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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HALLIBURTON ENERGY SERVICES, INC.,

Petitioner,

v.

U.S. WELL SERVICES, LLC, Patent Owner.

> IPR2021-01538 Patent 10,408,031 B2

Before LYNNE H. BROWNE, GEORGE R. HOSKINS, and SEAN P. O'HANLON, *Administrative Patent Judges*.

BROWNE, Administrative Patent Judge.

JUDGMENT Final Written Decision Determining All Claims Unpatentable 35 U.S.C. § 318(a)

I. INTRODUCTION

Halliburton Energy Services Inc. ("Petitioner"), on September 23, 2021, filed a Petition requesting *inter partes* review of claims 1–8 of U.S. Patent No. 10,408,031 B2 ("the '031 patent"). Paper 2 ("Pet."). We issued a Decision to Institute an *inter partes* review (Paper 9, "Dec.") of all challenged claims under all grounds.

After institution of trial, U.S. Well Services, LLC ("Patent Owner") filed a Patent Owner Response (Paper 14, "PO Resp."). Thereafter, Petitioner filed a Petitioner's Reply to Patent Owner's Response (Paper 20, "Pet. Reply"). Patent Owner did not file a Patent Owner's Sur-Reply.

Oral argument was conducted on December 14, 2022, for this proceeding and the transcript of the hearing has been entered as Paper 29.

We have jurisdiction under 35 U.S.C. § 6 and issue this decision under 35 U.S.C. § 318(a). After considering the evidence and arguments of both parties, and for the reasons set forth below, we determine that Petitioner has met its burden of showing, by a preponderance of the evidence, that claims 1–8 are unpatentable.

II. BACKGROUND

A. Real Parties-in-Interest and Related Proceedings

Petitioner identifies three companies as real parties-in-interest: itself; Halliburton Co.; and Halliburton Holdings LLC. *See* Pet. 1. Patent Owner identifies itself and ProFrac Holding Corporation as the real parties-in-interest. Paper 5, 1; Paper 28, 1.

The parties state that the '031 patent has not been asserted in litigation. Pet. 1; Paper 5, 1. The parties state that Petitioner filed petitions

for *inter partes* review against other patents held by Patent Owner, including: IPR2021-01032 against U.S. Pat. No. 9,410,410; IPR2021-01033 against U.S. Pat. No. 8,789,601; IPR2021-01034 against U.S. Pat. No. 10,337,308; IPR2021-01035 against U.S. Pat. No. 9,970,278; IPR2021-01036 against U.S. Pat. No. 9,611,728; IPR2021-01037 against U.S. Pat. No. 9,745,840; IPR2021-01038 against U.S. Pat. No. 10,408,030; IPR2021-01065 against U.S. Pat. No. 9,840,901; IPR2021-01066 against U.S. Pat. No. 10,020,711; IPR2021-01238 against U.S. Pat. No. 10,526,882; IPR2021-01315 against U.S. Pat. No. 9,893,500; IPR2021-01316 against U.S. Pat. No. 10,280,724; and IPR2021-01539 against U.S. Pat. No. 10,648,311. Pet. 1; Paper 5, 1.

B. The '031 Patent

The '031 patent for an "Automated Fracturing System and Method," issued September 10, 2019. Ex. 1001, codes (45), (54). It relates to an automated hydraulic fracturing system including an automated control system configured to monitor parameters of the automated hydraulic fracturing system via a plurality of sensing devices and transmit control instructions for one or more control devices to control an aspect of the automated system. *Id.* at code (57), 1:46–67. Figure 2 of the '031 patent is reproduced below.

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FIG.2

Figure 2 shows a schematic of an automated hydraulic fracturing system 40. *Id.* at 3:1–3. As shown in Figure 2, hydraulic fracturing system 40 includes several components for pressurizing wellbore 42. *Id.* at Fig. 2, 4:21–24. Specifically, hydraulic fracturing system 40 includes fluid source 50 (represented by a large chamfered rectangle) in the upper left corner of the figure. *Id.* at Fig. 2, 4:25–26. To the right of fluid source 50 is additive source 54 (represented by a small rectangle). *Id.* at Fig. 2, 4:26–30. Below and to the right of additive source 54 is hydration unit 48 (represented by a large rectangle). *Id.* at Fig. 2, 4:25–26. Above and to the right of hydration unit 48 is proppant source 62 (represented by a cylinder). *Id.* at Fig. 2,

4:36–38. Below and to the right of proppant source 62 is blender unit 58 (represented by a large rectangle). *Id.* at Fig. 2, 4:36. To the right of blender unit 58 is fracturing pump system 66 (represented by a chamfered rectangle) and below it is motor 69 (represented by a small rectangle). *Id.* at Fig. 2, 4:53–57. To the right of fracturing pump system 66 is wellhead assembly 71 (represented by a small rectangle). *Id.* at Fig. 2, 4:58–59. Below wellhead assembly 71 is wellbore 42 (shown as a vertical tunnel shaft) in subterranean formation 46 (represented by a large rectangle filled with cross-hatching). *Id.* at Fig. 2, 4:58–5:3.

Figure 2 further illustrates transformer 86 (represented by a small rectangle) below and between hydration unit 48 and blender unit 58. Ex. 1001, Fig. 2, 5:15–21. Below transformer 86 is generator 80 (also represented by a small rectangle). Id. To the left of generator 80 is turbine 74 (represented by a truncated cone) and below it is fuel source 76 (represented by a chamfered square). Id. at Fig. 2, 5:4-6. "Electricity generated in generator 80 is conveyed to transformer 86 via line 88" (represented by a dashed line extending between generator 80 and transformer 86). Id. at Fig. 2, 5:27–28. Transformer 86 is also connected to power bus 90 (represented by a horizontal dashed line extending from a point below the left half of fluid source 50 to motor 69) having lines 92, 94, 96, 98, and 100 (each of these lines is represented by a dashed vertical line extending from bus 90 as described below) connected thereto. Id. at Fig. 2, 5:32–33. "[L]ine 92 connects fluid source [50] to bus 90, line 94 connects additive source [54] to bus 90, line 96 connects hydration unit [48] to bus 90, line 98 connects proppant source [52] to bus 90, line 100 connects

blender unit [58] to bus 90." *Id.* at Fig. 2, 5:36–39. A portion of bus 90 extends past line 100 as line 101, connecting bus 90 to an optional variable frequency drive 102, connected to motor 69 by line 103. *Id.* at Fig. 2, 5:40–42.

Figure 2 further illustrates instrumentation devices 104 as small cubes within each component, including sensors 106 (cubes labeled "S") and controllers 108 (cubes labeled "C"), "arranged throughout the hydraulic fracturing system 40 and coupled to one or more of" the system components, including any of hydration unit 48, additive source 54, blender unit 58, proppant source 62, and pump 66. *Id.* at 5:53–63. "[I]nstrumentation 104 may include various sensors, actuators, and/or controllers." *Id.* at 5:63–64. "[T]he sensors may transmit data to a data van 38 [see Fig. 1], for collection and analysis, among other things." *Id.* at 6:38–39. The system also allows "for remote monitoring and control from diverse location[s] Fracturing control may be integrated in with the sensor and monitoring packages 104 to allow for automated action to be taken when/if needed." *Id.* at 6:48–52.

In operation, hydration unit 48 receives fluid from fluid source 50 via line 52 (represented by a solid arrow extending from the bottom of fluid source 50 to the left side of hydration unit 48). Ex. 1001, Fig. 2, 4:25–26. Hydration unit 48 also selectively receives additives from additive source 54 via line 56 (represented by a solid arrow extending from the right side of additive source 54 to the top of hydration unit 48). *Id.* at Fig. 2, 4:26–28. The fluid and additives are mixed in hydration unit 48 and transferred to blender unit 58 via line 60 (represented by a solid arrow extending from the right side of hydraulic unit 48 to the left side of blender unit 58). *Id.* at Fig. 2, 4:35–36. Proppant source 62 delivers proppant to blender unit 58 via line 64 (represented by a solid arrow extending from the right side of proppant source 62 to the top of blender unit 58) where the proppant is mixed with the fluid and additives to form a fracturing fluid. *Id.* at Fig. 2, 4:36–40. The fracturing fluid is delivered to fracturing pumping system 66 via line 68 (represented by a solid arrow extending from the right side of blender unit 58 to the left side of fracturing pumping system 66). *Id.* at Fig. 2, 4:40–44.

