

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

Case No. IPR2023-00558

Patent No. 11,136,870

PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-16 OF
U.S. PATENT NO. 11,136,870

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1001	U.S. Patent No. 11,136,870 by Joel Broussard <i>et al.</i> entitled “System for Pumping Hydraulic Fracturing Fluid using Electric Pumps” (“the ’870 Patent”)
1002	Declaration of Dr. Robert Durham
1003	File History for U.S. Patent No. 11,136,870
1004	File History for U.S. Patent No. 9,410,410
1005	U.S. Patent Publication No. 2012/0255734, Coli, <i>et al.</i> , “Mobile, modular, electrically powered system for use in fracturing underground formations,” (“ <i>Coli</i> ”) filed on April 6, 2012 and published on October 11, 2012.
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1007	Declaration of Nathaniel E. Frank-White, custodian of records for Internet Archive regarding Toshiba documents (May 27, 2022)
1008	U.S. Patent Publication No. 2011/0241590, Horikoshi, <i>et al.</i> , “Motor driving apparatus having fault diagnostic function,” (“ <i>Horikoshi</i> ”) filed on February 11, 2011 and published on October 6, 2011.
1009	U.S. Patent Publication No. 2010/0312415, Loucks, “Electrical Device Cooling Efficiency Monitoring,” (“ <i>Loucks</i> ”) filed on June 4, 2009 and published on December 9, 2010.
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1011	Gardner Denver, Inc., Well Servicing Pump, Model GD-2500Q, Quintuplex, Operating and Service Manual, 300FWF996 Revision C, (“ <i>Gardner</i> ”) published in April 2005, Tulsa, OK, USA.

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1016	Donald G. Fink, STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, 13 th ed. (McGraw-Hill, New York: 1993), ISBN: 0-07-020984-7 (“ <i>Fink</i> ”)
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1047	GX7 Low Voltage Severe Duty Specialty, Toshiba (Nov. 23, 2012), available at: https://web.archive.org/web/20101123025808/http://www.toshiba.com/ind/product_display.jsp?id1=7&id2=601
1048	IPR2021-01033, Paper 41 (P.T.A.B. Jan. 4, 2023) Final Written Decision concerning U.S. Patent No. 8,789,601
1049	U.S. Patent No. 8,789,601, Broussard <i>et al.</i> , “System for Pumping Hydraulic Fracturing Fluid Using Electric Pumps,” (“the ’601 Patent”) filed on February 26, 2014 and issued on July 29, 2014.
1050	Declaration of Robert Schaaf from <i>U.S. Well Services, LLC v. Tops Well Services, LLC et al.</i> , No. 3:19-cv-00237, Dkt. 72-9 (S.D. Tex. Apr. 24, 2020)
1051	Deposition Transcript of Robert Schaaf taken in IPR2021-01033 (July 1, 2022)
1052	Deposition Transcript of Robert Schaaf taken in IPR2021-01032, -01034, -01036, -01038 (June 29, 2022)
1053	<i>Halliburton Energy Services, Inc., et al. v. U.S. Well Services, LLC</i> , No. 6:22-cv-00906-ADA-DTG, Dkt. 50 (Feb. 8, 2023) (Joint Motion to Extend Scheduling Deadlines)

I. MANDATORY NOTICES

Real Party in Interest: Halliburton Energy Services, Inc. (“Halliburton” or “Petitioner”), Halliburton Co., and Halliburton Holdings LLC are the real parties in interest.

Related Matters: U.S. Patent No. 11,136,870 is asserted in a pending lawsuit entitled *Halliburton Energy Services, Inc., et al., v. U.S. Well Services, LLC*, 6:22-cv-00906-ADA (W.D. Tex.) (“Halliburton Litigation”). Petitioner is concurrently filing a Petition for IPR against U.S. Patent No. 9,650,871, which is asserted in a related pending lawsuit entitled *Halliburton Energy Services, Inc., et al. v. U.S. Well Services, LLC*, 6:22-cv-00905-ADA (W.D. Tex.).

In addition, Petitioner has filed Petitions for IPR against three other patents that involve substantially similar subject matter: IPR2021-01032 against U.S. Patent No. 9,410,410; IPR2021-01033 against U.S. Patent No. 8,789,601; and IPR2021-01034 against U.S. Patent No. 10,337,308.¹ Each of these Petitions resulted in

¹ IPR2021-01032 and IPR2021-01034 concern the patents that issued from the parent applications of the ’870 Patent at issue in the instant Petition. A terminal disclaimer was filed for the ’870 Patent in view of the patents at issue in IPR2021-01032 and IPR2021-01033. Ex. 1003 at 72–75,

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decisions to institute, were assigned to the same three-judge panel,² and all but one of the challenged claims from those three patents were found unpatentable.

Petitioner has also filed Petitions for IPR against other patents held by Patent Owner, including: IPR2021-01035 against U.S. Patent No. 9,970,278; IPR2021-01036 against U.S. Patent No. 9,611,728; IPR2021-01037 against U.S. Patent No. 9,745,840; IPR2021-01038 against U.S. Patent No. 10,408,030; IPR2021-01065 against U.S. Patent No. 9,840,901; IPR2021-01065 against U.S. Patent No. 9,840,901; IPR2021-01066 against U.S. Patent No. 10,020,711; IPR2021-01238 against U.S. Patent No. 10,526,882; IPR2021-01315 against U.S. Patent No. 9,893,500; IPR2021-01316 against U.S. Patent 10,280,724; IPR2021-01538 against U.S. Patent No. 10,408,031; and IPR2021-01539 against U.S. Patent No. 10,648,311; IPR2022-00074 against U.S. Patent No. 10,254,732; IPR2022-00610 against U.S. Patent No. 10,934,824. Aside from IPR2021-01539, each of these Petitions resulted in decisions to institute, and were assigned to the same three-judge panel as the three noted above.

Lead Counsel and Request for Authorization: Petitioner designates lead and back-up counsel as noted below. A Power of Attorney is filed concurrently herewith under 37 C.F.R. § 42.10(b).

² Judges Browne, Hoskins, and O'Hanlon comprised this panel.

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II. STANDING AND FEES

Standing: Petitioner certifies under 37 C.F.R. § 42.104(a) that the U.S. Patent No. 11,136,870 is eligible for *inter partes* review and that Petitioner is not barred or estopped from requesting *inter partes* review on the grounds set forth herein.

Fees: The Office is authorized to charge the fee set forth in 37 C.F.R. § 42.15(a) to Deposit Account No. 02-0384 as well as any additional fees that might be due in connection with this Petition.

III. OVERVIEW OF THE '870 PATENT

Petitioner challenges claims 1-16 (“Challenged Claims”) of U.S. Patent No. 11,136,870 (“the ’870 Patent”), titled “System for Pumping Hydraulic Fracturing Fluid using Electric Pumps.” *See* Ex. 1001.

A. *Subject Matter of the '870 Patent*

The ’870 Patent relates to hydraulic fracturing operations. The ’870 Patent explains that in traditional hydraulic fracturing operations, “pumping is typically performed by large diesel-powered pumps” to create fractures in a formation. Ex. 1001, 1:39-42. The ’870 Patent acknowledges several “problems associated with diesel pumps” (*e.g.*, high costs of maintaining, transporting, and fueling such pumps) and then re-states what was already known in the art—*i.e.*, that these problems can be overcome by “using pumps powered by electric motors.” Ex. 1001, 1:41-54; 1:24-26; *see* Ex. 1002, ¶39; Exs. 1005, 1013, 1014, 1020. In particular, the ’870 Patent is directed to “pumping fracturing fluid into an oil or gas well using pumps powered by electric motors.” *See* Ex. 1001, 1:23-26. The electric motor driven pumps are intended to replace the traditionally-used diesel powered pumps and thereby avoid the aforementioned problems. *See id.*, 1:53-55.

The ’870 Patent describes a hydraulic fracturing operation that includes “a plurality of pumps 10 mounted to pump vehicles 12.” *Id.*, 3:40. The ’870 Patent further states that “the pumps 10 are powered by electric motors 14, which can also

be mounted to the pump vehicles 12.” *Id.*, 3:42-44. The pumps 10 deliver fracturing fluid to a wellbore through a missile 18 positioned between the pumps 10 and a wellhead. *Id.*, 3:48-50.

As demonstrated herein, all features of the Challenged Claims, including the design considerations and purported advantages described in the ’870 Patent, were well known at the time the application leading to the ’870 Patent was filed.

B. *Prosecution History of the ’870 Patent*

The application that issued as the ’870 Patent—U.S. Patent Application No. 16/456,777—was filed June 28, 2019. Ex. 1003 at 272. The ’870 Patent is a continuation of U.S. Patent Application No. 15/202,085 (“’085 Application”) that issued as U.S. Patent No. 10,337,308 (the “’308 Patent”), which is a continuation of U.S. Patent Application No. 13/679,689 that issued as U.S. Patent No. 9,410,410 (the “’410 Patent”). After a preliminary amendment, the application included 20 claims, of which claims 2, 6, and 10 were independent. Ex. 1003 at 168-171.

In a first Non-Final Office Action dated November 23, 2020, the Examiner rejected claims 2-21, but found that then-pending dependent claims 3, 9, and 18 “would be allowable if rewritten in independent form including all of the base claim and any intervening claims.” Ex. 1003 at 94. Then-pending claims 3 and 9 recited: “wherein the variable frequency drive frequently performs electric motor diagnostics to prevent damage to the one or more electric motors.” Then-pending claim 18

recited: “wherein the variable frequency drive has one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat.” Applicant amended the independent claims (which issued as claims 1, 4, and 7) to recite the features previously recited in claims 3 (except for the word “frequently”), 9 (except for the word “frequently”), and 18. Ex. 1003 at 81-84. Applicant also filed terminal disclaimers over U.S. Patent No. 9,410,410 and U.S. Patent No. 8,789,601. *Id.*, 72-73. The Examiner approved the terminal disclaimers, and the application was then allowed. *Id.*, 18-23, 58.

Based on the above, the point of purported novelty of independent claims 1, 4, and 7 of the ’870 Patent lies in the variable frequency drive (“VFD”) performing diagnostics and heat sinks having thermal sensors to prevent damage to the motor. Such variable frequency drives, including diagnostic functionality and heat sinks having thermal sensors to prevent damage as required by the independent claims, however, were well known before the earliest priority date of the ’870 Patent.

C. *Priority Date of the ’870 Patent*

The ’870 Patent purports to claim priority to November 16, 2012. Petitioner relies on prior art that pre-dates November 16, 2012.

IV. SUMMARY OF PRIOR ART

Because the application that issued as the ’870 Patent claims priority having an effective filing date before March 16, 2013, it was examined under the pre-AIA

first to invent provisions. Ex. 1003.

A. *Coli* (Ex. 1005)

Coli refers to U.S. Patent Publication No. 2012/0255734, which was filed on April 6, 2012 and published on October 11, 2012. Ex. 1005. *Coli* is thus prior art to the '870 Patent under pre-AIA 35 U.S.C. §§ 102(a) and 102(e).

Like the '870 Patent, *Coli* involves a “fracturing system” for “delivering fracturing fluid to a wellbore at a fracturing operation.” Ex. 1005, [0034]. *Coli* discloses how the electrification of the fracturing operation can improve costs (*id.*, [0075]) and efficiency (*id.*, [0077]), as well as safety (*id.*, [0066]) and environmental impact (*id.*, [0080]). For example, *Coli* discloses using natural-gas powered turbines to generate electricity, which in turn powers electric motors for driving the pumps. *Id.*, [0042]. The turbines may use natural gas that is collected on site thereby “obviating the need for a constant supply of diesel fuel to the site and reducing the site footprint and infrastructure required for the fracturing operation.” *Id.*, [0036]; *see also id.*, [0075]. Further, the smaller size and lighter weight of pumping modules with electric motors “allow[s] for placement of four pumps 22 in the same physical dimension (size and weight) as the spacing needed for a single pump in conventional diesel systems.” *Id.*, [0049]. Thus, “the number of fracturing modules 20 placed on each trailer 10” is “maximized.” *See id.*, [0052].

Coli further discloses that the “[e]lectric motors [are] controlled via variable frequency drive [and] are far safer and easier to control than conventional diesel powered equipment.” *Id.*, [0066]. *Coli* discloses “a quintiplex or triplex plunger style pump, for example, the SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.,” which is a pump rated at 2500 horsepower or more. *Id.*, [0046]; [0049] (“[T]he present system can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.”); [0050] (“fracturing module 20,” which contains one or more pumps and electric motors, “is capable of operating at 2500 hp.”).

