

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

IPR2023-00558
U.S. PATENT NO. 11,136,870

PATENT OWNER'S PRELIMINARY RESPONSE

TABLE OF CONTENTS

I. Introduction.....	1
II. Challenged U.S. Patent No. 11,136,870.....	3
A. Overview of '870 Patent.....	3
B. During Prosecution, the examiner identified the two key limitations that overcame all cited prior art.....	5
III. Asserted Prior Art	6
A. Coli (EX-1005).....	6
B. Gardner (EX-1011).....	7
C. Toshiba (EX-1006).....	7
D. Horikoshi (EX-1008).....	9
E. Loucks (EX-1009).....	10
F. Vliet (EX-1010).....	11
IV. Skill Level of a POSITA.....	11
V. Claim Construction	12
VI. The Petition has not shown a reasonable likelihood of prevailing as to any claim given Toshiba does not disclose key limitations in the independent claims and the remaining grounds include non-analogous prior art.	12
A. The intrinsic evidence shows the claimed “ <i>diagnostics</i> ” must be for the “ <i>electric motor</i> ,” not the “ <i>variable frequency drive</i> ”	13
B. All of the Grounds relying on Toshiba fail because neither Coli nor Toshiba disclose key limitations required by independent claims 1, 4 and 7	15
1. The Petition fails to show that Coli or Toshiba discloses “ <i>electric motor diagnostics</i> ” as required by claims 1–6.....	16
2. The Petition fails to show that Coli or Toshiba discloses “ <i>heat sinks having thermal sensors</i> ” as required by claims 7–16.	24
C. The remaining grounds fail because the Petition relies on non-analogous prior art.....	28

1. The Petition fails to include any argument or cited evidence showing how Horikoshi and Loucks are analogous to the challenged patent.....	29
2. Horikoshi is not analogous art to the claimed invention.....	31
3. Loucks is also not analogous art to the claimed invention.....	34
VII. Conclusion	35

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>AI23 Sys., LLC v. Long Hua Tech. Co. LTD.</i> , Case IPR2021-00894, Paper 12 (PTAB Oct. 18, 2021).....	22
<i>Airbus S.A.S. v. Firepass Corp.</i> , 941 F.3d 1374 (Fed. Cir. 2019).....	33
<i>In re Bigio</i> , 381 F. 3d 1320 (Fed. Cir. 2004)	29, 31
<i>In re Clay</i> , 966 F.2d 656 (Fed. Cir. 1992).....	33, 35
<i>Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.</i> , 800 F.3d 1375 (Fed. Cir. 2015).....	28
<i>InfoBionic, Inc. v. Braemer Mfg., LLC</i> , IPR2015-01704, Paper 11 (PTAB Feb. 16, 2016).....	23
<i>Kinetic Techs., Inc. v. Skyworks Sols., Inc.</i> , IPR2014-00529, Paper 8 (PTAB Sept. 23, 2014).....	23, 24
<i>In re Nat. Alternatives, LLC</i> , 659 F. App’x 608 (Fed. Cir. 2016).....	29
<i>The Chamberlain Grp., LLC, v. Overhead Door Corp.</i> , IPR2022-00842, Paper 9 (PTAB Oct. 25, 2022).....	29
<i>Xerox Corp. v. Bytemark, Inc.</i> , IPR2022-00624, Paper 12 (PTAB Feb. 10, 2023).....	23, 26
Statutes	
35 U.S.C. § 314(a).....	2
35 U.S.C. § 316(e).....	28

Other Authorities

37 C.F.R. § 42.65(a).....	27
---------------------------	----

PATENT OWNER'S EXHIBIT LIST

Exhibit No.	Description
2001	Excerpt from Webster's New World College Dictionary, 5 th ed. (2016)

I. Introduction

Halliburton's Petition has two fatal defects: (1) Ground 1 fails to show how Toshiba discloses key limitations [in independent claims 1 and 4 (i.e., "*a variable frequency drive [that] performs electric motor diagnostics*") as well as claim 7 (i.e., "*one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor*")]; and (2) the prior art in the remaining grounds is non-analogous to the challenged patent and therefore cannot be used as part of a section 103 combination. As such, none of the asserted grounds demonstrate a reasonable likelihood that Petitioner will prevail with respect to at least one challenged claim and thus trial should not be instituted.

For Ground 1, the Petition first relies on Toshiba (EX-1006) as allegedly disclosing two key features. It is undisputed that, during prosecution, the examiner found the claims overcame the prior art of record because of these two key features: (i) "*wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the one or more electric motors,*" and (ii) "*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.*" With respect to the first feature, Toshiba discloses variable frequency drive faults, which are not "diagnostics" for an "electric motor." For the second feature, the Petition relies on unsupported expert testimony to stitch together passages from

Toshiba regarding a thermistor and heat sink that is contradicted by other evidence. With these two defects, Ground 1 is fatally flawed.