The '031 patent discloses an embodiment of an automated hydraulic fracturing method. *See* Ex. 1001, Fig. 5, 8:16–46. The method may include generating "[a]utomated instructions . . . for at least one of the source controller, the blender controller, or the pump controller" based on one or more monitored parameters. *Id.* at 8:40–46. "[O]ne or more functions of the first source, the blender, the pump, or other component of the hydraulic fracturing system may be controlled 156 via the respective controller based on the automated control instructions." *Id.* at Fig. 5, 8:47–51. "In some embodiments, the instructions may cause one or more control devices to automatically adjust one or more of a flow rate, a pressure, power, motor speed, gates, valve, actuators, delivery lines, and conveyance devices, pump rates, or cooling systems." *Id.* at 8:51–55.

C. Challenged Claims

Petitioner challenges claims 1–8. Pet. 11. Claim 1, the sole independent claim, is reproduced below with Petitioner's labels added for ease of reference:

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- 1[p] 1. An automated hydraulic fracturing method, comprising:
- 1[a] initiating a hydraulic fracturing operation using an automated hydraulic fracturing system;
- 1[b] delivering a fluid from a fluid storage system to a hydration unit;
- 1[c] delivering an additive from an additive storage system to the hydration unit;
- 1[d] mixing the fluid and the additive at the hydration unit to form a fluid mixture;
- 1[e] delivering the fluid mixture from the hydration unit to a blender;
- 1[f] delivering proppant from a proppant storage system to the blender;
- 1[g] mixing the fluid mixture and the proppant at the blender to form a fracturing fluid, the blender comprising a blender sensor for measuring one or more parameters associated with the blender and a blender controller for controlling one or more functions of the bender;
- 1[h] providing the fracturing fluid from the blender to a pump, the pump comprising a pump sensor for measuring one or more parameters associated with the pump and a pump controller for controlling one or more functions of the pump;
- 1[i] injecting the fracturing fluid from the pump into a wellhead coupled to a well;
- 1[j] monitoring one or more parameters of the hydraulic fracturing operation via a plurality of sensing devices integrated into the proppant storage system, the fluid storage system, the additive storage system, the hydration unit, the blender, and the pump;
- 1[k] generating automated instructions for at least one of the sensing and control devices based at l[e]ast in part on the one or more parameters; and

1[1] controlling one or more functions of the hydraulic fracturing operation via a plurality of control devices integrated into the proppant storage system, the fluid storage system, the additive storage system, the hydration unit, the blender, and the pump based at least in part on the automated instructions.

Ex. 1001, 10:32–11:4.

D. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis	
1-3, 5-8	102	Dykstra ¹	
1-3, 5-8	103	Dykstra	
2-4	103	Dykstra, Omont ²	

Pet. 11. In addition to the references listed above, Petitioner relies on the declaration of L. Brun Hilbert, Jr., Ph.D. (Ex. 1003). Patent Owner submits two declarations of Mr. Robert Schaaf (Ex. 2008, Ex. 2011).

III. ANALYSIS³

A petition must show how the construed claims are unpatentable under the statutory grounds it identifies. 37 C.F.R. § 42.104(b)(4). Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic*

¹ Dykstra, U.S. Patent Application Publication No. 2008/0236818 A1, published Oct. 2, 2008 (Ex. 1004) ("Dykstra").

² Omont, U.S. Patent Application Publication No. 2017/0226842 A1, published Aug. 10, 2017 (Ex. 1005) ("Omont").

³ We note again that Patent Owner did not file a Sur-Reply in response to Petitioner's Reply.

Drinkware, LLC v. Nat'l Graphics, Inc., 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must establish the facts supporting its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

A. Level of Ordinary Skill in the Art

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner contends that a person of ordinary skill in the art at the time of the invention of the '031 patent would have had the following education and experience:

either (1) a Bachelor of Science in Mechanical Engineering, Electrical Engineering, Petroleum Engineering or an equivalent field as well as at least two years of academic or industry experience in the oil and gas industry, including well drilling, completion, or production; or (2) at least four years of industry experience in the oil and gas industry, including well drilling, completion, or production.

Pet. 12. Patent Owner does not address the level of ordinary skill in the art. *See generally* PO Resp.

We adopt Petitioner's proposal as reasonable and consistent with the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

B. Claim Construction

For petitions filed on or after November 13, 2018, the "broadest reasonable interpretation" standard has been replaced with the federal court claim construction standard that is used to construe a claim in a civil action under 35 U.S.C. § 282(b). This is the same claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny.

Neither Petitioner nor Patent Owner provide any explicit construction of any claim terms. Pet. 12; PO Resp. 11. Except to the extent we explain how we interpret the claims in the analysis below, we decline to otherwise expressly construe any claim terms. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs* in the context of an *inter partes* review).

C. Overview of the Asserted Prior Art

1. Dykstra

Dykstra is a U.S. Patent Application Publication for a "Method and Apparatus for Controlling the Manufacture of Well Treatment Fluid," published October 2, 2008. Ex. 1004, codes (43), (54).

Dykstra discloses that "[a] typical well stimulation operation includes a proppant or sand system, a water system, a resin system, a gel system, a blending tub, and a pumping system." Ex. 1004 ¶ 3. Dykstra illustrates an embodiment of a well stimulation operation in Figure 2, reproduced below.



Figure 2 shows a flow diagram of a centralized well treatment facility. *Id.* ¶ 10. Figure 2 illustrates operations factory 100 (represented as a large rectangle) encompassing other components. *Id.* at Fig. 2, ¶ 8. Water supply 202 (represented as a small rectangle) is located in the top left corner of operations factory 100, with an arrow pointing down to pre-blender 201 (represented as a small rectangle). *Id.* Proppant 106 (represented as a small rectangle) is located to the right of water supply 202, with an arrow pointing down to mixer 204 (represented as a small rectangle). *Id.* Pre-blender 201 has an arrow pointing right to mixer 204. Pre-blender 201 and mixer 204 are encompassed within blending unit 105 (represented as a medium rectangle). *Id.* Chemicals 112 (represented as a small rectangle) are located below pre-blender 201 and outside of blending unit 105, with an arrow pointing up to

pre-blender 201. *Id.* Mixer 204 has an arrow pointing right to pumping grid 111 (illustrated as a small rectangle), which has an arrow pointing right to manifold 107 (illustrated as a small rectangle). *Id.*

Dykstra discloses that, "[i]n some embodiments, the operations of the chemical storage system, proppant storage system, blending unit, pumping grid, power unit, and manifolds are controlled, coordinated, and monitored by a central control system." *Id.* ¶ 21. "The central control system can be an electronic computer system capable of receiving analog or digital signals from sensors and capable of driving digital, analog, or other variety of controls of the various components in the fracturing operations factory." *Id.* "The central control system may use all of the sensor data from all units and the drive signals from their individual subcontrollers to determine subsystem trajectories." *Id.*

2. Omont

Omont is a U.S. Patent Application Publication for a "Monitoring Health of Additive Systems," published August 10, 2017. Ex. 1005, codes (43), (54).

Omont discloses "[a] monitoring system operable to monitor an oilfield additive system having multiple components." Ex. 1005, code (57). Specifically, Omont discloses a "monitoring system includes sensors and a monitoring device. Each sensor is associated with, and generates information related to the operational parameter of, a corresponding one of the oilfield additive system components." *Id.* ¶ 5.

Omont discloses a "process diagnostic tool 520 [that] performs process diagnostics for monitoring raw sensor data and/or other process IPR2021-01538 Patent 10,408,031 B2

parameters values to, for example, confirm that such values meet predetermined thresholds or are within predetermined ranges." *Id.* ¶ 94. "The process diagnostic tool 520 may also permit configuration of thresholds for alarms, whether preprogrammed or via the [human-machine interface] 310, such that changes in the sensors 204, 214, 222, variations in components of the additive system 200, and changes in process knowledge may be easily incorporated." *Id.* "Such alarms may be enhanced by adding a troubleshooting guide or a list of suggestions related to potential root causes of each alarm." *Id.*

D. Anticipation under 35 U.S.C. § 102

1. Principles of Law

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). To establish anticipation, "all of the elements and limitations of the claim must be shown in a single prior reference, arranged as in the claim." *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001).