Thus, a person of ordinary skill in the art (“POSITA”) would have understood that *Coli* discloses an entire fracturing system, that includes trailer-mounted electric pumps and motors, with associated variable frequency drives and natural-gas powered turbine generators. Ex. 1002, ¶110.

B. *Gardner* (Ex. 1011)

Gardner is an operating and service manual for Gardner Denver’s GD-2500Q Quintuplex pump (300FWF996 Rev C). Ex. 1011. As indicated on its cover, *Gardner* was published in August 2005 and was publicly available shortly thereafter. The custodian of records at Internet Archives provided an affidavit that the GD 2500Q Manual was available on the Internet no later than September 17, 2012.

Ex. 1012. *Gardner* is thus prior art to the '870 Patent under pre-AIA 35 U.S.C. §§ 102(a) and 102(b).

Gardner's "SWGS-2500" pump is expressly cited in *Coli* as an example of a suitable "quintiplex or triplex plunger style pump" that can be coupled to an electric motor and used in a fracturing module. Ex. 1005, [0046]. A POSITA would have understood that the "SWGS-2500 quintuplex pump" disclosed by *Coli* refers to a Gardner Denver GD-2500Q pump end coupled with a Gardner Denver SGWS fluid end. Ex. 1002, ¶139. *Gardner* discloses that the GD-2500Q is a quintuplex pump with a "Stroke Length" of "8.0 inches," and a "plunger size" (diameter) of "3.75, 4, 4.5, 5, 5.5, 5.75, 6, 6.5, [or] 6.75" inches. Ex. 1011, 14. In addition, *Gardner* discloses that the input power to the pump, which is the same as the output power of the electric motor coupled to the pump, is 2200 or 2500 bhp." *Id.* *Gardner* also discloses that the pump is rated at 2500 bhp. *Id.*

C. *Toshiba Manual* (Ex. 1006)

Toshiba Manual refers to "G7 Adjustable Speed Drive Operation Manual," Document No. 51546-009, published by Toshiba International Corp. ("Toshiba") with the cover bearing a copyright date of March 2005. Ex. 1006. As of 2012, Toshiba was a well-known manufacturer of motors and industrial drives for the oil and gas industry. Ex. 1002, ¶¶112-113 (citing Ex. 1045-1046). *Toshiba Manual* contains information regarding operation and setup of the G7 family of drives,

including the GX7 model. Ex. 1006; Ex. 1047. A POSITA would have reviewed the Toshiba website and product listings to learn about product offerings and VFD functionality. Ex. 1002, ¶¶113-114.

Toshiba Manual was publicly accessible from the Toshiba website at least by December 7, 2010, the date it was archived by the Internet Archive Wayback Machine. Ex. 1007, (Internet Archive Decl.) at 1, 25 (sponsoring Exhibit 1006). *See Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 18 (P.T.A.B. Dec. 20, 2019) (precedential) (public accessibility based on “webpage[s] from the Wayback Machine, a declaration from the office manager of the Internet Archive including the site’s archival records, and expert testimony asserting its public accessibility”). Accordingly, *Toshiba Manual* is prior art under 35 U.S.C. §§ 102(a) and 102(b) (pre-AIA).

Toshiba Manual is an Operations Manual for a VFD and contains a detailed description of a VFD. Ex. 1006. Similar to *Coli*, *Toshiba Manual* describes how the VFD controls an electric motor—by “deliver[ing] unparalleled motor control and reliability.” Ex. 1006 at 2 (Introduction); *see id.* at 65 (“ability to allow the user direct access to the motor control functions.”)

Toshiba Manual expressly discloses that the Electronic Operator Interface (EOI) “may be used to monitor system functions, input data into the system, or perform diagnostics.” *Id.* at 43. The diagnostics include a “fault screen” that

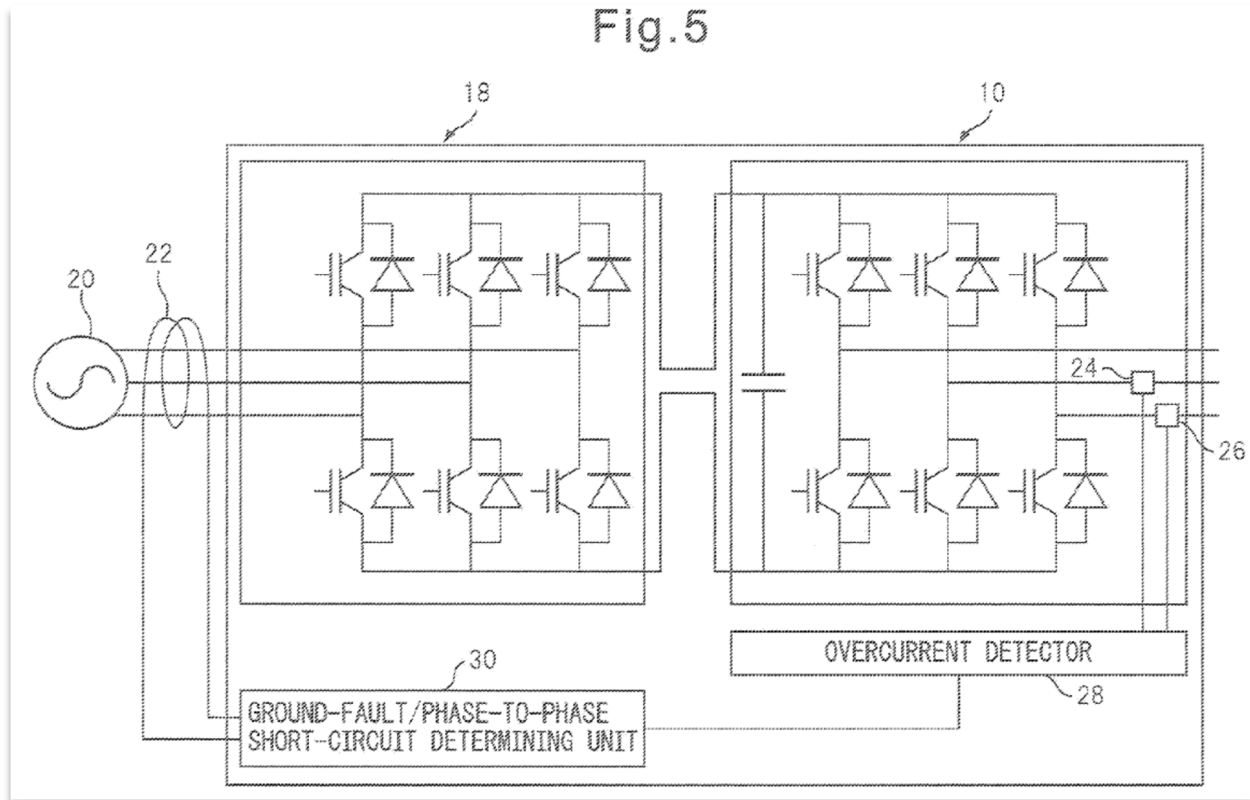
“identifies the active Fault.” *Id.* at 182-186 (Table 12, containing a list of five pages of faults that are diagnosed). The diagnostic functions result in an alarm or trip condition on the “adjustable speed drive” (ASD). *Id.* at 179. *Toshiba Manual* discloses performing electric motor diagnostics to prevent damage to the motor, including protecting against overload, overcurrent, overtorque, short circuit, and earth faults. Ex. 1006 at 19, 22, 160-163, 165. Several of the diagnostics are performed with “every run” or “every power up.” *Id.* at 162.

Toshiba Manual also teaches that the VFD comprises power semiconductors, including a rectifier and inverter formed from insulated gate bipolar transistors (IGBTs), having heat sinks to dissipate heat. *Id.* at 14 (“heat sink and other components may become extremely hot to the touch”); *see id.* at 204 (“cooling capacity of the heatsink”). The heat sinks have thermal sensors, e.g., an “internal thermistor” that protects against overheating. *Id.* at 180, 185. For example, one of the faults displayed by the EOI, which contains microprocessors that provides input to the VFD, is “Overheat,” which occurs when the “ASD ambient temperature [is] excessive.” *Id.* at 180. The “Overheat” fault can occur if the “ASD is operating at an elevated temperature,” if the “Cooling fan vent is obstructed,” or if the “Internal thermistor is disconnected.” *Id.*; *see id.* at 185 (overheat); *id.* at 163 (“cooling fan control”). A POSITA would have understood that the heatsink is the main heat dissipating device in the ASD cabinet. Ex. 1002, ¶¶ 120-123.

D. *Horikoshi* (Ex. 1008)

Horikoshi refers to U.S. Patent Publication No. 2011/0241590, which was filed on February 11, 2011 and published on October 6, 2011. Ex. 1008. *Horikoshi* is thus prior art to the '870 Patent under pre-AIA 35 U.S.C. §§ 102(a), 102(b) and 102(e).

Horikoshi is directed to a VFD that is “capable of detecting during operation a ground fault and a phase-to-phase short circuit.” *Id.*, [0011], [0027]. *Horikoshi* teaches the use of a “motor driving apparatus” that includes an “AC/DC converter 18 [that] converts three-phase AC power” into DC power, and an associated “DC/AC converter 10 [that] converts the DC power ... into frequency variable three-phase AC power for output.” *Id.*, [0027].



Id., Fig. 5.

The apparatus further includes “[c]urrent sensors” to detect current output from the DC/AC converter 10 to an electric motor. *Id.* The current sensors may be used to detect “overcurrent” associated with “the insulation resistance of the motor” connected to the drive apparatus. *Id.*, [0004], [0006]. The “overcurrent” can be caused by a “ground fault or a phase-to-phase short circuit.” *Id.*

Thus, *Horikoshi* is in a field of art—variable frequency drives—that is highly relevant to the ’870 Patent, which describes the use of variable frequency drives to control electric-motor driven pumps, and a POSITA would have understood that

Horikoshi prevents damages to electric motors by performing diagnostics. Ex. 1002, ¶¶126-129.

E. *Loucks* (Ex. 1009)

Loucks refers to U.S. Patent Publication No. 2010/0312415, which was filed on June 4, 2009 and published on December 9, 2010. Ex. 1009. *Loucks* thus qualifies as prior art to the '870 Patent under pre-AIA 35 U.S.C. §§ 102(a), 102(b), and 102(e).

Loucks is generally related to a “cooling efficiency monitoring method” for a “monitored electrical device.” Ex. 1009 at [0005]. The “cooling efficiency techniques and systems” may be used on “any device that consumes electrical energy and exhausts waste heat” including “transformers, circuit breakers, uninterruptible power supplies (UPSs) or variable frequency drives (VFDs).” *Id.*, [0036], [0060]. *Loucks* teaches that “for a variably loaded system, ... simply waiting for a high temperature limit to be reached may result in equipment damage that occurs in the time it takes to resolve the cooling problem.” *Id.*, [0018]. Thus, *Loucks* teaches the importance of “detect[ing] problems before temperatures reach alarm limits” in order to prevent “accelerated equipment degradation and early failure.” *Id.*

Loucks teaches a method for monitoring “operating cooling efficiency” based in part on calculating a “temperature differential between the equipment and an ambient temperature.” *Id.*, Abstract. The cooling efficiency monitoring system

comprises “multiple temperature sensors” including “a power electronics heat sink temperature sensor 510.” *Id.*, [0063]. These sensors provide measured temperature data to a computer 700, which includes a processor 702 and cooling efficiency logic 730. *Id.*, [0066]. *Loucks*’ cooling efficiency logic 730 uses the “ratio of the electrical power consumed by the monitored electrical device and the computed temperature differential,” to calculate an operating cooling efficiency indicator and compares it to a baseline cooling efficiency. *Id.*, [0069]-[0070].

F. *Vliet* (Ex. 1010)

Vliet refers to U.S. Patent Publication No. 2011/0197988, which was filed on February 16, 2011 and published on August 18, 2011. *See* Ex. 1010. *Vliet* is thus prior art to the ’870 Patent under pre-AIA 35 U.S.C. §§ 102(a), 102(b), and 102(e).

