and simultaneously pumping a plurality of well stimulation fluids. Ex. 2004 at ¶¶ 202-205. And neither Petitioner nor Dr. Nikolaou offers any modification that would enable it to do so.

E. All Grounds Also Fail As to the Dependent Claims

1. *Dependent Claims 2-23*

Dependent claims 2-23 each depend directly or indirectly from independent claim 1. Thus, all grounds fail as to dependent claims 2-23 for the same reasons provided above with respect to independent claim 1. *See* Ex. 2004 at § XI.D.2-23. All grounds further fail with respect to dependent claims 6, 8, 9, 11, 13, 16-20, and 23 for the additional reasons provided below.

2. *Dependent Claim 6: “the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, the proppant storage system, the first well, and the second well”*

The Petition reads on Crossley’s “power delivery system 156” onto the “power unit” of dependent claim 6 and asserts the power delivery system would be connected to the pumping grid, blending unit, and the proppant storage system from Albers in addition to the existing manifold and wells in Crossley. Pet. at 40. However, as Dr. Durham explains, Albers’s pump alone would require over 3,000 additional horsepower. Ex. 2004 at ¶ 162. The Petition fails to provide any reason why a POSITA would have had a reasonable expectation that Crossley’s power delivery system would be operable to connect (i.e., provide power sufficient to operate) Albers’s high horsepower pump and other fracture-stimulation equipment in addition to the existing “high power production equipment” that already exists on Crossley’s vessel. *Id.* And Dr. Nikolaou had not even considered this either. When asked in his deposition asked whether “Crossley’s power delivery system would have sufficient power to power Crossley’s components in addition to the blending unit and proppant storage system” of Albers, Dr. Nikolaou conceded that he “would have to think about that.” Ex. 2005 at 195:5-11.

3. ***Dependent Claim 8: “the well operations factory comprises a chemical storage system wherein the chemical storage system is operable to connect to the blending unit”***

Dependent claim 8 requires that the “chemical storage system is operable to connect to the blending unit.” The ’394 Patent explains that “the blending unit 105 is connected to the **chemical storage system** 112, the **proppant storage system** 106, a **water source** 202, and a pumping grid 111 and may prepare a fracturing fluid ... by mixing and blending fluids and chemicals” Ex. 1001 at 4:22-28. Thus, in the ’394 Patent, the chemical storage system is separate and distinct from the water source, and each is connected to the blending unit. Ex. 2004 at ¶ 166.

Albers discloses that its “blender unit draws fluid from a **fluid storage device**, draws proppant from a **sand trailer**, and mixes the two in a blender tub to form a slurry.” Ex. 1006 at 2:1-4. Albers does not disclose a chemical storage system operable to connect to the blending unit. Ex. 2004 at ¶ 167. The Petition nevertheless reads Albers’s “fluid storage device” on the “chemical storage system” of dependent claim 8. Pet. at 41-42. Albers’s fluid storage device contains “an uncomplexed **fluid**, which ... is preferably clay-stabilized or gelled water but can be any suitable fluid including a methanol water or a hydrocarbon-based fluid.” Ex. 1006 at 4:51-56. Dr. Nikolaou testified in his deposition that it’s “not unfair” to consider “clay-stabilized or gelled water” as “chemicals mixed with water.” Ex. 2005 at 201:8-21. However, there is no disclosure or teaching in Albers

of a separate chemical storage system that contains those chemicals before they are mixed with water. Ex. 2004 at ¶ 168. And the Petition fails to provide any reason a POSITA would have been motivated to modify Albers's disclosed fracture-stimulation equipment to include one as opposed to pre-mixing the chemicals into the water offsite. *Id.* This is not “an issue of semantics” as Dr. Nikolaou suggested. Ex. 2005 at 201:18-21. The Petition fails to meet its burden to show that Albers teaches or discloses a “chemical storage system operable to connect to the blending unit” as required by dependent claim 8.

4. ***Dependent Claim 9: “the well operations factory comprises a power unit operable to connect to the manifold, pumping grid, blending unit, the chemical storage system, the first well, and the second well”***

Dependent claim 9 contains similar limitations to those recited in dependent claims 6 and 8. The Petition fails to establish that the Crossley/Albers combination renders dependent claim 9 obvious for the same reasons provided for those claims. *See supra* § VI.E.2-3; Ex, 2004 at ¶ 170.