2. Anticipation by Dykstra

Petitioner asserts that Dykstra anticipates claims 1–3 and 5–8. Pet. 12–52. Patent Owner disagrees. PO Resp. 15–24. The Petition maps elements of Dykstra to each limitation of independent claim 1. Pet. 12–38. Patent Owner does not dispute Petitioner's contentions regarding limitations 1[b]–1[k] of claim 1. *See* PO. Resp. 14 (section heading). We have reviewed Petitioner's assertions and Dr. Hilbert's supporting testimony regarding these limitations of claim 1. We are persuaded, for the reasons stated by Petitioner, that Dykstra discloses limitations 1[b]-1[k]. Therefore, we focus our discussion on the preamble 1[p] and limitations 1[a] and 1[1], which are disputed by Patent Owner. *Id*.

a. Preamble 1[p]: An Automated Hydraulic Fracturing Method

For the preamble, Petitioner asserts that "[t]o the extent that the preamble is limiting, *Dykstra* discloses . . . 'An automated hydraulic fracturing method' through its description of 'stimulation of production site' using a hydraulic fracturing system involving 'several input systems [that] are often required to manufacture and deliver an appropriate well treatment fluid to a well formation." Pet. 13 (citing Ex. 1004 ¶ 3).

Patent Owner contends that "[t]he '031 Patent claims an automated hydraulic fracturing method for an entire fracturing system." PO Resp. 16. Patent Owner contends further that "*Dykstra's* disclosed central control system is configured to control, coordinate, and monitor the operation of various wellbore treatment equipment based on a rate set by an operator, and [is] not the automated system as recited in Claim 1." *Id.* (citing Ex. 1004 ¶ 21; Ex. 2011, 23–24). Therefore, according to Patent Owner, "*Dykstra* cannot anticipate . . . any of the Challenged Claims because it fails to disclose an automated fracturing system initiating a hydraulic fracturing operation, as recited in Claim 1." *Id.* at 17.

Petitioner replies that Patent Owner's argument contends "without support, that '[u]nlike *Dykstra*, the automated system [of the '031 Patent] does not require user input." Pet. Reply 3 (citing PO Resp 16). Petitioner

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replies further that "a lack of any user input is not a requirement of the claims" and that Patent Owner "is improperly attempting to construe the term 'automated' as being without any user input—without actually proposing a construction" for this claim term. *Id.*

In addition, Petitioner asserts that Patent Owner's implicit construction is inconsistent with "the '031 Patent specification's disclosure that 'the control center 140 may also include a user interface . . . [which] may also enable an operator to input control instructions for the components 134." *Id.* at 4 (alteration in original) (quoting Ex. 1001, 8:7–11). Petitioner asserts that Patent Owner "makes no attempt to reconcile its construction ('does not require user input') with the specification's disclosure of embodiments that 'enable an operator to input control instructions" and that Patent Owner "has offered no evidence to exclude embodiments from the specification, and the 'automated hydraulic fracturing system' in the Challenged Claims should not be interpreted to exclude any operator input."" *Id.*

Alternatively, Petitioner asserts that "[e]ven under [Patent Owner's] implicit and incorrect construction, *Dykstra* still discloses an 'automated' fracturing method and system where the subsystem components of claim 1 are controlled automatically without user input." Pet. Reply 5. According to Petitioner, "*Dykstra* provides numerous examples of control devices of 'the proppant storage system, the fluid storage system, the additive storage system, the hydration unit, the blender, and the pump,' in which the control devices do not require any user input." *Id.* (citing Pet 32–38; Ex. 1003

¶¶ 86–93). As examples, Petitioner asserts that "*Dykstra* includes embodiments in which each subsystem has a 'drive signal' that uses feedback signals from sensors to make adjustments and provides control for each subsystem." *Id.* (citing Pet. 26–33).

We agree with Petitioner that Patent Owner is reading the requirement that the automated hydraulic fracturing method be devoid of any user input into the preamble of claim 1. *See* Pet. Reply. 3–4. We further agree that the specification of the '031 patent does not support Patent Owner's implicit construction of "automatic" because the specification does not preclude some user input in its automated method. *See, e.g.*, Ex. 1001, 8:7–15.

Dykstra discloses

In embodiments containing multiple pumps, each pump has its own *automated* system with controllers, and the pump drive signal is split between all the pumps. This splitting occurs depending on the pump type and its best operating conditions. The *automated* system at each pump will then pump in order to meet that pump's rate set point.

Ex. 1004 ¶ 26 (emphasis added). We agree with Petitioner that this disclosure reads on the requirement of an "automated" method as broadly as claimed. Pet. 13. Thus, Dykstra reads on preamble 1[p] of claim 1.

b. Limitation 1[a]: Initiating a Hydraulic Fracturing Operation Using An Automated Hydraulic Fracturing System

Petitioner asserts that "*Dykstra* discloses 'initiating a hydraulic fracturing operation using an automated hydraulic fracturing system' through its disclosure of 'stimulation of production site' using a hydraulic fracturing system involving 'several input systems [that] are often required to manufacture and deliver an appropriate well treatment fluid to a well formation." Pet. 13–14 (alteration in original) (citing Ex. 1004 ¶ 3). Petitioner asserts that "*Dykstra* further discloses '[i]n the case of fracturing operations, the main fluid stream may be either the main fracture fluid being pumped or may be a slip stream off of a main fracture fluid stream" and that "*Dykstra* discloses that the 'automated system at each pump will then pump in order to meet that pump's rate set point,' as each pump has its own automated system with controllers." *Id.* at 14 (alteration in original) (quoting Ex. 1004 ¶¶ 2, 17, 26).

Patent Owner contends that "*Dykstra* does not teach '*initiating* a hydraulic fracturing operation using an automated hydraulic fracturing system,' as recited in Claim 1" because "*Dykstra*'s method and apparatus for controlling the manufacture of well treatment fluid does not disclose an 'automated hydraulic fracturing operation,' as required by the preamble, which includes 'initiating a hydraulic fracturing operation." PO Resp. 17 (citing Ex. 1001, claim 1; Ex. 2011, 25). Patent Owner asserts further that "Petitioner's assertion that '*Dykstra* teaches initiating a hydraulic fracturing operation using an automated hydraulic fracturing system' through its disclosure of 'stimulation of production site using a hydraulic fracturing system." *Id.* (citing Pet. 13–14).

Petitioner replies that Patent Owner's "second argument stems from its first argument . . . that *Dykstra* does not disclose an 'automated fracturing system,' and therefore, *Dykstra* cannot disclose 'initiating a hydraulic fracturing operation using an automated hydraulic fracturing system.'" Pet. Reply 5–6 (citing PO Resp. 17–18). Petitioner asserts that Patent Owner's "arguments fail, because they require reading limitations into the word 'automated' from the specification and also contradict the '031 Patent's description that 'an operator may input control instructions.'" *Id.* at 6.

Again, we agree with Petitioner that Patent Owner's arguments are premised on reading limitations from the specification into the word "automated" and are inconsistent with the specification of the '031 patent. Pet. Reply 6. Further, although claim 1 does refer to an "automated" system, limitation 1[a] does not require the "initiating" step (specifically) to be automated, as Patent Owner's argument seems to imply that it does.

We also note that Patent Owner mischaracterizes Petitioner's position regarding limitation 1[a], in that Petitioner's assertions do not rely solely on Dykstra's disclosure of "stimulation of production site using a hydraulic fracturing system," as argued by Patent Owner. As discussed above, Petitioner also relies on Dykstra's teachings of a pumped main fluid that is automatically pumped. Pet. 14.

Dykstra discloses stimulation of a production site (i.e. initiating a hydraulic fracturing operation) using a pumping system. Ex. 1004 ¶ 3. Dykstra further discloses an embodiment of the pumping system that is automatically controlled (i.e. an automated hydraulic fracturing system). *Id.* ¶ 26. Therefore, Dykstra discloses initiating a hydraulic fracturing operation using an automated hydraulic fracturing system, which reads on limitation 1[a].

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c. Limitation 1[1]: Controlling One or More Functions of the Hydraulic Fracturing Operation Via a Plurality of Control Devices Integrated Into the Proppant Storage System, the Fluid Storage System, the Additive Storage System, the Hydration Unit, the Blender, and the Pump Based at Least in Part on the Automated Instructions

Petitioner asserts that Dykstra

discloses "controlling one or more functions of the hydraulic fracturing operation [via] a plurality of control devices ... based at least in part on the automated instructions" through its disclosure that "the operations of the chemical storage system, proppant storage system, blending unit, pumping grid, power unit, and manifolds are controlled, coordinated, and monitored by a central control system."