Vliet discloses a “fuel delivery system for delivery of fuel to fuel tanks of equipment at a well site during fracturing” and acknowledges that “[f]or use at different well sites, the fuel delivery system should be portable and transportable to various well sites.” Ex. 1010, [0014], [0003]. *Vliet* further discloses that the “pumps” and “electrical equipment” are on a trailer and “are supplied with power from a conventional generator or *generators* (not shown), *which may conveniently be mounted on the trailer.*” *Id.*, [0027] (emphasis added). *Vliet* further discloses that the “spatial orientation” of the components, including generators, is “a matter of design choice for the manufacturer and will depend on space requirements.” *Id.*

G. Summary of Grounds

Petitioner requests cancellation of the claims on the following obviousness (35 U.S.C. § 103) grounds:

Ground	Claims	Prior Art
1	1-16	<i>Coli</i> in view of <i>Toshiba Manual</i>
2	1-6	<i>Coli</i> in view of <i>Horikoshi</i>
3	7-16	<i>Coli</i> in view of <i>Loucks</i>
4A	12 and 13	<i>Coli</i> in view of <i>Toshiba Manual</i> and <i>Vliet</i>
4B	12 and 13	<i>Coli</i> in view of <i>Loucks</i> and <i>Vliet</i>
5A	14 and 15	<i>Coli</i> in view of <i>Toshiba Manual</i> and <i>Gardner</i>
5B	14 and 15	<i>Coli</i> in view of <i>Loucks</i> and <i>Gardner</i>

V. DISCRETIONARY DENIAL WOULD BE INAPPROPRIATE

A. Discretionary Denial Under *Fintiv* factors is not appropriate³

The factors described in *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB March 20, 2020) (Precedential) (“*Fintiv-P*”) favor institution.

At the time of this Petition, discovery has not commenced in the Halliburton Litigation and, although a stay motion has not yet been filed in the Halliburton Litigation, Petitioner intends to promptly file a stay motion with respect the ’870

³ Petitioner reserves its rights to contest a denial of institution based on the *Fintiv* framework.

Patent in the event of IPR institution. The Board has treated related factors as neutral after declining to speculate on the outcome of a stay motion. *See, e.g., HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (PTAB Jan. 14, 2021) (“*HP*”) (instituting IPR after declining to speculate on likelihood of a stay in Western District of Texas).

“[I]t is often reasonable for a Petitioner to wait to file its petition until it learns which claims are being asserted against it in the parallel proceeding.” *Fintiv-I* at 11. Here, Petitioner filed this Petition against all claims of the ’870 Patent promptly after Patent Owner filed a counterclaim of infringement of the ’870 patent against Petitioner in the Halliburton Litigation on November 7, 2022. Due to Petitioner’s diligence, it would be premature at the time of this Petition to argue regarding the timing of respective milestones in this proceeding versus the Halliburton Litigation. If Patent Owner raises § 314(a) arguments in a Preliminary Response, Petitioner respectfully requests the opportunity to reply prior to institution, in order to address expected schedules and whether a *Sand Revolution* stipulation would be appropriate.

Nevertheless, Petitioner notes that the parties have invested minimal resources in the Halliburton Litigation as fact discovery has not yet commenced and, the parties have jointly moved to extend the litigation schedule. *See* Ex. 1053. Further, the court’s work in the Halliburton Litigation has thus far consisted of administrative oversight and preliminary case management. The court in the Halliburton Litigation

has not issued any substantive orders related to the '870 Patent.

Additionally, this Petition presents a “compelling unpatentability challenge” (see Ex. 1015 at 3-5), as the PTAB recently issued Final Written Decisions in IPR2021-01032 (U.S. Patent No. 9,410,410), IPR2021-01033 (U.S. Patent No. 8,789,601), and IPR2021-01034 (U.S. Patent No. 10,337,308) involving patents with substantially similar subject matter and finding all but one challenged claim to be unpatentable. The same primary prior art reference from those proceedings, *Coli*, is used as the primary reference in this Petition. See *Coolit Sys., Inc. v. Asetek Danmark A/S*, IPR2021-01196, Paper 10 at 14-15 (P.T.A.B. Dec. 28, 2021) (granting institution in part because of “the similarity between the claims” of the challenged patent and those of the parent patent where the Board had issued a Final Written Decision finding all claims unpatentable by the same prior art reference). The Board should not discretionarily deny on this basis alone. See Ex. 1015 at 3-5.

B. *Discretionary Denial Under 35 U.S.C. § 325(d) is not appropriate*

In considering its discretion under § 325(d), “the Board uses the following two-part framework: (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented the Office; and (2) if the first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of the challenged claims.” *Advanced Bionics, LLC v.*

MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (P.T.A.B. Feb. 13, 2020) (precedential) (“*Advanced Bionics*”).

The Board has found that the *Becton, Dickinson & Co. v. B. Braun Melsungen AG* factors favor institution in situations where even a single non-cumulative secondary reference distinguished the prior-art ground regardless of other overlapping references. *Oticon Medical AB et al. v. Cochlear Limited*, IPR2019-00975, Paper 15 at 9-20 (PTAB Oct. 16, 2019) (precedential). In its Institution Decision in IPR2021-01032 on U.S. Patent No. 9,410,410 (“the ’410 Patent”), the Board found that, even though *Coli* was cited on the face of the ’410 Patent, the first part of the *Advanced Bionics* framework was not satisfied “because the particular combinations set forth in the petition were not considered by the examiner.” IPR2021-01032, Paper 12 at 17. Specifically, the petition in that case did not assert *Coli* alone but asserted *Coli* in combination with *Horikoshi*, which was not presented to the Office during prosecution. *Id.* at 18. Thus, the Board concluded that the combination of references asserted in the petition was not presented previously to the Office and that, based on this fact alone, denial of the petition under § 325(d) was not warranted.

This same analysis applies to this case. *Coli* is listed on the face of the ’870 patent and was substantively considered by the Examiner during the prosecution of a parent application—*i.e.*, U.S. Patent Application No. 15/202,085, which issued as

U.S. Patent No. 10,337,308. However, the Petition sets forth obviousness grounds based on combinations of *Coli* with prior art that was not considered by the Examiner, namely combinations including *Coli* in view of *Toshiba Manual*, *Horikoshi*, and/or *Loucks*. Thus, the first part of the *Advanced Bionics* framework is not satisfied because the Petition includes grounds based on combinations of prior art not previously presented to the office. As a result, § 325(d) is not sufficiently implicated under the circumstances here, and denying the Petition under § 325(d) is unwarranted.

VI. LEVEL OF ORDINARY SKILL IN THE ART

As of the time of the claimed invention, a POSITA would have 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.

VII. CLAIM CONSTRUCTION

Claim terms in IPR are construed according to their “ordinary and customary meaning” to those of skill in the art. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc); 37 C.F.R. § 42.100(b). For the purposes of this proceeding and the grounds presented herein, Petitioner does not propose any constructions.

Constructions are proposed “only to the extent necessary.” *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”))).

VIII. A REASONABLE LIKELIHOOD EXISTS THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

Pursuant to 37 C.F.R. § 42.104(b)(4)-(5), all of the Challenged Claims are unpatentable for the reasons set forth in detail below. Ex. 1002, ¶¶18, 42.

A. *Ground 1: Claims 1-16 are obvious over Coli in view of Toshiba Manual*

The combination of *Coli* and *Toshiba Manual* discloses and/or suggests all limitations of claims 1-16, and thus renders those claims obvious. Ex. 1002, ¶147.

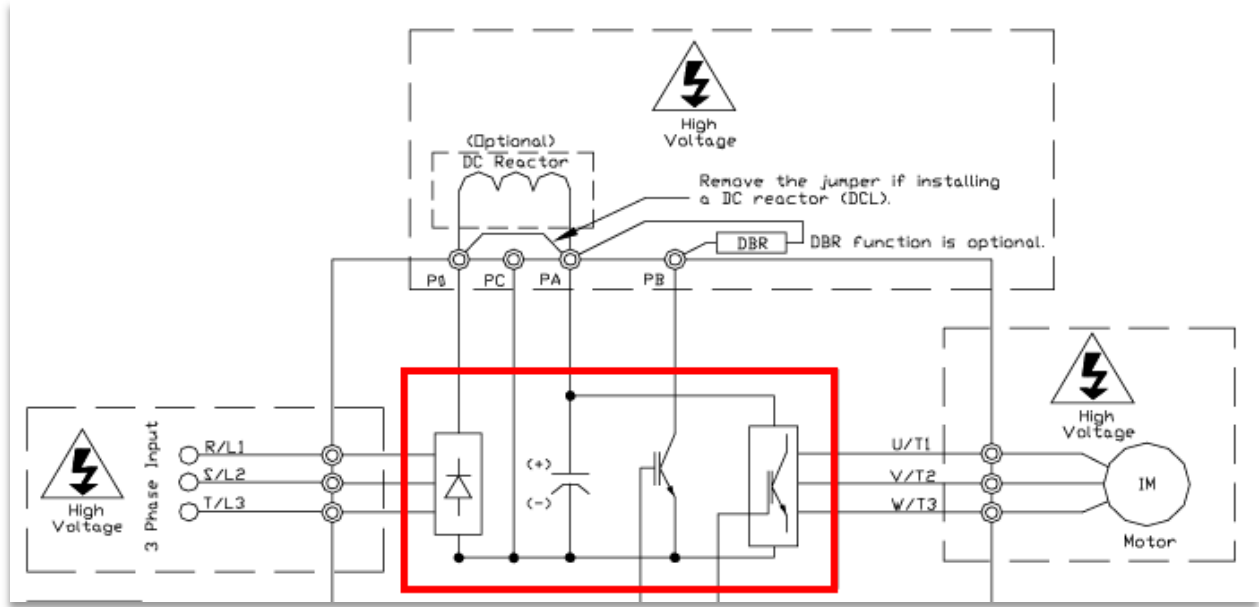
1. One of skill in the art would have been motivated to combine *Coli* with *Toshiba Manual*

Coli discloses how the electrification of a traditional fracturing operation can provide a number of benefits including improving costs (Ex. 1005, [0075]), efficiency (*id.*, [0077]), safety (*id.*, [0066]), and environmental impact (*id.*, [0080]). Ex. 1002, ¶148. Regarding safety, *Coli* discloses that “[e]lectric motors controlled via variable frequency drive are far safer and easier to control than conventional diesel powered equipment.” Ex. 1005, [0066]. *Coli* further discloses the necessity for monitoring VFD and motor operation. *Id.*, [0066]. *Coli* explains that because

“electric motors are controlled by variable frequency drives . . . the control software and variable frequency drives [“VFD”] calculate a maximum current available to the motors.” *Id.*, [0065]. *Toshiba Manual* discloses further details about these VFD features described by *Coli*. See Ex. 1006.

Toshiba Manual, entitled “G7 Adjustable Speed Drive Operation Manual,” describes the functionality, and schematics of a quintessential VFD. Ex. 1006; Ex. 1002, ¶150. A POSITA would have understood that a Variable Frequency Drive or VFD is another term for an Adjustable Speed Drive (ASD). Ex. 1002, ¶¶56, 115. *Toshiba Manual* provides numerous examples of electric motor diagnostics, including overload protection, over-current protection, electronic thermal protection, overheat, overcurrent stall level, motor 150% OL time limit, short circuit test, over-torque trip, and earth fault trip. Ex. 1006 at 19, 22, 160-163, 165, 180; Ex. 1002, ¶¶117, 150. The diagnostics further includes a “fault screen” that “identifies the active Fault.” Ex. 1006 at 182-186 (Table 12). *Toshiba Manual* further discloses the use of alarms to indicate that “a Fault is imminent if existing operating conditions continue unchanged.” Ex. 1006 at 179.

Toshiba Manual also discloses that its VFD includes a rectifier circuit and an inverter circuit (AC-DC-AC converter) to convert fixed-frequency input electricity to DC and then to constant-frequency AC:



Ex. 1006 at 36 (annotated); Ex. 1002, ¶120. The inverters and rectifiers, including insulated-gate bipolar transistors (IGBTs), are examples of “power semiconductors.” Ex. 1006, 180, 183; Ex. 1002, ¶¶120, 151. *Toshiba Manual* further discloses that its VFD contains a “heat sink,” which “may become extremely hot to the touch.” Ex. 1006 at 14. To detect an “elevated temperature” of the VFD, an “[i]nternal thermistor” (i.e., “thermal sensor”) monitors the temperature. Ex. 1006 at 180, 184-185; Ex. 1002, ¶¶122, 151. *Toshiba Manual* further teaches the use of cooling fans in order to protect against “overheat,” which are controlled by a CPU (i.e., a “microprocessor”). Ex. 1006 at 58, 163, 174, 185, 204; Ex. 1002, ¶¶122, 151.

A POSITA would have been motivated to use the VFD described in *Toshiba Manual* as the variable frequency drive in *Coli*, or to enhance the *Coli* VFD with the features taught by *Toshiba Manual*. Ex. 1002, ¶¶148-158. For example, Patent

Owner previously asserted through its expert that heat-sink related elements are “familiar components in the industry.” Ex. 1050, ¶63; *see also* Ex. 1052, 175:10-176:11. A POSITA would have been motivated to combine *Toshiba Manual* with *Coli* for *Toshiba Manual*’s express disclosure of VFD control and monitoring of parameters of the electric motor in *Coli*, such as current, voltage, speed, temperature, torque, and load, and use the diagnostic functionality of *Toshiba Manual* (e.g., the alarms and fault trips) in order to prevent damage to the electric motor. Ex. 1006 at 179; *see id.* at 182-85 (Table 12, listing diagnostics); Ex. 1002, ¶153. Furthermore, a POSITA would have been motivated to combine *Toshiba Manual* with *Coli* to include the power semiconductor heat sinks having thermal sensors in order to prevent overheating of the electric motor. Ex. 1002, ¶154.