For the remaining grounds, the Petition relies on two non-analogous references: Horikoshi (EX-1008) and Loucks (EX-1009). The Petition, as it must, fails to provide any cited evidence or even an argument addressing how these two references are analogous to the challenged patent. In particular, the Petition does not include any argument or evidence regarding how these references are in the same field of endeavor as the '870 patent. Nor does the petition include any argument or cited evidence regarding any problem facing the inventors of that patent and how the two references are relevant to that problem. Consequently, Petitioner has not satisfied its burden to show that Horikoshi and Loucks are analogous references. And, even if Petitioner did make such an argument, both references are non-analogous as further explained below.

Because all the grounds in the Petition suffer from one or more of these defects, Petitioner has failed to meet its burden under 35 U.S.C. § 314(a) to show a reasonable likelihood that at least one challenged claim is invalid and thus trial should not be instituted.

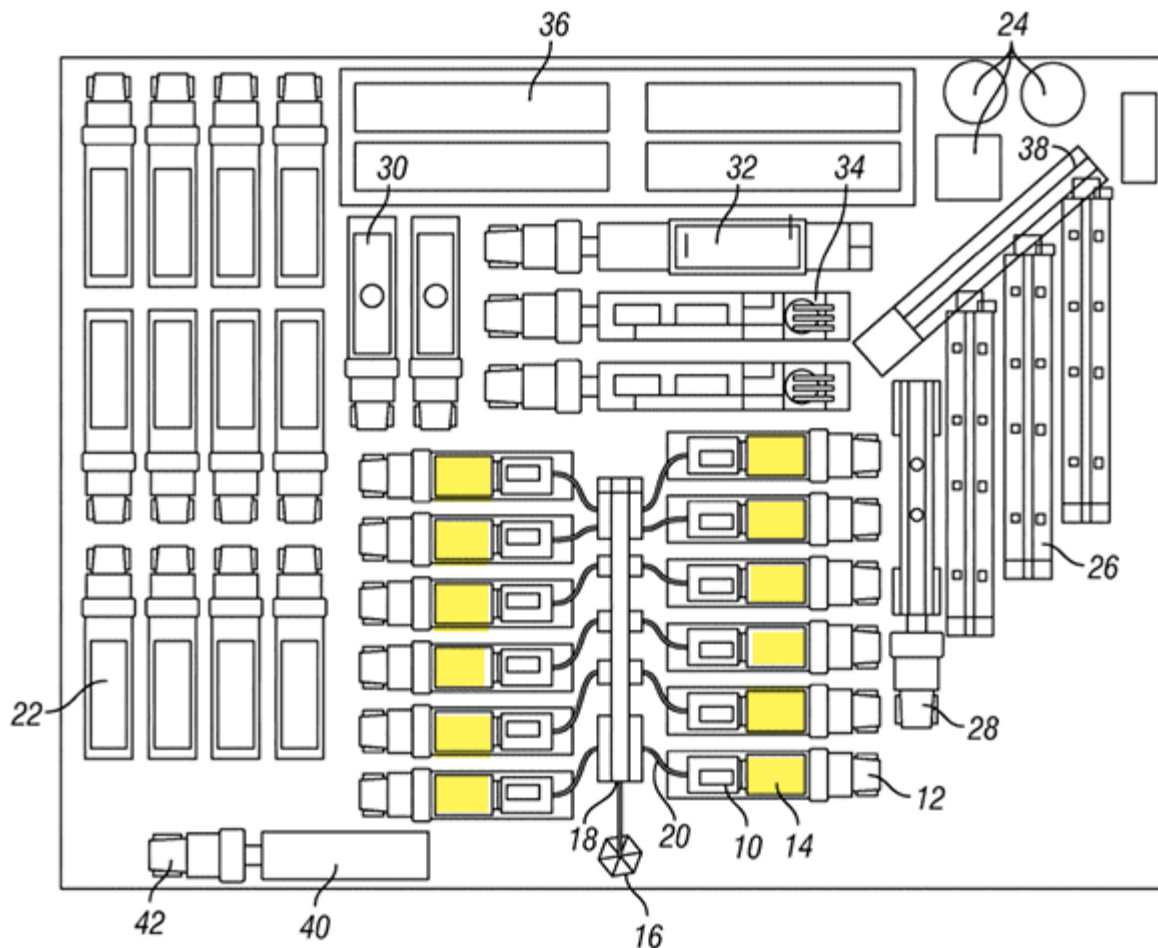
II. Challenged U.S. Patent No. 11,136,870

A. Overview of '870 Patent

The '870 patent claims priority to U.S. Patent No. 9,410,410. EX-1001, 1:8–17. Accordingly, the effective filing date for the '870 patent is November 16, 2012.

The '870 patent relates to hydraulic fracturing in oil and gas wells, which entails pumping fluid into underground formations at high pressure. EX-1001, Abstract; 1:23–26; 1:39–40. Typically, this pumping is performed by large diesel-powered pumps. *Id.*, 1:40–42. Diesel-powered pumps, however, have significant drawbacks, such as being expensive to repair and hard to move. *See id.*, 1:42–51.