Pet. 32 (alteration in original) (quoting Ex. 1004 ¶ 21). Petitioner asserts further "that '[t]he central control system can be an electronic computer system capable of receiving analog or digital signals from sensors and capable of driving digital, analog, or other variety of controls of the various components in the fracturing operations factory." *Id.* Petitioner asserts that "*Dykstra* discloses '[t]he central control system may use all of the sensor data from all units and the drive signals from their individual subcontrollers to determine subsystem trajectories." *Id.* As an example, Petitioner asserts that "control over the manufacture, pumping, gelling, blending, and resin coating of proppant by the control system can be driven by well formation needs such as flow rate." *Id.* at 32–33 (citing Ex. 1004, Figs. 3–4, ¶¶ 22– 31). In addition, Petitioner asserts that Dykstra discloses "that the 'plurality of control devices [are] integrated into the proppant storage system, the fluid storage system, the additive storage system, the hydration unit, the blender, and the pump" in that "*Dykstra* discloses that each and every 'subsystem[] in this disclosure' 'has its own controller, implemented in some embodiments in a computer." Pet. 33 (second alteration in original) (citing Ex. 1004 ¶ 26). In support of these assertions, Petitioner quotes Dykstra's disclosure that

[o]nce the subsystems and their actuators produce their respective rates, such as the pump rate 352, the water rate 362, the sand rate 372, the gel water rate 535, the gel powder rate 536, the resin sand rate 515 and the resin rate 516, these outputs are converted back to virtual torque feedback at converters 380 in a manner which preserves their relative importance (or weights) in the overall system such that they may be properly compared

and its disclosure that "the actuators in each subsystem, such as the pump actuators or water system actuators, each have their own proportional integral controllers, each measuring their own speed and trying to match their own rates." *Id.* (alteration in original) (quoting Ex. 1004 ¶ 31, Fig. 4). Petitioner quotes Dykstra's disclosure "that 'each of these controllers is producing an output drive signal which is monitored via the converted signals of the torque feedback." *Id.* Thus, according to Petitioner, "*Dykstra* discloses controllers or actuators for each of the subsystems disclosed in *Dykstra*." *Id.* at 33–34.

Patent Owner contends that, "[i]n contrast to the computer system (*e.g.*, central control system) to control the output rate in *Dykstra*, Claim 1 of the '031 Patent claims an automated hydraulic fracturing method that

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controls the entire automated hydraulic fracturing system, not just the output of a desired well treatment fluid." PO Resp. 18 (citing Ex. 2011, 21). Patent Owner contends further that "[a]lthough *Dykstra* discloses that the various wellbore treatment equipment may include sensors and controllers, Dykstra does not disclose monitoring, generating, or controlling a hydraulic fracturing operation via a plurality of sensing devices and control devices as recited in Claim 1 of the '031 Patent." Id. at 10 (citing Ex. 2011, 26). As an example, Patent Owner contends that "nothing in *Dykstra* discloses that an individual pump may be dropped out to prevent a failure, nor that the system as a whole may automatically select the best pump to make up that needed rate." Id. (citing Ex. 2011, 27). Thus, according to Patent Owner, "[t]he broad language in *Dykstra* . . . is insufficient to disclose the specific features of monitoring, generating, and controlling the hydraulic fracturing operation via a plurality of sensing and control devices integrated into the wellbore treatment equipment as recited in Claim 1." Id. at 20-21 (citing Ex. 1004 ¶ 21; Ex. 2011, 27).

In addition, Patent Owner contends that

Dykstra does not teach "controlling one or more functions of the hydraulic fracturing operation via a plurality of <u>control</u> <u>devices integrated into</u> the proppant storage system, the fluid storage system, the additive storage system, the hydration unit, the blender, and the pump based at least in part on the automated instruction," as recited in Claim 1.

PO Resp. 21 (quoting Ex. 1001, claim 1). Rather, according to Patent Owner, "*Dykstra* merely teaches 'a central control system' which can be 'an electronic computer system." *Id.* at 22 (citing Ex. 1004 \P 21). Patent Owner asserts further that "nothing in *Dykstra* discloses or suggests control of the entire hydraulic fracturing operation." *Id.* at 24 (citing Ex. 2011, 30).

Regarding Patent Owner's argument that Dykstra does not teach a central control system that can control the system as a whole, Petitioner replies that "the Board already rejected this improper claim interpretation in its Institution Decision, stating 'the claims do not require "control of the hydraulic fracturing operation as a whole."" Pet. Reply 6. Petitioner replies further that "[a]s a corollary to its 'system as a whole' argument, [Patent Owner] creates a list of hydraulic fracturing operations," "[h]owever, none of these features that [Patent Owner] alleges are missing from *Dykstra* are required by claim 1 of the '031 Patent." *Id.* at 7. According to Petitioner, Patent Owner's expert, "Robert Schaaf, agreed that 'wellbore treatment [that] may be in control to shut itself down to prevent failures,' dropping out an "individual pump . . . to prevent failure," and 'automatically select[ing] the best pump to make up that needed rate' are not requirements of claim 1." *Id.* (alterations in original) (citing Ex. 1014, 67:23–69:5).

Petitioner also replies that Patent Owner "incorrectly criticizes *Dykstra* by limiting its teachings to only controlling the 'output rate' using its virtual rate control 320" because Patent Owner's argument is "divorced from the claim language." Pet. Reply 8 (citing PO Resp. 18–19). Petitioner asserts that "[c]laim 1 of the '031 Patent merely requires 'controlling **one or more** functions of the hydraulic fracturing operation,' not **all** functions." *Id.* (quoting Ex. 1001, claim 1). Petitioner asserts further that "*Dykstra* discloses control of many other aspects of its hydraulic fracturing operation aside from the 'output rate." *Id.* (citing Pet. 32–38; Ex. 1003 ¶¶ 86–93). In addition, Petitioner replies that even accepting Patent Owner's "argument as true that *Dykstra* only discloses 'maintain[ing] a certain output of a desired well treatment fluid,' that would be sufficient to meet the claim's requirement of 'controlling one or more functions of the hydraulic fracturing operation." *Id.* at 8–9 (alteration in original) (citing PO Resp. 19–20).

Regarding Patent Owner's argument "that *Dykstra* merely teaches a 'a central control system' and not controllers that are 'integrated into' the various subsystems," Petitioner replies that "there is no disclosure in the '031 Patent of what it means for a sensor or controller to be 'integrated into' a subsystem, and [Patent Owner] has proposed no construction for the term." Pet. Reply 9. Petitioner asserts that Patent Owner "tries to read additional requirements into the phrase 'integrated into,' without stating what those requirements are," as Patent Owner and its expert "merely conclude that '*Dykstra* does not teach or suggest that the control is integrated (*i.e.*, coupled) to the components for this entire fracturing system." *Id.* at 9–10 (citing PO Resp 26; Ex. 2011, 30; *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016)).

Petitioner replies further that "even under [Patent Owner's] implicit construction that 'integrated into' means 'coupled'... *Dykstra* discloses the claims" in that "[t]he Petition provides detailed examples of how *Dykstra's* control devices, including more than just the 'central control system'... are 'integrated into'... each of the subsystems required in claim 1." *Id.* at 10 (citing Pet. 32–38; Ex. 1003 ¶¶ 86–93). As an example, Petitioner asserts that "*Dykstra* teaches that 'the actuators in each subsystem, such as the pump actuators or water system actuators, each have their own proportional integral controllers, each measuring their own speed and trying to match their own rates." *Id.* (citing Ex. 1004 ¶ 31; Pet. 33–34; Ex. 1003 ¶¶ 86–87). Petitioner asserts further that "[i]n his deposition, Mr. Schaaf agreed that an actuator is an example of a 'control device' as claimed in the '031 Patent." *Id.* (citing Ex. 1014, 71:13–15). Petitioner provides another example on pages 10–13 of its Reply.