A POSITA would have a reasonable expectation of success in combining *Coli* with *Toshiba Manual* because VFD technology was well-known before the ’870 Patent. Ex. 1002, ¶157. As explained by Dr. Durham, VFDs have been used in industrial oil and gas operations since the 1960s. Ex. 1002, ¶¶61-65 (citing Exs. 1021-1025). By the 1980s, the VFD had garnered general industry-wide acceptance, and their popularity continued to grow such that by the early 2000s, installations of large VFDs in petroleum operations were so ubiquitous that industry-wide standards had to be adopted. Ex. 1002, ¶¶68-74 (citing Ex. 1027-1029). Moreover, *Toshiba Manual* dates back to 2005 (*see* Ex. 1006) and expressly teaches basic features that

a POSITA would have already implemented in *Coli*. For example, a POSITA would have been motivated to simply substitute the VFD of *Coli* for the VFD of *Toshiba Manual* that has the diagnostic functionality and temperature monitoring to prevent damage, without affecting the other functionalities of *Coli*. Ex. 1002, ¶¶155, 158; *Agrizap, Inc. v. Woodstream Corp.*, 520 F.3d 1337, 1344 (Fed. Cir. 2008) (“The asserted claims simply substitute a resistive electrical switch for the mechanical pressure switch employed by the Gopher Zapper.”). The results of the combination would have been predictable and obvious to a POSITA. Ex. 1002, ¶158. Alternatively, a POSITA would have been motivated to enhance the VFD of *Coli* with the diagnostic and temperature monitoring functionality described in *Toshiba Manual* because such an improvement represents the mere application of a known technique (i.e., the fault detection and temperature monitoring including heat sinks of the VFD in *Toshiba Manual*) to predictably improve a similar system (i.e., the VFD of *Coli*) in the same way. Ex. 1002, ¶156; see *KSR Int’l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740 (2007).

2. Claim 1

- i. **1[pre] A system for hydraulically fracturing an underground formation in an oil or gas well to extract oil or gas from the formation, the oil or gas well having a wellbore that permits passage of fluid from the wellbore into the formation, the system comprising;**

To the extent the preamble is limiting, *Coli* discloses a “system for hydraulically fracturing an underground formation in an oil or gas well” through its description of a “system and method for hydraulic stimulation of underground hydrocarbon-bearing formations.” Ex. 1005, Title, [0009]; *see* Ex. 1048 at 20-21.⁴ The “hydraulic stimulation” in *Coli* includes “fracturing operations” in which “pressurized fluid” is delivered to a wellbore. *Id.*, [0006], [00013]. One wellbore described in *Coli* is a “single horizontal wellbore in a tight natural gas formation.” *Id.*; Ex. 1002, ¶159.

ii. 1[a] a trailer for attachment to a truck; and

Coli discloses a “fracturing operation [that] includes one or more trailers 10, each housing one or more fracturing modules 20.” Ex. 1005, [0038]. *Coli* explains that while traditional fracturing infrastructure includes fluid pumps “housed on a dedicated truck and trailer configuration,” *i.e.*, “[e]ach trailer 5 is attached to a truck 6,” *Coli*’s improved fracturing system “requires significantly less infrastructure” because each trailer 10 “does not need a *dedicated* truck 6.” *Id.*,

⁴ Citations to the Final Written Decision in IPR2021-01033 (Paper 41) (Ex. 1048) concerning U.S. Patent No. 8,789,601 (“601 Patent”) (Ex. 1049) relate to the Board’s determination that the same or substantially similar claim elements are disclosed by the same prior art.

[0007], [0037], [0040] (emphasis added). Thus, a POSITA would have understood that each trailer 10 is “for attachment to a truck” when needed to move or transport equipment. Ex. 1002, ¶160. Furthermore, a POSITA would have understood that the use of trucks to transport trailers to and from oil and gas well sites has been well-known for decades long before the ’870 Patent. Ex. 1002, ¶161.

iii. 1[b] two or more pumps attached to the trailer and fluidly connected to the well, the pumps configured to pump fluid into the wellbore;

As discussed above, *Coli* discloses a “trailer 10 for housing one or more fracturing modules 20,” where “[e]ach fracturing module 20 can include an electric motor 21 and a fluid pump 22 coupled thereto.” Ex. 1005, [0040]. Fracturing modules 20 are “removably mounted to a trailer 10 to facilitate ease of replacement as necessary.” *Id.*, [0040]; Ex. 1002, ¶162. As shown below in Figure 3 of *Coli*, in one embodiment, “four electric motors 21 and pumps 22 are transported on a single trailer 10.”

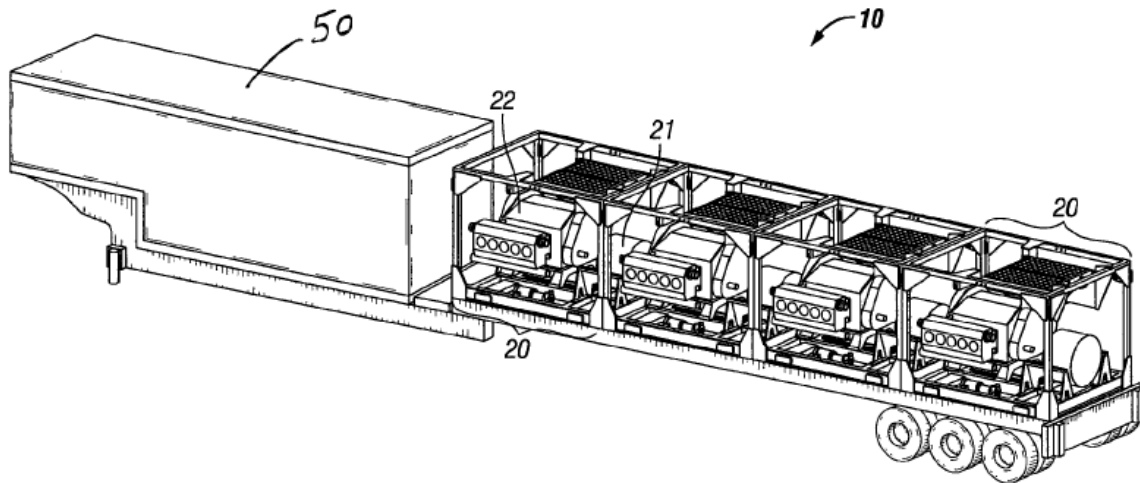
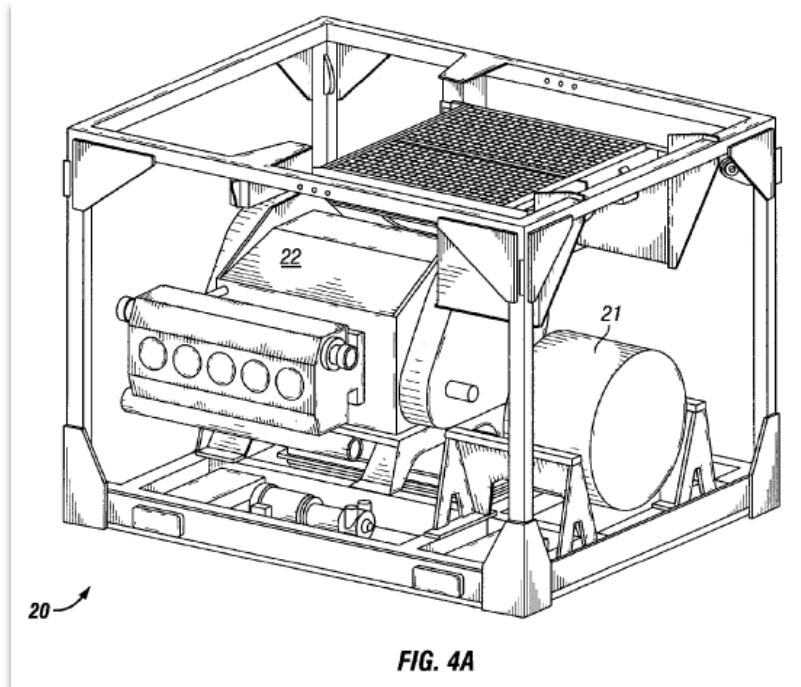


FIG. 3

Id., Fig. 3. *Coli* teaches that the fracturing modules 20 (i.e., the electric motor 21 and fluid pump 22) “utilize electric power ... to pump the fracturing fluid directly to the wellbore.” *Id.*, [0040]. Thus, *Coli* discloses claim 1[b]. Ex. 1002, ¶162; see Ex. 1048 at 21-23.

iv. 1[c] one or more electric motors attached to the pumps to drive the pumps, the electric motors attached to the trailer; and

As discussed above, *Coli* teaches that “[e]ach fracturing module 20 can include an electric motor 21 coupled to one or more electric pumps 22,” where the fracturing modules 10 are housed on a trailer 10. Ex. 1005, [0040], [0046]. Figure 4A of *Coli* provides an illustrative embodiment of fracturing module 20:



Id., Fig. 4A; *see also* Fig. 4B, [0025], [0046]. *Coli* teaches that “medium low voltage AC permanent magnet electric motor 21 receives electric power from turbine generator 30, and is coupled directly to pump 22.” *Id.*, [0052]. Thus, a POSITA would have understood that the electric motor drives the hydraulic fracturing pump. Ex. 1002, ¶164; Thus, *Coli* discloses claim 1[c]. Ex. 1002, ¶164; *see* Ex. 1048 at 21-23.

- v. **1[d] a variable frequency drive connected to the electric motor to control the speed of the motor, wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the one or more electric motors.⁵**

Coli discloses that “[t]ypically, each fracturing module 20 will be associated with a drive housing for controlling electric motor 21 and pumps 22, as well as an electrical transformer and drive unit 50.” Ex. 1005, [0047]. *Coli* specifically teaches the use of a “variable speed motor” within the fracturing module 20, and further teaches that the electric motors used in the system can be “controlled by variable frequency drives” that “essentially ‘tell’ the motors what they are allowed to do.” *Id.*, [0011], [0065]. A POSITA would have understood these descriptions to disclose “a variable frequency drive connected to the electric motor to control the speed of the motor.” Ex. 1002, ¶165; *see* Ex. 1048 at 23-29.

⁵ Although Petitioner believes that “to prevent damage to the one or more electric motors” element is non-limiting, as discussed below, the prior art discloses this element. *See Bristol Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1376 (Fed. Cir. 2001) (certain claim language was properly understood as “only a statement of purpose and intended result” and not calling for “a manipulative difference in the steps of the claim.”).

As discussed above, *Toshiba Manual* likewise discloses an “Adjustable Speed Drive” or VFD used to control the speed of a motor. Ex. 1006 at 2, 44; Ex. 1002, ¶166. *Toshiba Manual* further discloses operating a VFD with the ability to “perform diagnostics.” Ex. 1007 at 43. The diagnostics includes a “fault screen” that “identifies the active Fault.” *Id.* at 182–186 (Table 12, containing a list of 5 pages of faults that are diagnosed). *Toshiba Manual* further discloses that the variable frequency drive performs electric motor diagnostics to prevent various types of damage to the electric motor, including protecting against overload, overcurrent, overtorque, short circuit, and earth faults. Ex. 1007 at 162; Ex. 1002 ¶¶117, 150, 166. *Toshiba Manual* further explains that its VFD controls a motor that, in turn, may power a pump. *See* Ex. 1006 at 23 (“[t]he output terminals of the ASD . . . must be connected to the motor that is to be controlled”); *id.* at 71 (describing prevention of “motor overload trips when used on fans, blowers, pumps, and other centrifugal loads which require less torque at lower frequencies”).

As discussed above, it would have been obvious to a POSITA to use the *Toshiba Manual* VFD as the VFD in *Coli* to provide additional diagnostic capability of the VFD and prevent the various types of damage disclosed in *Toshiba Manual* (i.e., a VFD “connected to the electric motor . . . wherein the [VFD] performs electric motor diagnostics to prevent damage to the one or more electric motors.”). *See supra* Section VIII.A.1; Ex. 1002, ¶¶152-155, 167.; Ex. 1001 7:58-61. Alternatively, it

would have been obvious to a POSITA to enhance *Coli*'s VFD with the diagnostic functionality expressly taught by *Toshiba Manual*. Ex. 1002, ¶¶152-156, 168.