5. ***Dependent Claims 11 and 13: “the [first/second] connection is operable to deliver a [stimulation] fluid from the [first/second] well to the manifold”***

The Petition emphasizes that “each well [in Crossley] has a **flow line jumper**” that “‘tie[s] into a collection manifold’ so that ‘**production fluids from a well-site** can be commingled for unitary transport to another location.’” Pet. at 62 (citing Ex. 1005 at [0045]) (emphasis in original). The Petition further concedes

that “Crossley does not explicitly state that the flow line jumpers return a stimulation fluid,” but nevertheless argues it would have been obvious to do so in the combination of Crossley/Albers or, in the alternative, in view of Lehman. Pet. at 43, 45, 62-64. As Dr. Durham explains, however, a POSITA would not have been motivated to use Crossley’s system that commingles production fluids for unitary transport to flowback fracture-stimulation fluids because doing so would result in either: (1) fracture-stimulation fluid being commingled with production fluids thereby adding further time and expense to separate the fluids, or (2) if commingling these two fluids was to be avoided, significant delay of production (on the order of months) while fracture-stimulation fluid was flowed back from every well in Crossley’s cluster of wells. Ex. 2004 at ¶¶ 175-176. Furthermore, with respect to Lehman, Albers distinguishes its gaseous nitrogen fracture-stimulation fluids from the two types of fracture-stimulation fluids discussed in Lehman as being suitable for Lehman’s flowback (e.g., water-based fluids and foam-based fluids). Ex. 1006 at 1:6-61; Ex. 1009 at [0059], [0079]; Ex. 2005 at 193:17-21; Ex. 2004 at ¶ 211. Thus, the Petition has not established at a POSITA would have been motivated by Lehman to flowback Albers’s fracture-stimulation fluid.

6. *Dependent Claims 16-19: “[third/fourth] connection between the manifold and the [first/second] well” and “operable to deliver a fluid from the [first/second] well to the manifold”*

The Petition apparently relies on Crossley’s disclosures of “one or more strings of production tubing” as being the claimed third and fourth connections. Pet. at 49-50. However, these strings of production tubing stop at the wellhead and do not extend to the manifold. Ex. 2004 at ¶ 183. More specifically, Crossley discloses “that one or more strings of production tubing are provided in the wellbore of each well ... to provide a flowpath for production fluids to the wellhead” and that each well has a tree at the wellhead and then a flow line jumper extending from the tree to the collection manifold. Ex. 1005 at [0044]-[0045].

Thus, Crossley discloses only a singular connection per well (*i.e.*, the flow line jumper) that extends between the manifold and the well. Ex. 2004 at ¶ 184. Indeed, Dr. Nikolaou conceded in his deposition that Crossley does not disclose multiple flowpaths in the flow line jumper, testifying the “one or more strings of production tubing ... provide a flow path for production to the wellhead ..., and from that point on, there’s no discussion as to what happens in the jumper from there to the manifold.”). Ex. 2005 at 208:7-16. The same is true of Albers. Ex. 2004 at ¶ 185. Thus, the Petition improperly relies on the same connection as both the first and third connections and the same connection as both the second and fourth connections and therefore fails to establish that the Crossley/Albers

combination discloses the claimed third and fourth connections. Ex. 2004 at § XI.D.16-19.

7. ***Dependent Claim 20: “the well operations factory and means for simultaneously flowing treatment fluid are located on a boat”***

The Petition reads Crossley’s collection manifolds on the claimed “means for simultaneously flowing,” but as the Petition acknowledges, Crossley’s collection manifolds are underwater and are not located on a boat in the embodiment on which it relies. Pet. at 52. The Petition nevertheless asserts it would have been obvious to have the collection manifolds located on the boat because it would be easier to perform maintenance on them and it would have been obvious to try given a finite number of identified, predictable solutions. *Id.* However, Dr. Nikolaou conceded in his deposition that “[i]t’s logical the collection manifolds are where they are” and that he “ha[d]n’t thought about” whether to put them on Crossley’s boat. Ex. 2005 at 211:20-212:14.

Furthermore, as Dr. Durham explains, relocating Crossley’s collection manifolds to the boat would be contrary to Crossley’s teaching that the use of the collection manifolds enables “production fluids from a well-site [to] be commingled for unitary transportation to another location (such as a gathering facility seen at 190 in Figure 5).” Ex. 1005 at [0045]; Ex. 2004 at ¶ 192. Thus, the

Petition fails to establish that a POSITA would have been motivated to relocate Crossley's collection manifolds to the boat.

* * * * *

Accordingly, Petitioner has failed to demonstrate that the Challenged Claims are rendered obvious by the Grounds in the Petition.

VII. CONCLUSION

For the foregoing reasons, Patent Owner respectfully requests that the Board deny the Petition.

July 11, 2024
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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Response has a word count of 13,990, as defined by 37 C.F.R. § 42.24 using the word count feature of Microsoft Word.

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. § 42.6(e), the undersigned certifies that on the 11th day of July, 2024, a complete and entire copy of PATENT OWNER'S RESPONSE UNDER 37 C.F.R. § 42.107 and related documents were served on Petitioner via electronic mail to counsel for Petition at the following addresses:

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