We agree with Petitioner that Patent Owner's first set of arguments regarding limitation 1[1] (PO Resp. 18–21) are premised on an overly narrow implicit interpretation of limitation 1[1]. *See* Pet. Reply 6. Specifically, for the reasons discussed by Petitioner reproduced above, we agree that claim 1 does not require "an automated hydraulic fracturing method that controls *the entire* automated hydraulic fracturing system" as argued by Patent Owner. PO Resp. 18 (emphasis added).

Dykstra discloses that "the operations of the chemical storage system, proppant storage system, blending unit, pumping grid, power unit, and manifolds are controlled, coordinated, and monitored by a central control system." Ex. 1004 ¶ 21. Dykstra further discloses that "[t]he central control system can be an electronic computer system capable of receiving analog or digital signals from sensors and capable of driving digital, analog, or other variety of controls of the various components in the fracturing operations factory." *Id.* Dykstra states that "[t]he central control system may use all of the sensor data from all units and the drive signals from their individual subcontrollers to determine subsystem trajectories." *Id.* As an example, Dykstra discloses "control over the manufacture, pumping, gelling, blending, and resin coating of proppant by the control system can be driven

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by well formation needs such as flow rate" and that "[t]he control system will substantially simultaneously cause the delivery of the proppant and chemical components comprising a well treatment fluid with the desired property at the desired rate to the blending unit where it can be immediately pumped to the desired well location." *Id.* These disclosures in Dykstra read on the requirement of controlling one or more functions of the hydraulic fracturing operation based at least in part on automated instructions as set forth in limitation 1[1].

We also agree with Petitioner, for the reasons discussed by Petitioner reproduced above, that Patent Owner's second set of arguments regarding limitation 1[1] (PO Resp. 21–25) ignore the examples provided in Dykstra. *See* Pet. Reply 12–13. In one such example, Dykstra discloses that

A sensor or sensors in the blender tub can measure the gel or resin composition of the fracturing fluid as it is being pumped into a well. This data can be entered into the virtual rate control 320 or the blender volume control 410 according to method and apparatus described above so that the appropriate water, sand, resin, and gel drive signals can maintain operational consistency with the desired resin and gel composition of the well treatment fluid.

Ex. 1004 ¶ 31. Dykstra further discloses that, "[b]y driving the input systems . . . according to a virtual rate control that takes into account a desired rate and feedback signals of the current rates of the input systems, the operation of a well treatment operation can be coordinated and consistent performance can be maintained across the various subsystems." *Id.* In addition, Dykstra discloses that "the actuators in each subsystem, such as the pump actuators or water system actuators, each have their own proportional

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integral controllers, each measuring their own speed and trying to match their own rates" and that "each of these controllers is producing an output drive signal which is monitored via the converted signals of the torque feedback." *Id.* These disclosures in Dykstra read on the requirement for a plurality of integrated control devices set forth in limitation 1[1].

d. Determination For Claim 1

For the reasons discussed above, and in view of all of the evidence and arguments submitted, we determine that Petitioner has shown, by a preponderance of evidence, that Dykstra anticipates claim 1.

e. Claim 2

Claim 2 depends from claim 1 and adds the steps of "detecting that at least one of the one or more parameters is outside of an acceptable threshold" ("limitation 2[a]") and "automatically stopping or adjusting at least one of the one or more functions in response to the detection" ("limitation 2[b]"). Ex. 1001, 11:6–9.

For limitation 2[a], Petitioner asserts that "*Dykstra* discloses 'detecting that at least one of the one or more parameters is outside of an acceptable threshold' through its disclosure that '[t]he central control system may use all of the sensor data from all units and the drive signals from their individual subcontrollers to determine subsystem trajectories." Pet. 38 (quoting Ex. 1004 ¶ 21). Petitioner asserts further that

Dykstra discloses "a desired property 310 of well treatment fluid to be pumped into a well is determined by any particular needs of a well formation" and "[p]roperty 310 can be a rate at which well treatment fluid is desired to be pumped into a well formation measured in gallons per second, for example, or kilograms per second or any other mass or volumetric rate." *Id.* (alteration in original) (quoting Ex. 1004 \P 22). In addition, Petitioner asserts that

Dykstra discloses that "[i]n the case that a desired rate is used, rate 310 is entered into a virtual rate control 320, causing the control system 320 to drive the output rate of the fracturing operations factory to the desired rate," which "may be done, for example, by increasing or decreasing the rates of one or more of the various subsystem components depending on whether the subsystem's output is in line with the desired rate 310."

Id. at 38–39 (alteration in original) (quoting Ex. 1004 ¶¶ 22–29).

Determining "whether the subsystem's output is in line with the desired rate

310' is," according to Petitioner, "detecting' whether the pump rate is

'outside of an acceptable threshold.'" *Id.* at 39 (quoting Ex. 1003 \P 94).

As another example, Petitioner asserts that

Dykstra also discloses that "[e]ach tank's level, material weight, and calibrated orifice can be used to monitor and control the amount of desired proppant delivered to the blending unit" and "each tank's orifice can be adjusted to release proppant at faster or slower rates depending upon the needs of the formation and to adjust for the flow rates measured by the change in weight of the tank."

Pet. 39 (alteration in original) (quoting Ex. 1004 ¶ 16). According to Petitioner, "monitoring [and] controlling the amount of desired proppant delivered to the blending unit entails 'detecting' whether the proppant flow rate is 'outside of an acceptable threshold." *Id.* (citing Ex. 1003 ¶ 95; Pet. 32-38).

For limitation 2[b], Petitioner asserts that

[*Dykstra*] discloses "automatically stopping or adjusting at least one of the one or more functions in response to the detection" through its disclosure of a "Desired Rate 310" in

Fig. 4, such that "[i]n the case that a desired rate is used, rate 310 is entered into a virtual rate control 320, causing the control system 320 to drive the output rate of the fracturing operations factory to the desired rate."

Pet. 39–40 (second alteration in original) (quoting Ex. 1004 ¶¶ 22, 31, citing *id.* at Fig. 4). Petitioner asserts further that "*Dykstra* also discloses '[t]he total pump rate 352 of the pump system is determined by processing or adjusting the pump drive signal 350," wherein 'the pump system, like all of the subsystems in this disclosure, has its own controller, implemented in some embodiments in a computer." *Id.* at 40 (alteration in original) (quoting Ex. 1004 ¶ 26). According to Petitioner, "adjusting the pump rate after determining whether it is at the desired value by means of a computer-based controller is 'automatically . . . adjusting' the pump rate 'in response to the detection." *Id.* (alteration in original) (citing Ex. 1003 ¶ 96).

Petitioner asserts further that "*Dykstra* also discloses that '[e]ach tank's level, material weight, and calibrated orifice can be used to monitor and control the amount of desired proppant delivered to the blending unit' and the 'information can be transmitted to a controller or control area" and that "'[e]ach tank's orifice can be adjusted to release proppant at faster or slower rates depending upon the needs of the formation and to adjust for the flow rates measured by the change in weight of the tank." Pet. 40 (first alteration in original) (citing Ex. 1004 ¶¶ 16, 29, Fig. 4). According to Petitioner, "adjusting the proppant flow rate after determining whether it is at the desired value by means of [a] controller is 'automatically . . . adjusting' the flow rate 'in response to the detection." *Id.* at 40–41 (second alteration in original) (quoting Ex. 1003 ¶ 97).

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Patent Owner contends that "[s]ince Claim 2 depends from Claim 1, Claim 2 is not anticipated . . . by *Dykstra*." PO Resp. 25. In addition, Patent Owner contends that "Dykstra does not teach 'detecting that at least one of the one or more parameters is outside of an acceptable threshold and automatically stopping or adjusting at least one of the one more functions in response to the detection." Id. at 26 (quoting Pet. 38, citing Ex. 2011, 33). At best, according to Patent Owner, "Dykstra discloses that a desired rate 310 is entered into a virtual rate control system 320, causing the virtual rate control system 320 to drive the output rate of the fracturing operations factory to the desired rate" which is "[m]erely 'monitor[ing] and control[ling] the amount of desired proppant delivered to the blending unit' [which] does not teach 'detecting that . . . the one or more parameter is outside of an acceptable threshold and automatically stopping or adjusting at least one or more functions,' as recited in the Claim 2." Id. (second, third, and fifth alterations in original) (citing Ex. 1004 ¶¶ 16, 22–29, Fig. 4; Ex. 2011, 33–34).