3. Claim 2

- i. The system of claim 1, further comprising: a skid to which at least one of the pumps and the one or more electric motors are attached.**

Coli discloses that “pumping systems are typically mobilized on skids or tractor-trailers.” Ex. 1005, [0005]; [0040]; [0082]. *Coli* further discloses a “trailer 10 for housing one or more fracturing modules 20,” wherein “[t]railer 10 can also be a skid.” *Id.*, [0040]. In addition, *Coli* discloses that “each fracturing module 20 will be associated with a drive housing for controlling electric motor 21 and pumps 22, as well as an electrical transformer and drive unit 50 (see FIG. 3).” *Id.*, [0047]. Accordingly, a POSITA would have understood that *Coli* teaches “a skid to which at least one of the pumps and the one or more electric motors are attached.” Ex. 1002, ¶170. Additionally, such a configuration would have been obvious to a POSITA in view of the disclosure. Ex. 1002, ¶170.

4. Claim 3

- i. The system of claim 1, further comprising: a natural gas powered generator for connection to the electric motor that provides electric power to the electric motor.**

Coli discloses “[o]ne or more natural gas-powered turbine generators 30.” Ex. 1005, [0038]; Ex. 1002, ¶¶171-172. *Coli* teaches that the fracturing modules

20 (i.e., the claimed “plurality of pumps” and associated electric motors) are “operatively associated” with and “receive electric power” from the turbine generators 30 (i.e., the claimed “natural gas powered generator for connection to the electric motor that provides electric power to the electric motor”). Ex. 1005, claims 1-4, [0040], [0009] (“each electric fracturing module comprising an electric motor and a coupled fluid pump, each electric motor operatively associated with the dedicated source of electric power.”). Moreover, as discussed by Dr. Durham, the use of natural-gas powered turbine generators to produce electrical energy has been well-known since long before the ’870 Patent. Ex. 1002, ¶¶96-104 (citing Exs. 1036, 1037, 1039, 1040-1044). *Coli* discloses claim 3. Ex. 1002, ¶172; Ex. 1048 at 30-31.

5. Claim 4

- i. **4[pre] A method of hydraulically fracturing an underground formation in an oil or gas well to extract oil or gas from the formation, the oil or gas well having a wellbore that permits passage of fluid from the wellbore into the formation, the method comprising:**

To the extent the preamble is limiting, *Coli* discloses the preamble through its description of a “method of delivering fracturing fluid to a wellbore” in order to create fractures in the formation so as to “provid[e] a permeable membrane for hydrocarbon fluids and gases to flow through so they may be recovered.” Ex. 1005, [0009], [0035]. Ex. 1002, ¶172. *Coli* otherwise discloses the preamble of claim 4

for the same reasons that *Coli* discloses the preamble of claim 1. *See supra* Section VIII.A.2; Ex. 1048 at 20-21.

ii. 4[a] pumping fluid into the wellbore using hydraulic fracturing pumps;

As discussed above with respect to claim 1[b], *Coli* discloses this claim limitation through its disclosure of fracturing modules 20 each including an electric motor 21 and pump 22, which “pump the fracturing fluid directly to the wellbore.” Ex. 1005, [0040]. Thus, *Coli* discloses claim 4[a]. Ex. 1002, ¶175; *see supra* Section VIII.A.2; Ex. 1048 at 21-23.

iii. 4[b] powering the hydraulic fracturing pumps using an electric motor; and

Similar to claim 1[c] discussed above, *Coli* teaches “a medium low voltage AC permanent magnet electric motor 21 receives electric power from turbine generator 30, and is coupled directly to pump 22.” Ex. 1005, [0052]; *see also* [0040], [0046]; Figs. 4A, 4B. A POSITA would have recognized that the electric motor powers the hydraulic fracturing pump. Ex. 1002, ¶176; *see supra* Section VIII.A.2; Ex. 1048 at 21-23.

iv. 4[c] controlling the speed of the motor using a variable frequency drive, wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the electric motor.

Claim 4[c] is similar in scope to claim 1[d] but stated as a method step rather than a system element, and therefore, is disclosed by the combination of *Coli* and

Toshiba Manual in the same way as described for claim 1[d] above. Ex. 1002, ¶177; *see supra* Section VIII.A.2; Ex. 1048 at 23-29.

6. Claim 5

- i. The method of claim 4, further comprising: powering the electric motor using a generator.**

The scope of claim 5 is subsumed within claim 3, and therefore, is disclosed by *Coli* in the same way as described for claim 3 above. Ex. 1002, ¶178; *see supra* Section VIII.A.4; Ex. 1048 at 30.

7. Claim 6

- i. The method of claim 5, further comprising: powering the generator using natural gas.**

The scope of claim 6 is subsumed with claim 3, and therefore, is disclosed by *Coli* in the same way as described for claim 3 above. Ex. 1002, ¶179; *see supra* Section VIII.A.4; Ex. 1048 at 30-31.

8. Claim 7

- i. 7[pre] A system for hydraulically fracturing an underground formation in an oil or gas well to extract oil or gas from the formation, the oil or gas well having a wellbore that permits passage of fluid from the wellbore into the formation, the system comprising:**

To the extent the preamble is limiting, the preamble of claim 7 is identical to the preamble of claim 1, and therefore, is disclosed by *Coli* in the same manner as described above. Ex. 1002, ¶180; *see supra* Section VIII.A.2; Ex. 1048 at 20-21.

- ii. 7[a] a pump fluidly connected to the well; and**

As discussed with respect to claim 1[b], *Coli* discloses electric pumps 22 that “pump fluid directly to the wellbore.” Ex. 1005, [0040]. Per the language of the preamble, a wellbore is a component of the well, and therefore, by virtue of *Coli* teaching pumping fluid “directly to the wellbore,” *Coli* also discloses pumping fluid to the well. Ex. 1002, ¶181; *see supra* Section VIII.A.2; Ex. 1048 at 21-23.

iii. 7[b] an electric motor to power the pump;

Claim 7[b] is subsumed within the subject matter of claim 4[b], and therefore, is disclosed by *Coli* in the same manner as described above. Ex. 1002, ¶182; *see supra* Section VIII.A.5; Ex. 1048 at 21-23.

iv. 7[c] the pump configured to pump fluid into the wellbore; and

Claim 7[c] is subsumed within the subject matter of claim 1[b], and is thus disclosed by *Coli* in the same manner as described above. Ex. 1002, ¶183; *see supra* Section VIII.A.2; Ex. 1048 at 21-23.

v. 7[d] a variable frequency drive connected to the electric motor to control the speed of the motor and having one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat.

As discussed above with respect to claims 1 and 4, both *Coli* and *Toshiba Manual* disclose a VFD used to control the speed of an electric motor. Ex. 1002, ¶184; *see supra* Section VIII.A.2; Ex. 1048 at 23-29. *Toshiba Manual* further discloses a VFD with a rectifier circuit and an inverter circuit (AC-DC-AC

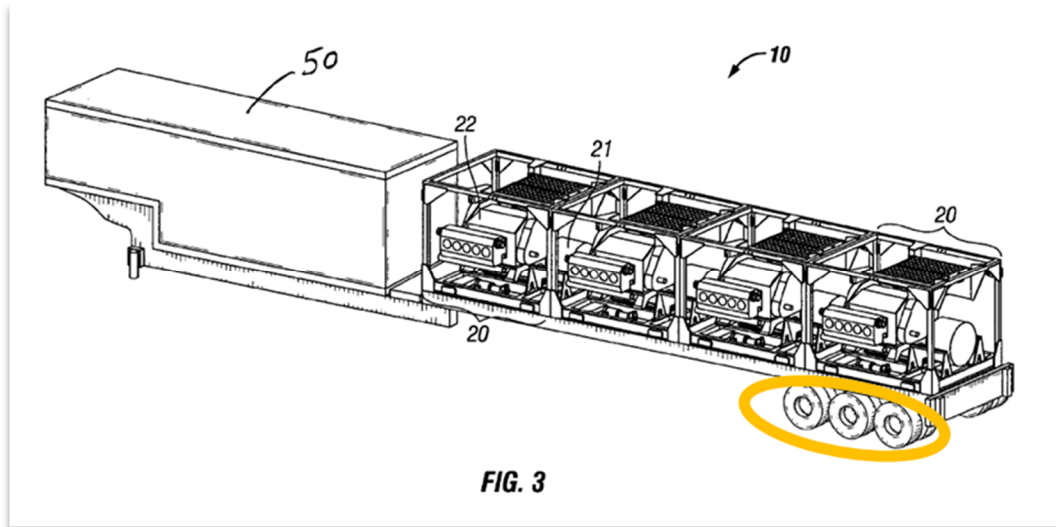
converter), each comprising IGBTs, are examples of “power semiconductors.” Ex. 1006 at 36; Ex. 1002, ¶185. *Toshiba Manual* also teaches that the power semiconductors have heat sinks. *Id.* at 14 (“heat sink and other components may become extremely hot to the touch”); *see id.* at 204 (“cooling capacity of the heat sink”). The heat sinks have thermal sensors (e.g., thermistors) monitored by a microprocessor to prevent damage caused by excessive heat. Ex. 1002, ¶186. For example, one of the faults displayed by the Electronic Operator Interface (“EOI”) (which contains microprocessors) is “Overheat,” which occurs when the “ASD ambient temperature is excessive.” Ex. 1006 at 2, 42-43, 180. The “Overheat” error can occur if the “ASD is operating at an elevated temperature,” if the “Cooling fan vent is obstructed,” or if the “Internal thermistor is disconnected.” *Id.*; *see id.* at 185 (overheat); *id.* at 163 (“cooling fan control”). *Toshiba Manual* further teaches that a CPU can set the cooling fans to be “Automatic” or “Always on” to prevent the motor from overheating. Ex. 1006 at 163; Ex. 1002, ¶186. In order for the CPU (i.e., microprocessor) to operate the cooling fans in “Automatic” mode, it would have been necessary to monitor the temperature data so that the microprocessor could determine when to turn the fans on (i.e., to supply additional cooling) or off (i.e., to conserve energy when additional cooling is not needed). Ex 1002, ¶186. A POSITA would have understood that the heat sink would necessarily have sensors (e.g., thermistors) to report the temperature measurements

to the CPU (i.e., microprocessor). Ex. 1002, ¶186. By performing the “protective function” of heatsink “overheat,” *Toshiba Manual* discloses that the purpose of monitoring the heat sinks using a microprocessor is to “prevent damage caused by excessive heat.” Ex. 1006 at 163, 185; Ex. 1002, ¶186. In view of these disclosures of *Toshiba Manual*, a POSITA would have understood that *Toshiba Manual* discloses a VFD with power semiconductors having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat. Ex. 1002, ¶186. Furthermore, as explained in Dr. Durham’s declaration, heat sinks and temperature monitoring using sensors were well-known long before the ’870 Patent. Ex. 1002, ¶¶87-95 (citing Exs. 1030-1035); *see also* Ex. 1050, ¶63; Ex. 1052, 175:10-176:11.

9. Claim 8

- i. The system of claim 7, wherein the electric pump is mounted on a vehicle, and can be ported from one well to another.**

Coli teaches “one or more fracturing modules,” each including “an electric motor 21 and a fluid pump 22,” and each removably mounted on a trailer 10 (i.e., the plurality of pumps are mounted on a trailer). Ex. 1005, [0040]. *Coli* further teaches that the “plurality of electric motors 21 and pumps 22 can be transported on a single trailer 10” (i.e., the pumps 22 are capable of being “ported from one well to another”):



Id., [0040], Fig. 3. A POSITA would have understood the teachings in *Coli* regarding the transportation of pumps on a trailer to disclose the transportation of pumps “from one well to another.” Ex. 1002, ¶188. Additionally, such a use would have been obvious to a POSITA in view of *Coli*. *Id.*, ¶188; Ex. 1048 at 32.

10. Claim 9

- i. **The system of claim 7, further comprising: a generator electrically connected to the electric motor to provide electric power to the motor.**

Claim 9 is subsumed within the subject matter of claim 3 and therefore, is disclosed by *Coli* in the same manner as described for claim 3. Ex. 1002, ¶189; *see supra* Section VIII.A.4; Ex. 1048 at 30.

11. Claim 10

- i. **The system of claim 9, wherein the generator is fueled by natural gas.**

Claim 10 is subsumed within the subject matter of claim 3 and therefore, is disclosed by *Coli* in the same manner as described for claim 3. Ex. 1002, ¶190; *see supra* Section VIII.A.4; Ex. 1048 at 30-31.

12. Claim 11

i. The system of claim 9, wherein the generator is a turbine generator.