Petitioner replies that Patent Owner "ignores the relevant disclosure from *Dykstra* that is specifically laid out in the Petition." Pet. Reply 14. Specifically, Petitioner asserts that Patent Owner ignores Dykstra's disclosure of "achiev[ing] a desired property 310 of well treatment fluid to be pumped into a well' by 'for example, increasing or decreasing the rates of one or more various subsystem components depending on whether the subsystem's output is in line with the desired rate 310," which is detecting whether the pump rate is outside of an acceptable threshold. *Id.* (citing Pet. 38–39; quoting Ex. 1004 ¶ 22). We agree with Petitioner that Patent Owner's arguments ignore Dykstra's disclosures discussed above. Patent Owner's arguments are conclusory and appear to rely on the fact that Dykstra does not use the term "acceptable threshold" *in haec verba*.

Dykstra discloses "increasing or decreasing the rates of one or more of the various subsystem components depending on whether the subsystem's output is in line with the desired rate 310." Ex. 1004 ¶ 22. We agree with Petitioner that determining "whether the subsystem's output is in line with a desired rate" requires detecting the subsystem's output and determining if it is outside of an acceptable threshold. *See* Pet. 38–39. We further agree with Petitioner that increasing or decreasing the rate of that subsystem is adjusting its functions. *See id.* at 39–40. Dykstra discloses increasing or decreasing the rate in response to determining (detecting) whether the output is in line with a desired rate. Ex. 1004 ¶ 22. Thus, we agree with Petitioner that these disclosures, taken together, meet the limitations of claim 2.

For the reasons discussed above, and in view of all of the evidence and arguments submitted, we determine that Petitioner has shown, by a preponderance of evidence that Dykstra anticipates claim 2.

f. Claim 3

Claim 3 depends from claim 1 and adds the steps of "detecting substandard performance in one or more areas of the automated hydraulic fracturing system" ("limitation 3[a]"), "automatically troubleshooting the automated hydraulic fracturing system based on live or previously collected data from the sensing devices" ("limitation 3[b]"), "determining one or more causes or suspected causes of the substandard performance" ("limitation 3[c]"), and "automatically adjusting one or more components of the automated hydraulic fracturing system to resolve the substandard performance" ("limitation 3[d]"). Ex. 1001, 11:11–21.

For limitation 3[a], Petitioner asserts that "determining whether proppant flow rate is not at the desired value is 'detecting substandard performance." Pet. 41 (citing Ex. 1003 \P 98).

For limitation 3[b], Petitioner asserts that Dykstra discloses limitation 3[b] "through its disclosure that '[i]n the case that a desired rate is used, rate 310 is entered into a virtual rate control 320, causing the control system 320 to drive the output rate of the fracturing operations factory to the desired rate." Pet. 41 (alteration in original) (quoting Ex. 1004 \P 22).

For limitation 3[c], Petitioner asserts that

Dykstra discloses "determining one or more causes or suspected causes of the substandard performance" through its disclosure that "[i]n the case that a desired rate is used, rate 310 is entered into a virtual rate control 320, causing the control system 320 to drive the output rate of the fracturing operations factory to the desired rate."

Pet. 43 (alteration in original) (quoting Ex. 1004 ¶ 22). Petitioner asserts further that Dykstra "discloses '[t]he total pump rate 352 of the pump system is determined by processing or adjusting the pump drive signal 350." *Id.* (alteration in original) (quoting Ex. 1004 ¶ 26). According to Petitioner, "adjusting the pump rate after determining whether it is at the desired value by means of a computer-based controller involves 'determining one or more causes or suspected causes of the substandard performance." *Id.* (citing Ex. 1003 ¶ 101).

For limitation 3[d], Petitioner asserts that

Dykstra discloses "automatically adjusting one or more components of the automated hydraulic fracturing system to resolve the substandard performance" through its disclosure that "[i]n the case that a desired rate is used, rate 310 is entered into a virtual rate control 320, causing the control system 320 to drive the output rate of the fracturing operations factory to the desired rate."

Pet. 44 (alteration in original) (quoting Ex. 1004 ¶ 22). Petitioner asserts further that Dykstra "discloses '[t]he total pump rate 352 of the pump system is determined by processing or adjusting the pump drive signal 350." *Id.* (alteration in original) (quoting Ex. 1004 ¶ 26). According to Petitioner, "adjusting the pump rate after determining whether it is at the desired value by means of a computer-based controller involves 'automatically adjusting one or more components of the automated hydraulic fracturing system to resolve the substandard performance." *Id.* at 44–45 (citing Ex. 1003 ¶¶ 103–104).

Patent Owner contends that "[s]ince Claim [3] depends from Claim 1, Claim [3] is not anticipated . . . by *Dykstra*." PO Resp. 27. In addition, Patent Owner contends that Dykstra does not disclose any of the limitations of claim 3. *Id.* (citing Ex. 1001, claim 3; Ex. 2011, 34–36). Specifically, Patent Owner contends that "[m]erely using an entered rate 310 to drive an output and 'processing or adjusting the pump drive signal" does not disclose these limitations. *Id.* at 28. Patent Owner contends further that "[p]roducing a drive signal does not detect a substandard performance or automatically troubleshoot the automated hydraulic fracturing system or determine one or more causes or suspected causes of the substandard performance." *Id.* (citing Ex. 2011, 36). Patent Owner also contends that "*Dykstra* does not teach 'determining one or more causes or suspected causes of the substandard performance" because "merely disclosing driving the output rate does not teach 'determining one or more causes or suspected causes of the substandard performance." *Id.* at 28–29 (citing Ex. 2011, 36). Patent Owner contends further that "*Dykstra* is not concerned with the efficiency or control of the entire system, but with merely controlling the output rate of a fluid. Therefore, *Dykstra* cannot anticipate . . . Claim 3." *Id.* at 29.

Petitioner replies by reiterating its argument that "*Dykstra* teaches 'detecting a substandard performance' through its disclosure of determining 'whether the subsystem's output is in line with the desired rate 310."' Pet. Reply 14–15 (citing Pet. 41; Ex. 1004 ¶ 22). Petitioner asserts that Patent Owner "does not dispute or even address this disclosure from *Dykstra*." *Id.* at 15.

Regarding Patent Owner's arguments in general, Petitioner asserts that they are conclusory and do not provide "further detail regarding the 'automatically troubleshooting' and 'determining one or more causes or suspected causes' claim limitations, other than reciting the claim language in the specification." *Id.* (citing Ex. 1001, 9:27–43). For these claim terms, Petitioner asserts that "*Dykstra's* system must assess the subsystem components to determine which component's rate needs to be increased or decreased and, therefore, meets the 'automatically troubleshooting' limitation" and that "by identifying the specific subsystem component that is causing the discrepancy in desired rate and adjusting the rate of that subsystem component, the claimed 'determining one or more causes or suspected causes' is disclosed." *Id.* at 15–16 (citing *Samsung Elecs. Am., Inc. v. Kanuu Pty Ltd.*, IPR2020-00737, Paper 111 at 48–49 (PTAB Sept. 21, 2021); Pet. 43–44).

We agree with Petitioner that Patent Owner's arguments are conclusory. Pet. Reply 15. We further determine that they do not address the disclosures in Dykstra relied upon in support of Petitioner's challenge.

Dykstra discloses "detecting substandard performance in one or more areas of the automated hydraulic fracturing system" through its disclosure of monitoring the sensor data from all the units of the system and the drive signals of the units' individual sub-controllers to determine if the required flow rate is maintained. Ex. 1001, 11:12–13; see Ex. 1004 ¶ 21; see also Pet. 41. Dykstra discloses "automatically troubleshooting the automated hydraulic fracturing system based on live or previously collected data from the sensing devices" through its disclosure of controlling the delivery of proppant and chemical components of well treatment fluid to maintain the desired flow rate. Ex. 1001, 11:14–16; see Ex 1004 ¶¶ 16, 21, 26; see also Pet. 41–43. Dykstra discloses "determining one or more causes or suspected causes of the substandard performance" through its disclosure of monitoring the level, the weight, and the rate of consumption of material in the proppant tanks. Ex. 1001, 11:17–18, see Ex. 1004 ¶ 16; see also Pet. 43–44. Dykstra discloses "automatically adjusting one or more components of the automated hydraulic fracturing system to resolve the substandard performance" through its disclosure of increasing or decreasing the rates of one or more of the subsystem components to achieve the desired rate 310. Ex. 1001, 11:19–21;

see Ex. 1004 ¶¶ 22, 26; *see also* Pet. 44–45. Thus, Dykstra discloses all of the limitations of claim 3.