As discussed above regarding claim 3, *Coli* discloses “a plurality of generators” which can be “[o]ne or more natural gas-powered turbine generators 30.” Ex. 1005, [0038]. Thus, *Coli* discloses claim 11. Ex. 1002, ¶191; *see supra* Section VIII.A.4; Ex. 1048 at 42.

13. Claim 12

i. The system of claim 9, wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another.

Coli teaches “one or more fracturing modules,” each including “an electric motor 21 and a fluid pump 22,” that are removably mounted on a trailer 10 (i.e., the plurality of electric motors and pumps are mounted on a trailer). Ex. 1005, [0040]. *Coli* further teaches that the “plurality of electric motors 21 and pumps 22 can be transported on a single trailer 10” (i.e., the electric motors and pumps are capable of being “ported from one well to another”). *Id.*

Furthermore, *Coli* discloses a trailer-mounted generator, as a POSITA would have known that the specific turbine generator referenced in *Coli*, “a TM2500+

turbine generator sold by General Electric,” is trailer-mounted. Exs. 1037-1038; Ex. 1002, ¶¶100, 195 (explaining that the “TM” stands for “trailer-mounted”); *Monsanto Tech. LLC v. E.I. DuPont de Nemours & Co.*, 878 F.3d 1336, 1345 (Fed. Cir. 2018) (relying on “extrinsic evidence” to interpret a “prior art’s teaching”).

Such a configuration would have further been obvious to a POSITA in view of *Coli*’s express teachings of trailer-mounted electric motors and pumps, as it would have been likewise obvious to mount the associated generators on trailers to provide power to the trailer-mounted electric motors and pumps. Ex. 1005, [0040]; Ex. 1002, ¶¶192-196; Ex. 1048 at 32-33 (determining “it would have been obvious to provide trailer-mounted generators in *Coli*’s system”).

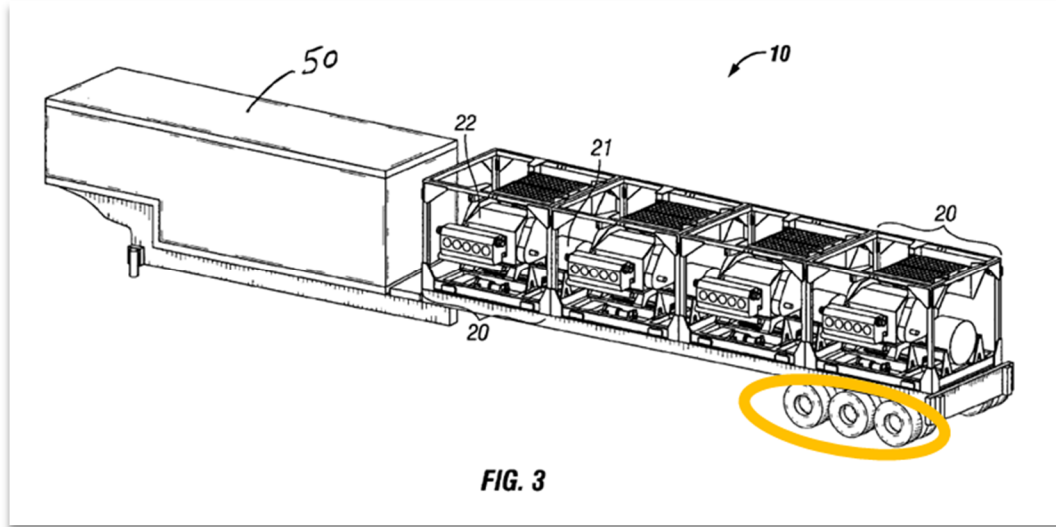
A POSITA would have understood the teachings in *Coli* regarding the trailer-mounted electric motors, pumps, and generators to disclose the transportation of electric motors, pumps, and generators “from one well to another.” Ex. 1002, ¶¶192, 197. Additionally, such a use would have been obvious to a POSITA in view of *Coli*, particularly in view of *Coli*’s stated portability goals. Ex. 1005, [0063]; Ex. 1002, ¶197; Ex. 1048 at 32.

14. Claim 13

i. The system of claim 12, wherein the vehicle is a truck having at least five axles.

Figure 3 of *Coli* clearly depicts a trailer 10 with three axles “for housing one or more fracturing modules,” wherein “[e]ach fracturing module” includes “an

electric motor 21 and a fluid pump 22 coupled thereto.” Ex. 1005, [0040], Fig. 3; Ex. 1002, ¶198; Ex. 1048 at 43.



Further, *Coli* discloses “[e]ach trailer 5 is attached to a truck 6.” Ex. 1005, [0037]; [0007]; [0039]; [0078]. A POSITA would have understood that any truck pulling the trailer in *Coli* would have at least two axles. Ex. 1002, ¶198. Accordingly, *Coli* discloses a vehicle that is truck-trailer configuration with a total of 5 axles. *Id.*, ¶198. Additionally, a “unitary” truck with five axles would have been obvious to a POSITA in view of this disclosure of a three axle semi-trailer intended to be attached to and pulled by a tractor (commonly referred to collectively as a “tractor-trailer truck,” a “semi-trailer truck,” and a “semi-truck”) because a POSITA would have known that the semi-trailer portion could be permanently attached to the tractor portion of the truck instead of as a detachable trailer, as is done with many commercial trucks. Ex. 1002, ¶199. Furthermore, a POSITA

would have understood that the number of axles used on a vehicle is a simple design choice, with the number of axles to use being determined based on the amount of load that is supported by the axles. Ex. 1002, ¶200.

15. Claim 14

- i. The system of claim 7, wherein the pump is a triplex or quinteplex pump rated at about 2250 hydraulic horsepower or more.**

Coli discloses an electric motor that is “coupled to one or more electric pumps,” and discloses that a “suitable pump” is a “quintuplex or triplex plunger style pump, for example, the SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.,” which is rated at 2500 bhp (brake horsepower). Ex. 1005, [0046]. *Coli* further discloses that while conventional diesel powered fluid pumps rated for 2250 horsepower typically only deliver about 1800 hp to the pumps, the electric motors of *Coli* “can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.” *Id.*, [0049] (emphasis added). Because the motor of *Coli* delivers 2500 hp to the pump, a POSITA would have understood that the pump must be rated for at least that amount of delivered power. Ex. 1002, ¶201. Furthermore, a POSITA would have known that the Gardner SWGS-2500 pump disclosed in *Coli* was rated at 2500 hp, as specified in *Gardner*. Ex. 1011 at 14, 21; *Monsanto Tech. LLC v. E.I. DuPont de Nemours & Co.*, 878 F.3d 1336, 1345 (Fed. Cir. 2018) (relying on “extrinsic evidence” to interpret a “prior art’s teaching”).

Thus, *Coli* discloses “wherein the pump is a triplex or a quinteplex pump rated at about 2250 horsepower or more.” Ex. 1002, ¶¶201-202; Ex. 1048 at 40.

16. Claim 15

- i. The system of claim 7, wherein the electric motor has a maximum continuous power output of about 1750 brake horsepower or more.**

Coli discloses that the motor “can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.” Ex. 1005, [0049]. Accordingly, a POSITA at the time the ’870 Patent was filed would have recognized that *Coli* discloses the “electric motor has a maximum continuous power output of about 1750 horsepower or more.” Ex. 1002, ¶203; Ex. 1048 at 41.

17. Claim 16

- i. The system of claim 7, wherein the electric motor has a maximum continuous torque of about 8750 lb-ft or more.**

Coli discloses that the “electric motor can be capable of operation in the range of up to 1500 rpms and up to 20,000 ft/lbs of torque.”⁶ Ex. 1005, [0011]. Accordingly, a POSITA at the time the ’870 Patent was filed would have recognized

⁶ As explained in Dr. Durham’s declaration, the unit of torque is ft-lb, as recited in the claim. Ex. 1002, ¶108 n.1. There appears to be a typo in *Coli* insofar as it expresses torque in ft/lbs, as opposed to ft-lbs.

that *Coli* discloses an “electric motor has a maximum continuous torque of about 8750 ft-lb or more.” Ex. 1002, ¶204; Ex. 1048 at 41-42.

B. Ground 2: Claims 1-6 are obvious over *Coli* in view of *Horikoshi*

The combination of *Coli* and *Horikoshi*, either alone or in combination, discloses and/or suggests all limitations of claims 1-6, and thus renders those claims obvious. Ex. 1002, ¶205. Specifically, *Horikoshi* in combination with *Coli* discloses “wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the [at least one] electric motor” as required by independent claims 1 and 4. Ex. 1002, ¶206. All other elements of claims 1-6 are disclosed or rendered obvious by *Coli* as explained in Ground 1.

1. One of skill in the art would have been motivated to combine *Coli* with *Horikoshi*

As discussed above, *Coli* teaches the benefits of replacing traditional diesel powered fracturing operations with electric-powered operations, including improving costs (Ex. 1005, [0075]), efficiency (*id.*, [0077]), safety (*id.*, [0066]), and environmental impact (*id.*, [0080]). Ex. 1002, ¶210. *Coli* also discloses the need for “variable frequency drives,” which are used to “essentially ‘tell’ the motors what they are allowed to do” and explains the safety benefit of “[e]lectric motors controlled via variable frequency drive are far safer and easier to control than conventional diesel powered equipment.” Ex. 1005, [0066]. *Coli* explains that because “electric motors are controlled by variable frequency drives . . . the control

software and variable frequency drives [“VFD”] calculate a maximum current available to the motors.” *Id.*, [0065].

And in the event the actual current exceeds the maximum current calculated by the VFD, *Horikoshi* provides an “apparatus that can reliably detect any overcurrent occurring in the DC/AC converter” of the VFD. Ex. 1008, [0004]. A POSITA would have understood that “overcurrent” is a potential source of damage to an electric motor, and detecting overcurrent associated with “a ground fault or a phase-to-phase short circuit” is a way to protect the electric motor from damage. Ex. 1002, ¶¶207-214. Indeed, *Horikoshi* discloses “provid[ing] protection against ground faults by detecting the presence or absences of a ground fault before starting the operation [of a motor] by applying a ground-fault detecting control signal to the AC/DC converter.” Ex. 1008, [0008], [0010]. Thus, *Horikoshi* discloses that as of 2011—the filing date of *Horikoshi*—prior art VFD diagnostic techniques were well-known. Ex. 1002, ¶212. *Horikoshi*, however, explains that in the prior art “no description is given of how a distinction is made between a ground fault and a phase-to-phase short circuit.” Ex. 1008, [0008]. To rectify that deficiency, *Horikoshi* states its object as providing “a motor driving apparatus having a fault diagnostic function capable of detecting during operation a ground fault and a phase-to-phase short circuit by distinguishing one from the other.” *Id.*, [0011].

Although *Coli* does not expressly disclose the diagnostic capabilities of its VFD, it would have been obvious from *Horikoshi* that having the diagnostic capability to detect a ground fault or a phase-to-phase short is desirable to prevent damage to the motors. Ex. 1002, ¶¶207-217; *see also* Ex. 1019, 3-5, 13. Indeed, a POSITA would have been motivated to combine *Coli* with *Horikoshi* with a reasonable expectation of success. *Id.* Specifically, a POSITA would have been motivated to simply substitute the VFD of *Coli* for the VFD of *Horikoshi* that has the diagnostic functionality to detect a ground fault or a phase-to-phase short circuit, without affecting the other functionalities in *Coli*. *Id.*, ¶218; *Agrizap, Inc. v. Woodstream Corp.*, 520 F.3d 1337, 1344 (Fed. Cir. 2008) (“The asserted claims simply substitute a resistive electrical switch for the mechanical pressure switch employed by the Gopher Zapper.”). The results of the combination would have been predictable and obvious to a POSITA. Ex. 1002, ¶¶207-221; Ex. 1048 at 29 (determining that “Petitioner ha[d] set forth reasoning with rational underpinning explaining why it would have been obvious to combine the teachings of *Coli* and *Horikoshi*”). Alternatively, a POSITA would have understood that the VFD of *Coli* would be enhanced with the diagnostic functionality of *Horikoshi* because such an improvement represents the use of a known technique (i.e., the fault detection of *Horikoshi*) to predictably improve a similar system (i.e., the VFD of *Coli*) in the

same way. *Id.*; see *KSR Int’l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1740 (2007); Ex. 1002, ¶¶219, 221.

2. Claim 1

- ii. **1[d] a variable frequency drive connected to the electric motor to control the speed of the motor, wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the at least one electric motor.**

As discussed above, *Coli* expressly teaches a VFD used to control the speed of an electric motor. Ex. 1005, [0040]; see *supra* Section VIII.A.2. *Horikoshi* teaches the use of a “motor driving apparatus comprising an AC/DC converter for converting three-phase AC power supplied from a three phase AC power supply into DC power and a DC/AC converter for converting the DC power output from the AC/DC converter into three-phase AC power for supply to a motor.” Ex. 1008, [0012], [0027]. Consistent with the plain language of the claims (e.g., “a variable frequency drive connected to the electric motor to control the speed of the motor,” as recited in claim 1 of the ’870 Patent), a POSITA would have understood *Horikoshi*’s description of the “motor driving apparatus” to be quintessentially that of a VFD that supplies “three-phase AC power” “to a motor” and thus controls its speed. Ex. 1002, ¶¶222-224; Ex. 1048, 23-29.

Horikoshi further teaches that the “motor driving apparatus [has] a fault diagnostic function.” Ex. 1008, [0002]. Specifically, *Horikoshi* teaches that that

the apparatus can include current sensors to “detect any overcurrent occurring in the DC/AC converter and can also identify whether the cause [of the overcurrent] is a ground fault or a phase-to-phase short circuit” associated with “insulation resistance of the motor” or the power source providing power to the apparatus.” *Id.*, [0004], [0006]. A POSITA would have understood that “overcurrent” is a potential source of damage to an electric motor, and detecting overcurrent associated with “a ground fault or a phase-to-phase short circuit” is a way to protect the electric motor from damage. Ex. 1002, ¶¶225-227; Ex. 1052, 205:11-206:18.⁷ Indeed, *Horikoshi* discloses that such an apparatus may “provide *protection* against ground faults by detecting the presence or absences of a ground fault *before starting the operation* by applying a ground-fault detecting control signal to the AC/DC converter.” Ex. 1008, [0008]; *see* Ex. 1001, 2:36-39 (identifying grounding and shorting as two causes of electric motor damage); Ex. 1052, 211:9-16. Accordingly, a POSITA would have understood that *Horikoshi* discloses a variable frequency drive that “performs electric motor diagnostics to prevent damage to the at least one electric motor.” Ex. 1002, ¶¶226; Ex. 1051, 97:8-17; Ex. 1048 at 23-29 (“Petitioner

⁷ Exs. 1050-1052 are prior testimony from Patent Owner’s expert Robert Schaaf in related proceedings regarding substantially similar patents, including the ’601 Patent.

persuasively argues that Horikoshi’s detection and classification of an overcurrent condition is the performance of electric motor diagnostics as recited in the claims”).

As discussed in Section VIII.B.1, it would have been obvious to a POSITA to enhance the VFD of *Coli* with the diagnostic functionality of *Horikoshi*. Ex. 1002, ¶¶207-221, 227. Indeed, a VFD performing electric motor diagnostics was well-known prior to the filing of the ’870 Patent. Ex. 1002, ¶¶75-86 (citing Exs. 1016, 1017, 1008); Ex. 1050, ¶82. Specifically, it would have been obvious to modify the VFD described in *Coli* to include the diagnostic functionality of *Horikoshi* at least because both references discuss or are directed to the control of electric motors using VFDs, and the incorporation of *Horikoshi*’s diagnostic functionality would have been obvious to try and would have yielded predictable results. *Id.*, ¶227. Alternatively, a POSITA would have understood the “motor driving apparatus” in *Horikoshi* to be interchangeable with the “variable frequency drives” in *Coli* such that it would have been obvious to simply substitute the “motor driving apparatus” in *Horikoshi* for the “variable frequency drives” in *Coli* to take advantage of the overcurrent protection provided by *Horikoshi*. *Id.*, ¶228; Ex. 1048 at 29-29 (“Petitioner relies on Horikoshi to identify a problem and solution and argues it would have been obvious to incorporate the solution (overcurrent detection and classification) in *Coli*’s system.”).

3. Claim 4

- iii. **4[c] controlling the speed of the motor using a variable frequency drive, wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the electric motor.**

Claim 4[c] is similar in scope to claim 1[d] but stated in slightly different words, and therefore, is disclosed by the combination of *Coli* and *Horikoshi* in the same way as described above for claim 1. Ex. 1002, ¶229; Ex. 1048 at 23-29.

C. Ground 3: Claims 7-16 are obvious over *Coli* in view of *Loucks*

The combination of *Coli* and *Loucks* discloses and/or suggests all limitations of claims 7-16, and thus renders those claims obvious. Ex. 1002, ¶230. Specifically, *Loucks* in combination with *Coli* discloses or renders obvious a variable frequency drive “having one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat” as required by independent claim 7. Ex. 1002, ¶231. All other elements of claims 7-16 are disclosed or at least rendered obvious by *Coli* as described above in Ground 1.

1. One of skill in the art would have been motivated to combine *Coli* with *Loucks*

A POSITA would have been motivated to combine *Coli* with *Loucks* with a reasonable expectation of success, as the combination represents nothing more than applying a known technique—i.e., adding power semiconductor heat sinks and associated temperature sensors—to the VFD of *Coli* in order to prevent damage to the VFD caused by excessive heat. Ex. 1002, ¶232-237.

Coli discloses that “[e]lectric motors controlled via variable frequency drive are far safer and easier to control than conventional diesel powered equipment.” Ex. 1005, [0066]. *Coli* explains that because “electric motors are controlled by variable frequency drives ... the control software and variable frequency drives calculate a maximum current available to the motors.” Ex. 1005, [0065].

Loucks teaches techniques for improved “cooling efficiency” and applies those techniques to “any device that consumes electrical energy and exhausts waste heat” including “variable or adjustable frequency drives.” Ex. 1009, [0060]; *see also* [0036]. A POSITA would have found these techniques readily applicable to the VFD of *Coli*. Ex. 1002, ¶235-237. *Loucks* teaches the importance of “detect[ing] problems before temperatures reach alarm limits” because “electrical or electronic equipment can malfunction due to over-temperature.” *Id.*, [0018]. *Loucks* further teaches that without such protections in place, “the consequences of not cooling equipment properly may result in accelerated equipment degradation and early failure.” *Id.*, [0018]. *Loucks* provides further details regarding the protection of electrical devices, including protecting VFDs from damage due to excessive temperatures, and a POSITA would have employed the thermal management techniques of *Loucks* to enhance the VFD of *Coli* to prevent “over-temperature” and ensuing “equipment damage.” *Id.*, [0018], [0060]; Ex. 1002, ¶235-237.

Loucks discloses preventing damage to power electronics by using a “cooling efficiency monitoring system” that comprises “[m]ultiple temperature sensors” including “a power electronics heat sink temperature sensor 510.” Ex. 1009, [0063]. These sensors provide measured temperature data to a computer 700, which includes a processor 702 and cooling efficiency logic 730, which in one example, is implemented in the processor 702. *Id.*, [0066]. The “processor 702 may be a variety of various processors including dual microprocessor other multi-processor architectures.” *Id.*, [0072]. The cooling efficiency logic 730 computes a “temperature differential between the temperature of the monitored device and the ambient temperature, and uses that differential to calculate an “operating cooling efficiency indicator.” *Id.*, [0008], [0068]-[0070].

A POSITA would have been motivated to combine *Coli*’s VFD with *Loucks*’ heat sinks and associated temperature sensors monitored by a microprocessor in order to prevent damage or malfunction as taught in *Loucks*. Ex. 1002, ¶¶235-237. Moreover, a POSITA would have understood that the power semiconductor components of the VFD require cooling to prevent semiconductor damage caused by excessive heat, and the use of heat sinks to do so was well-known long before the ’870 Patent. Ex. 1002, ¶235. Particularly in view of *Loucks*’ applications to VFDs, a POSITA would have been motivated to look to *Loucks*’ heat sinks and temperature sensors and employ *Loucks*’ cooling efficiency monitoring techniques

to “detect problems” with *Coli’s* VFD “before temperatures reach alarm limits” and to ensure that it does not “malfunction” or suffer from “accelerated equipment degradation and early failure.” Ex. 1009, [0018]; Ex. 1002, ¶¶235-237.

A POSITA would have had a reasonable expectation of success in adding the heat sinks with temperature monitoring of power electronics because doing so represents well-known technology. Ex. 1002, ¶¶75-95 (citing Exs. 1016, 1017, 1008, 1030-1035). Furthermore, Figures 4-6 of *Loucks* provide “examples of how sensors could be installed in typical enclosures containing a variety of heat producing electrical devices,” including VFDs, and a POSITA would have understood how to install *Loucks’* heat sink and associated temperature sensors monitored by a microprocessor into *Coli’s* VFD in view of these examples. Ex. 1009, [0061]; *see also* [0036]; Ex. 1002, ¶236. As one example, Figure 5 of *Loucks* shows an enclosure 505 (e.g., for *Coli’s* VFD) that includes a power electronics heat sink temperature sensor 510, a microprocessor temperature sensor 520, and an ambient temperature sensor 540. Ex. 1009, [0063]. As explained by Dr. Durham, incorporating *Loucks’* heat sink and temperatures sensors monitored by a microprocessor into *Coli’s* VFD would have been routine and ordinary to a POSITA, and doing so would have been further obvious based on *Loucks’* examples. Ex. 1002, ¶236.

Accordingly, a POSITA would have been motivated to incorporate the heat sink and associated temperature sensors and temperature monitoring by a microprocessor as taught in *Loucks* into the variable frequency drive described in *Coli* to prevent damage caused by excessive heat, without affecting the other functionalities in *Coli*. Ex. 1002, ¶¶237-238. Such a combination represents the application of a known technique (i.e., to incorporate the heat sink, temperature sensors, and temperature monitoring using a microprocessor of VFDs as taught in *Loucks*) to a known device (e.g., VFD of *Coli*) ready for improvement to yield predictable results (i.e., to protect against malfunction, equipment degradation, and early failure due to overheating). Ex. 1002, ¶¶237-238; *KSR*, 127 S. Ct. at 1740. Such a combination likewise represents the use of a known technique (i.e., to incorporate the heat sink and associated temperature sensors and temperature monitoring by a microprocessor to prevent malfunction of variable frequency drives as taught in *Loucks*) to predictably improve a similar system (i.e., to protect *Coli*'s VFD from malfunction, degradation, and early failure due to excessive heat) in the same way (i.e., by providing heat sinks, temperature sensors, and temperature monitoring). Ex. 1002, ¶¶237-238; *KSR*, 127 S. Ct. at 1740. Indeed, as explained in Dr. Durham's declaration, the use of heat sinks and temperature sensors monitored by a microprocessor was well-known long before the '870 Patent, and a POSITA would have known how to incorporate these well-known heat sinks, temperature

sensors, and a microprocessor into the VFD of *Coli* with a reasonable expectation of success. Ex. 1002, ¶¶237-238.

1. Claim 7

- iv. 7[e] a variable frequency drive connected to the electric motor to control the speed of the motor and having one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat.**

As discussed above for claims 1 and 4, *Coli* discloses a VFD used to control the speed of an electric motor. Ex. 1002, ¶239; *see supra* Sections VIII.A.2.d, VII.A.5.iv, VII.B.2-3. *Loucks* discloses “a cooling efficiency method” that can be applied specifically to VFDs and includes monitoring a “power electronics heat sink temperature sensor 510.” Ex. 1009, [0063]; *see also* [0003] (“Traditional methods of detecting [overheating] problems including ... measuring the temperature of inlet air, exhaust air, heat sinks, or other areas of equipment.”). A computer 700, including a processor 702 and cooling efficiency logic 730, uses data collected from the heat sink temperature sensor 510, “determin[es] a monitored electrical device temperature and an ambient temperature proximate the monitored electrical device to compute a temperature differential,” and calculates the cooling efficiency based in part on the differential. *Id.*, [0066]-[0068]; *see also* [0057] (“Logic may include a software controlled microprocessor.”). In doing so, *Loucks* teaches a cooling efficiency monitoring technique that “detect[s] problems before temperatures reach

alarm limits” to prevent equipment damage, accelerated degradation, and early failure. *Id.*, [0018].

Thus, a POSITA would have understood that *Loucks* discloses power semiconductor heat sinks, sensors, and microprocessors, that can coordinate to monitor the temperature of the variable frequency drive of *Coli* and prevent damage caused by excessive heat. Ex. 1002, ¶¶240-241. Such heat sinks, sensors, and microprocessors used to monitor the temperature and prevent damage from overheat were well-known in the art prior the filing date of the '870 Patent. Ex. 1002, ¶¶75-95 (citing Exs. 1016, 1017, 1008, 1030-1035).