For the reasons discussed above, and in view of all of the evidence and arguments submitted, we determine that Petitioner has shown, by a preponderance of evidence that Dykstra anticipates claim 3.

g. Claims 5–8

We have reviewed Petitioner's evidence in support of its challenge to claims 5–8 and the testimony in support thereof provided by its expert Dr. Hilbert. Pet. 45–53; Ex. 1003 ¶¶ 106–115. Patent Owner does not separately address these claims. *See generally* PO Resp. Rather, Patent Owner contends that "[s]ince Claims 5–8 depend from Claim 1, Claims 5–8 are not anticipated . . . by *Dykstra*." PO Resp. 30.

Patent Owner's argument is unconvincing, as we have determined that Dykstra anticipates claim 1. Having reviewed all of the evidence and arguments presented, we further determine that Petitioner has demonstrated, by a preponderance of evidence, that Dykstra anticipates claims 5–8.

h. Summary for Challenge Based on Anticipation

For the reasons discussed above, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that Dykstra anticipates claims 1–3 and 5–8.

E. Obviousness under 35 U.S.C. § 103

1. Principles of Law

A claim is unpatentable under §103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a

whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations).⁴ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "While the sequence of these questions might be reordered in any particular case," *KSR*, 550 U.S. at 407, the Federal Circuit has explained that an obviousness determination can be made only after consideration of all of the *Graham* factors. *See, e.g., Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1360 (Fed. Cir. 2012).

 Obviousness of Claims 1–3 and 5–8 Based on Dykstra Petitioner asserts that claims 1–3 and 5–8 are rendered obvious by Dykstra. Pet. 53. Specifically, Petitioner asserts that "should the Board or Patent Owner take the position that certain claim limitations of claims 1–3 and 5–8 are not expressly disclosed in *Dykstra*, a [person of ordinary skill in the art] would still have understood these limitations to be rendered obvious by *Dykstra*." *Id*.

⁴ Secondary considerations may include long-felt but unsolved need, failure of others, unexpected results, commercial success, copying, licensing, and praise. *See Graham*, 383 U.S. at 17–18; *Leapfrog Enters., Inc. v. Fisher–Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007).

Patent Owner contends that "Petitioner does not meet its burden to prove that claims 1–3 and 5–8 are obvious over *Dykstra* alone because *Dykstra* is silent and does not teach or suggest" several limitations of claim 1. PO Resp. 30. According to Patent Owner, "the deficiencies discussed regarding *Dykstra* are not cured by Petitioner's mere reliance on *Dykstra* alone for an obviousness argument under § 103." *Id.*

We have determined that claims 1–3 and 5–8 are anticipated by Dykstra. As anticipation is the ultimate of obviousness, we also determine that Dykstra renders these claims obvious. *In re Baxter Travenol Labs*, 952 F.2d 388, 391 (Fed. Cir. 1991).

 Obviousness of Claims 2–4 Over Dykstra and Omont Petitioner asserts that claims 2–4 are unpatentable over the combined teachings of Dykstra and Omont. Pet. 59. As we have determined that claims 2 and 3 are anticipated by Dykstra, we only discuss claim 4 in addressing this challenge.

Claim 4 depends from claim 1 and adds the steps of "detecting that at least one performance issue of the automated hydraulic fracturing system" ("limitation 4[a]") and "providing troubleshooting codes or alerts indicative of one or more sources of the performance issue" ("limitation 4[b]"). Ex. 1001, 11:24–27.

For limitation 4[a], Petitioner asserts that a person of ordinary skill in the art "would have understood that 'whether the subsystem's output is in line with the desired rate 310' [in *Dykstra*] is 'detecting that at least one performance issue of the automated hydraulic fracturing system," and "that determining whether proppant flow rate is not at the desired value is 'detecting that at least one performance issue of the automated hydraulic fracturing system.'" Pet. 67 (citing Ex. 1003 ¶ 143). Petitioner asserts further that it would have been obvious to a person of ordinary skill in the art "to enhance the control system of *Dykstra* by adding the monitoring and troubleshooting functionality of the process diagnostic tool of *Omont*, without affecting the other functionalities in *Dykstra*." *Id.* (citing Ex. 1003 ¶ 144).

For limitation 4[b], Petitioner asserts that "*Omont* discloses that '[t]he process diagnostic tool 520 may also permit configuration of thresholds for alarms, whether preprogrammed or via the HMI 310, such that changes in the sensors 204, 214, 222, variations in components of the additive system 200, and changes in process knowledge may be easily incorporated." Pet. 68 (quoting Ex. 1005 ¶ 94). Petitioner asserts that "*Omont* further discloses that '[s]uch alarms may be enhanced by adding a troubleshooting guide or a list of suggestions related to potential root causes of each alarm." *Id.* (alteration in original). As an example, Petitioner asserts that

Omont discloses "comparing the power end oil pressure on a pump 152 to a threshold value while the associated prime mover 154 is driving the pump 152" and "if the pressure falls below the threshold value, the process diagnostic tool 520 may issue a low power end oil pressure warning, via the HMI 310."

Id. (citing Ex. 1005 \P 94). And, as another example, Petitioner asserts that

Omont discloses "comparing an air pressure of the pump 152 to a threshold value" and "if the air pressure falls below the threshold value, the process diagnostic tool 520 may issue a low air pressure warning and display a list of potential resolutions, such as checking the air supply, compressor, filter, or hoses (e.g., for leaks) of the pump 152." *Id.* (citing Ex. 1003 ¶ 145).

Based on these disclosures and examples, Petitioner reasons that it would have been obvious to a person of ordinary skill in the art "to enhance the control system of *Dykstra* by adding the monitoring and troubleshooting functionality of the process diagnostic tool of *Omont*, without affecting the other functionalities in *Dykstra*." *Id.* at 69 (citing Ex. 1003 ¶ 146).

Patent Owner contends that "the substance of *Omont* relied upon by Petitioner fails to teach the specific features of monitoring, generating, and controlling the hydraulic fracturing operation via a plurality of sensing and control devices integrated into the wellbore treatment equipment as recited in Claim 1 of the '031 Patent." PO Resp. 47 (citing Ex. 1004 ¶ 21; Ex. 2011, 33–34).

Patent Owner also contends that there is no motivation to combine Dykstra and Omont. PO Resp. 47. Regarding the proposed modification, Patent Owner contends that "the problems that *Dykstra* and *Omont* each seek to address are different." PO Resp. 47 (citing Ex. 2011, 37–38). Patent Owner contends further that "Petitioner has failed to show what would have led a [person of ordinary skill in the art], in the absence of the '031 Patent disclosure, to 'combine' the 'apparatus for controlling the manufacture of well treatment fluid' of *Dykstra* with the 'process diagnostic tool' of *Omont.*" *Id.* (citing Pet. 60–61). Patent Owner contends further that "during his deposition, Dr. Hilbert stated that the motivation to combine *Dykstra* and *Omont* came from the subject matter of the 'claims, the elements, and the specifications' of the '031 Patent." *Id.* at 49 (citing Ex. 2012, 69:3–6). Patent Owner also contends that "[s]ince Claim 4 depends from Claim 1, Claim 4 is not obvious." *Id.* at 53.

In addition, Patent Owner contends that Dykstra and Omont were considered by the Examiner and the Examiner's findings should be given significant weight. PO Resp. 53. In other words, Patent Owner requests that we reconsider our Decision Instituting Trial. Paper 9. Patent Owner's request is untimely and we do not revisit our prior determination under 35 U.S.C. § 325(d) that "Petitioner has shown material error in the Examiner's failure to apply Dykstra." *Id.* at 15.

Petitioner replies that Patent Owner cites no case law supporting its argument that the references cannot address different problems stating "that is not the test for motivation to combine." Pet. Reply 17–18 (citing *KSR*, 550 U.S. at 420). Petitioner replies further that "Dr. Hilbert clarified that he misspoke [during his deposition] and was referring to the 'claims, elements, and the specifications' of the prior art for his obviousness analysis." *Id.* Petitioner asserts that "other portions of the deposition make clear that Dr. Hilbert was applying the teachings of the prior art." *Id.* (citing Ex. 2012, 63:6–14, 69:13–21, 123:14–124:4).