D. Ground 4A: Claims 12 and 13 are obvious over *Coli* in view of *Toshiba Manual* and *Vliet*

The combination of *Coli* in view of *Toshiba Manual* and *Vliet* discloses and/or suggests all limitations of claims 12 and 13, and thus renders those claims obvious. Ex. 1002, ¶¶243-244. To the extent that Patent Owner argues that *Coli* in view of *Toshiba Manual* does not sufficiently disclose or render obvious “wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another,” this ground is presented as an alternative to Ground 1. All other elements of claims 12 and 13 are disclosed or rendered obvious by *Coli* in view of *Toshiba Manual* as explained in Ground 1.

1. One of skill in the art would have been motivated to combine *Coli*, *Toshiba Manual*, and *Vliet*

In addition to being motivated to combine *Coli* with *Toshiba Manual* as described in Section VIII.A.1 of Ground 1, a POSITA would have been motivated to further combine *Coli* with *Vliet* with a reasonable expectation of success, because the combination represents nothing more than the use of the known technique of mounting generators on a trailer just as the pumps, motors, and related equipment of *Coli* are mounted to improve convenience, efficiency, and portability of *Coli*'s fracturing system. Ex. 1002, ¶¶245-248. Additionally, the teaching, suggestion, and motivation in *Vliet* (and in *Coli* itself) would have led a POSITA to modify the system of *Coli* to arrive at the claimed invention. Ex. 1002, ¶249.

As discussed above, *Coli* involves a “fracturing system” for “delivering fracturing fluid to a wellbore at a fracturing operation.” Ex. 1005, [0034]. *Coli* discloses “[e]ach electric motor 21 is paired to a pump 22 as a single fracturing module 20” that “can be removably mounted to trailer 10 to facilitate ease of replacement as necessary.” Ex. 1005, [0040]. Further as discussed in Section VIII.B.13, to the extent the claim is read such that the pump, electric motor, and generator are mounted on the same trailer (which is not required), then *Coli* renders it obvious. Ex. 1002, ¶¶196-197, 245.

Like *Coli*'s disclosure and/or suggestion of mounting generators, pumps, and motors on a trailer, *Vliet* discloses that “at a well site during fracturing” the “pumps” and “electrical equipment” are on a trailer and “are supplied with power from a

conventional generator or generators (not shown), which may conveniently be mounted on the trailer.” Ex. 1010, [0003], [0027]. *Vliet* further teaches that the “spatial orientation” of the components, including generators, is a matter of design choice for the manufacturer and will depend on space requirements.” *Id.*; Ex. 1002, ¶246. Accordingly, to the extent the Board determines that *Coli* does not expressly disclose or render obvious the mounting of a generator on a vehicle (i.e., trailer) with the pump and electric motor, a POSITA would have been motivated to modify *Coli* such that the generator in *Coli* is also mounted on the vehicle (i.e., trailer) with the pump and electric motor for portability. Ex. 1002, ¶247. The results of the combination would have been predictable and obvious to a POSITA. Ex. 1002, ¶¶247-249; Ex. 1048 at 35.

2. Claim 12

- i. **The system of claim 9, wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another.**

Vliet discloses a “fuel delivery system for delivery of fuel to fuel tanks of equipment at a well site during fracturing” and acknowledges that “[f]or use at different well sites, the fuel delivery system should be portable and transportable to various well sites.” Ex. 1010, [0014], [0003]. *Vliet* further discloses that the “pumps” and “electrical equipment” are mounted on a trailer and “are supplied with power from a conventional generator or generators (not shown), which may

conveniently be mounted on the trailer.” *Id.*, [0027]. A POSITA would, therefore, have understood these teachings directed to a system “wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another.” Ex. 1002, ¶250; *see* Ex. 1048 at 35-36 (determining that “Vliet supports Petitioner’s contentions” because Vliet discloses a trailer-mounted turbine generator).

E. Ground 4B: Claims 12 and 13 are obvious over *Coli* in view of *Loucks* and *Vliet*

The combination of *Coli* in view of *Loucks* and *Vliet* discloses and/or suggests all limitations of claims 12 and 13, and thus renders those claims obvious. Ex. 1002, ¶251. To the extent that Patent Owner argues that *Coli* in view of *Loucks* does not sufficiently disclose or render obvious “wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another,” this ground is presented as an alternative to Ground 3. All other elements of claims 12 and 13 are disclosed or rendered obvious by *Coli* in view of *Loucks* as explained in Ground 1.

1. One of skill in the art would be motivated to combine *Coli*, *Loucks*, and *Vliet*

In addition to being motivated to combine *Coli* with *Loucks* as explained in Section VIII.C.1 of Ground 3, a POSITA would have been motivated to further combine *Coli* and *Loucks* with *Vliet* with a reasonable expectation of success for the

same reasons stated above in Section VIII.D.1 for Ground 4A. Ex. 1002, ¶252; Ex. 1048 at 35.

2. Claim 12

- i. The system of claim 9, wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another.**

To the extent that Patent Owner argues that the combination of *Coli* and *Loucks* does not render obvious the limitation “wherein the pump, electric motor, and generator are mounted on a vehicle, and can be ported from one well to another” as described in Ground 3, *Vliet* expressly discloses this limitation for the same reasons stated above in Section VIII.D.2 for Ground 4A. Ex. 1002, ¶253; Ex. 1048 at 35-36.

F. Ground 5A: Grounds 14 and 15 are obvious over *Coli* in view of *Toshiba Manual* and *Gardner*

The combination of *Coli* in view of *Toshiba Manual* and *Gardner*, either alone or in combination, discloses and/or suggests all limitations of claims 14 and 15, and thus renders those claims obvious. Ex. 1002, ¶254. To the extent that Patent Owner argues that *Coli* in view of *Toshiba Manual* does not sufficiently disclose “wherein the pump is a triplex or a quinteplex pump rated at about 2250 horsepower or more,” this ground is presented as an alternative to Ground 1 for claims 14 and 15. All other elements of claims 14 and 15 are disclosed or rendered obvious by *Coli* in view of *Toshiba Manual* as explained above in Ground 1.

1. One of skill in the art would be motivated to combine *Coli*, *Toshiba Manual*, and *Gardner*

In addition to being motivated to combine *Coli* with *Toshiba Manual* as described in Section VIII.A.1 of Ground 1, a POSITA would have been motivated to further combine *Coli* and *Toshiba Manual* with *Gardner* with a reasonable expectation of success, because *Gardner* provides details of the specific pump model disclosed in *Coli*. Ex. 1002, ¶255. Specifically, *Coli* discloses the use of a “quintuplex or triplex plunger style pump, for example, the SWGS-2500 Well Service Pump sold by Gardner Denver, Inc” for use in a fracturing operation. Ex. 1005, [0046]. The “SWGS-2500 quintuplex pump” disclosed by *Coli* refers to a Gardner Denver GD-2500Q pump end coupled with a Gardner Denver SGWS fluid end. Ex. 1002, ¶256. *Gardner* discloses that the SWGS-2500 pump of *Coli*—i.e., GD-2500Q pump—is rated at 2500 bhp. Ex. 1011 at 14. Thus, *Coli* provides an express motivation to combine with *Gardner*.

2. Claim 14

i. The system of claim 7, wherein the pump is a triplex or quinteplex pump rated at about 2250 hydraulic horsepower or more.

As discussed in Section VIII.A.15, *Coli* discloses a motor “coupled to one or more electric pumps,” and discloses that a suitable pump is a “quintuplex or triplex plunger style pump, for example, the SWGS-2500 Well Service Pump sold by Gardner Denver, Inc.,” which is rated at 2500 bhp (brake horsepower). Ex. 1005,

[0046], [0049]. *Coli* further discloses that while conventional diesel powered fluid pumps rated for 2250 horsepower typically only deliver about 1800 hp to the pumps, the electric motors of *Coli* “can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.” *Id.*, [0049]; [0050] (“fracturing module 20,” which contains one or more pumps and electric motors, “is capable of operating at 2500 hp.”). Because the motor of *Coli* delivers 2500 hp to the pump, a POSITA would have understood that the pump must be rated for at least that amount of delivered power. Ex. 1002, ¶258. Furthermore, *Gardner* expressly discloses that the SWGS-2500 pump is rated at 2500 hp. Ex. 1011 at 14; *see* Ex. 1001, ¶¶139-146; Ex. 1018. A POSITA would have understood that *Coli* in view of *Gardner* at least renders obvious “wherein the pump is a triplex or a quinteplex pump rated at about 2250 horsepower or more.” Ex. 1002, ¶259; Ex. 1048 at 40.

G. *Ground 5B: Claims 14 and 25 are obvious over Coli in view of Loucks and Gardner*

The combination of *Coli* in view of *Loucks* and *Gardner* discloses and/or suggests all limitations of claims 14 and 15, and thus renders those claims obvious. Ex. 1002, ¶260. To the extent that Patent Owner argues that *Coli* in view of *Loucks* does not sufficiently disclose or render obvious “wherein the pump is a triplex or a quinteplex pump rated at about 2250 horsepower or more,” this ground is presented as an alternative to Ground 3 for claims 14 and 15. All other elements of claims 14

and 15 are disclosed or rendered obvious by *Coli* in view of *Loucks* as explained in Ground 3.

1. One of skill in the art would be motivated to combine *Coli* with *Loucks* and *Gardner*

In addition to being motivated to combine *Coli* with *Loucks* as explained in Section VIII.C.1 of Ground 3, a POSITA would have been motivated to further combine *Coli* and *Loucks* with *Gardner* with a reasonable expectation of success for the same reasons stated above in Section VIII.F.1 for Ground 5A. Ex. 1002, ¶261.

2. Claim 14

i. The system of claim 7, wherein the pump is a triplex or quinteplex pump rated at about 2250 hydraulic horsepower or more.

As described in Ground 3, the combination of *Coli* and *Loucks* discloses and/or suggests the limitation of claim 14. To the extent the Board determines that the combination of *Coli* and *Loucks* does not disclose the limitation “wherein the pump is a triplex or a quinteplex pump rated at about 2250 horsepower or more,” *Gardner* expressly discloses this limitation for the same reasons stated above in Section VIII.F.2 for Ground 5A. Ex. 1002, ¶262; Ex. 1048 at 40.

IX. SECONDARY CONSIDERATIONS

Patent Owner has not identified any evidence of secondary considerations of non-obviousness tied to the claimed invention of the '870 Patent in the Halliburton Litigation (and of course has not had the opportunity to present any such evidence

in this proceeding). Relying on an employee declaration, Patent Owner did advance certain “secondary indicia” arguments during the prosecution of the ’410 Patent, of which the ’870 Patent is a continuation. Ex. 1004, 149-182. Petitioner does not know, however, if Patent Owner plans to advance the same secondary indicia arguments for the ’870.

Even if Patent Owner were to advance the same arguments, Patent Owner’s arguments would fail, because they lack the requisite “nexus.” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (“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. The patentee bears the burden of showing that a nexus exists.”); *see* Ex. 1048 at 58-63 (“Patent Owner has not established persuasively that it is entitled to a presumption of nexus.”).

Furthermore, even if Patent Owner were able to establish any secondary considerations and a proper nexus, any such secondary considerations would be insufficient to overcome the strong case of obviousness presented here. *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007); Ex. 1048 at 63-71 (“Patent Owner’s asserted objective evidence of nonobviousness is weak.”).

X. CONCLUSION

Petitioner respectfully requests that *inter partes* review of the '870 Patent be instituted and that the Challenged Claims be cancelled as unpatentable under 35 U.S.C. § 318(b).

Respectfully submitted,

BAKER BOTTS L.L.P.

A handwritten signature in black ink, appearing to read 'Elizabeth D. Flannery', with a long horizontal flourish extending to the right.

February 10, 2023
Date

Elizabeth Durham Flannery (Reg. No. 59,509)
LEAD COUNSEL FOR PETITIONER

CERTIFICATE OF SERVICE

The undersigned hereby certifies on this 10th day of February 2023, that true and correct copies of the foregoing PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-16 OF U.S. PATENT NO. 11,136,870 and Exhibits 1001-1053, and Petitioner's power of attorney were served in their entirety to Patent Owner via FedEx Express® or Express Mail:

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Petition for *Inter Partes* Review of U.S. Patent No. 11,136,870

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Respectfully submitted,

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A handwritten signature in black ink, appearing to read "Elizabeth Durham Flannery", with a long horizontal flourish extending to the right.

February 10, 2023

Date

Elizabeth Durham Flannery (Reg. No. 59,509)
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**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME
LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE
REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 13,738 words, excluding the parts exempted by 37 C.F.R. § 42.24(a).
2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word in 14-point Times New Roman.

Respectfully submitted,

BAKER BOTTS L.L.P.

A handwritten signature in black ink, appearing to read 'Elizabeth Durham Flannery', with a long horizontal flourish extending to the right.

February 10, 2023
Date

Elizabeth Durham Flannery (Reg. No. 59,509)
LEAD COUNSEL FOR PETITIONER