We agree with Petitioner that that the combined teachings of Dykstra and Omont would have rendered claim 4 obvious to one of ordinary skill in the art. Specifically, we agree with Petitioner's reasoning that it would have been obvious to a person of ordinary skill in the art "to enhance the control system of *Dykstra* by adding the monitoring and troubleshooting functionality of the process diagnostic tool of *Omont*" in order "to 'prevent operation stoppages and severe damage to other components." Pet. 61, 67 (citing Ex. 1005 ¶ 3; Ex. 1003 ¶¶ 127–128, 144). We credit Dr. Hilbert's testimony in support of Petitioner's reasoning and agree that it appears Dr. Hilbert misspoke regarding the basis for his obviousness analysis during his deposition. Ex. 1003 ¶¶ 143–146. We further find Patent Owner's arguments to be unconvincing because, even assuming that Dykstra and Omont "seek to address" different problems (as Patent Owner contends), such contentions do not preclude a determination that it would have been obvious to combine the teachings of Dykstra and Omont in the manner outlined in the Petition.

4. Alleged Objective Evidence of Nonobviousness

Notwithstanding what the teachings of the prior art would have suggested to one skilled in the art, objective evidence of nonobviousness (so called "secondary considerations") may lead to a conclusion that the challenged claims would not have been obvious. *In re Piasecki*, 745 F.2d 1468, 1471–72 (Fed. Cir. 1984). Objective evidence of nonobviousness "may often be the most probative and cogent evidence in the record" and "may often establish that an invention appearing to have been obvious in light of the prior art was not." *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (citing *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)).

"In order to accord substantial weight to secondary considerations in an obviousness analysis, 'the evidence of secondary considerations must have a "nexus" to the claims, i.e., there must be "a legally and factually sufficient connection" between the evidence and the patented invention."" Fox Factory, Inc. v. SRAM, LLC, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (citing Henny Penny Corp. v. Frymaster LLC, 938 F.3d 1324, 1332 (Fed. Cir. 2019)). "The patentee bears the burden of showing that a nexus exists" WMS Gaming Inc. v. Int'l Game Tech., 184 F.3d 1339, 1359 (Fed. Cir. 1999). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. Demaco Corp. v. F. Von Langsdorff Licensing Ltd., 851 F.2d 1387, 1392 (Fed. Cir. 1988). Nexus is presumed when "the patentee shows that the asserted objective evidence is tied to a specific product and that product 'embodies the claimed features, and is coextensive with them.'" Fox Factory, 944 F.3d at 1373 (quoting Polaris Indus., Inc. v. Arctic Cat, Inc., 882 F.3d 1056, 1072 (Fed. Cir. 2018)). "A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations," because "the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the 'direct result of the unique characteristics of the claimed invention." Id. at 1373–74 (citing In re Huang, 100 F.3d 135, 140 (Fed. Cir. 1996)).

a. Petitioner's Alleged Failure to Rebut the Objective Evidence of Nonobviousness

Patent Owner asserts that "Petitioner's failure to address any secondary considerations is fatal to its obviousness arguments." PO Resp. 59. Specifically, Patent Owner contends that, prior to the filing of the Petition, "[i]t was [publicly] reported . . . that ProFrac acquired a licensing agreement covering [Patent Owner's] patented technology." *Id.* n.4. Thus, IPR2021-01538 Patent 10,408,031 B2

according to Patent Owner, "Petitioners have failed to state a *prima facie* case of obviousness." *Id.* at 59.

In this case, where the evidence of objective indicia is a public announcement of a licensing agreement covering unnamed patent(s) between Patent Owner and a third party (ProFrac),⁵ we do not fault Petitioner for not addressing this evidence in the Petition. Patent Owner raised the issue of secondary considerations in its Response to the Petition. PO Resp. 57–59. Petitioner responded by addressing secondary considerations in its Reply. Pet. Reply 21–23. Patent Owner had the opportunity to file a Sur-reply and could have responded to Petitioner's arguments, but it chose not to do so.

b. Alleged Nexus Between the Evidence and the Claimed Invention

Patent Owner does not even attempt to demonstrate nexus between the alleged license and the challenged claims. PO Resp. 57–59. In fact, the word "nexus" does not appear in Patent Owner's Response. *Id*.

Petitioner contends that Patent Owner "completely fails to tie the purported evidence of secondary considerations to any product or patent, much less show that any such product or patent is coextensive with the evidence." Pet. Reply 23. Petitioner contends further that "[e]ven if there were nexus, the purported evidence of secondary considerations is lacking" because Patent Owner "has failed to even introduce the license agreement

⁵At the time of the announcement of a licensing agreement between Patent Owner and ProFrac Holding Corp. ("ProFrac"), it appears that Patent Owner had not been acquired by ProFrac. *See* PO Resp. 59; Paper 28, 1.

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with ProFrac Manufacturing, LLC into evidence, and instead merely submits public articles that discuss the license agreement, one of which is [Patent Owner's] own press release." *Id.* (citing PO Resp. 59; Exs. 2010, 2014, 2015). Petitioner asserts that "[t]here is no indication from these articles as to which patents (or how many patents) the license agreement covers or whether the '031 Patent is one of those unidentified patents, as the terms of the license agreement have not been provided." *Id.* Thus, according to Petitioner, "even setting aside nexus, [Patent Owner's] unsupported secondary considerations should be given no weight." *Id.*

We agree with Petitioner that Patent Owner has not demonstrated the requisite coextensive requirement to be afforded a presumption of nexus or, absent the presumption, shown that evidence of secondary considerations is the "direct result of the unique characteristics of the claimed invention." *See* Pet. Reply 22–23.

For these reasons, we determine that Patent Owner is not entitled to the presumption of nexus. For these same reasons, we further determine that Patent Owner has not directly demonstrated nexus.

c. Alleged Commercial Success

Although we do not find nexus for the reasons discussed above, in the interest of full and complete consideration of the record, we discuss Patent Owner's evidence of commercial success via an alleged licensing of the '031 patent.

Exhibit 2010 is a Yahoo News press release that purports that Patent Owner sold PIK Notes that ProFrac converted into licenses. Ex. 2010, 1–2. However, Patent Owner has not entered the asserted license(s) into the record in this proceeding. Therefore, we are unable to evaluate the veracity of Exhibit 2010 or determine if the '031 patent is included in the asserted license. Moreover, Patent Owner's attempt to establish that the purported license includes the '031 patent without making the license of record in this proceeding violates the best evidence rule. *See* Fed. R. Evid. 1002 ("An original writing, recording, or photograph is required in order to prove its content unless these rules or a federal statute provides otherwise."); 37 C.F.R. § 41.152(a) ("Except as otherwise provided in this subpart, the Federal Rules of Evidence shall apply to contested cases."). For at least these reasons, we do not find Exhibit 2010 persuasive of commercial success. Patent Owner's other evidence of this licensing agreement (Exs. 2014 and 2015) are not persuasive of commercial success for the same reasons.

Accordingly, for at least the foregoing reasons, we find Patent Owner's evidence of commercial success to be weak evidence of nonobviousness.

5. Determination For Claim 4

Petitioner has shown that the individual limitations of claim 4 of the '031 patent are disclosed by Dykstra and Omont, and Petitioner provides persuasive arguments regarding why a person of ordinary skill in the art would have combined the teachings of these references. Patent Owner's objective indicia of nonobviousness is comparatively weak. When considering all of the evidence of obviousness and nonobviousness together (*see In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1079 (Fed. Cir. 2012)), we conclude Petitioner has IPR2021-01538 Patent 10,408,031 B2

demonstrated, by a preponderance of the evidence, that claim 4 would have been obvious over Dykstra and Omont.

IV. SUMMARY⁶

For the reasons discussed above, we find that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1–8 are unpatentable as set forth in the table below:

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not shown Unpatentable
1-3, 5-8	102	Dykstra	1-3, 5-8	
1-3, 5-8	103	Dykstra	1-3, 5-8	
2–4	103	Dykstra,	47	
		Omont		
Overall			1-8	
Outcome				

V. ORDER

⁶ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

⁷⁷ We do not reach this ground for claims 2 and 3.

After due consideration of the record before us, and for the foregoing reasons, it is:

ORDERED that claims 1–8 of the '031 patent are held unpatentable; and

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

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