To overcome these problems, the '870 patent describes a fracturing system and method that uses electric motors controlled by a variable frequency drive. *Id.*, 1:62–2:8. Figure 1 depicts such an exemplary system and method using electric motors 14 (in yellow) equipped with variable frequency drive (not shown) below:



EX-1001, Fig. 1 (annotated); 3:59–62 (“In addition, each electric motor 14 can be equipped with a variable frequency drive (VFD), and an A/C console, that controls the speed of the electric motor 14, and hence the speed of the pump 10.”). The ’870 patent further explains that the variable frequency drive also “frequently perform[s] electric motor diagnostics to prevent damage to the electric motor if it becomes grounded or shorted.” *Id.*, 2:36–39. The challenged patent also explains that a variable frequency drive may include “power semiconductor heat sinks having one

or more thermal sensors monitored by a microprocessor to prevent semiconductor damage caused by excessive heat. *Id.*, 2:39–42.

B. During Prosecution, the examiner identified the two key limitations that overcame all cited prior art.

The examiner allowed the challenged claims over the prior art of record because the claims recited one of two novel features: (i) “*wherein the variable frequency drive performs electric motor diagnostics to prevent damage to the one or more electric motors,*” or (ii) “*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.*” See EX-1003, 94 (stating dependent claims 3, 9, and 18 that recited one of these two features would “be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.”); *id.*, 168–70 (showing dependent claims 3, 9, and 18). Petitioner does not dispute that the examiner found these two limitations were key to allowing the challenged claims to issue over the cited prior art. Pet. at 6 (“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 [electric motor] diagnostics and heat sinks having thermal sensors to prevent damage to the motor.”)

III. Asserted Prior Art

A. Coli (EX-1005)

Coli relates to hydraulic fracturing in hydrocarbon-bearing wells. EX-1005, [0003]. Coli recognizes drawbacks of the diesel motors typically used in such drilling. *Id.*, [0005]; [0008]. Coli purports to improve upon known fracturing systems by using electric motors and generators powered by natural gas to drive the pumps. *Id.*, [0009]–[0011]; [0038]. Coli purports that this use of electric components beneficially reduces the amount of infrastructure, makes control safer and easier, facilitates syncing the equipment within the system, and reduces costs. *Id.*, [0039]; [0066]; [0071]; [0073].

Figure 3 is a schematic plan view of Coli's fracturing trailer and is reproduced below.

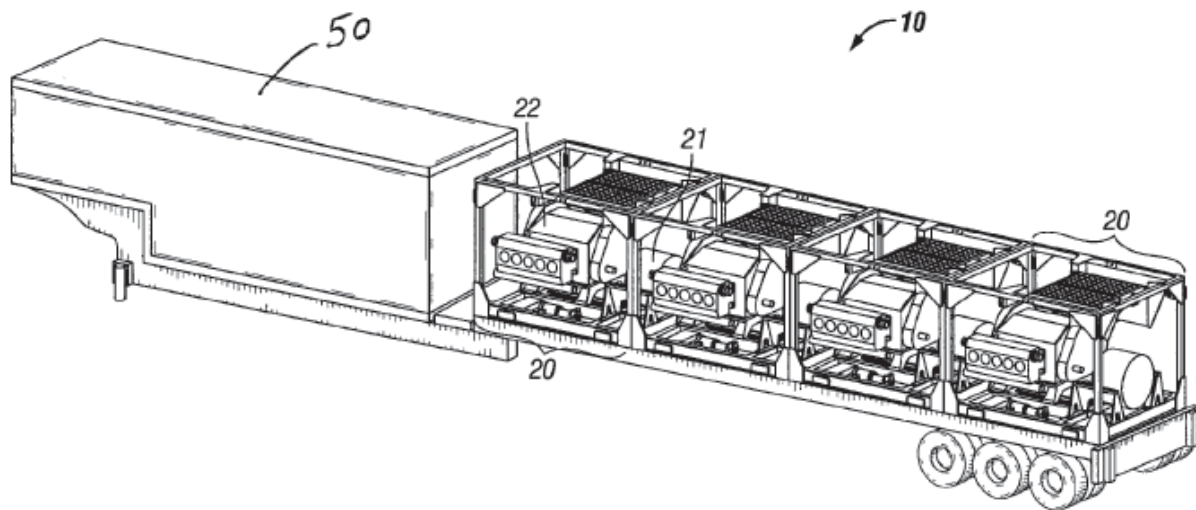


FIG. 3

Figure 3 is a schematic diagram of trailer 10 housing four fracturing modules 20. EX-1009, [0040]. Each fracturing module 20 includes electric motor 21 coupled directly to fluid pump 22. *Id.*, [0040]; [0052]. The trailer housing also includes an electrical transformer and drive unit 50 to step down the power voltage from turbine generator 30 (not shown) to electric motor 21. *Id.*, [0047]. The “[f]racturing modules 20 utilize electric power from turbine generator 30 to pump the fracturing fluid directly to the wellbore.” *Id.*, [0040]. The Petition, however, does not contend that Coli’s drive unit 50 performs “*electric motor diagnostics*” or includes “*heat sinks having thermal sensors.*”

B. Gardner (EX-1011)

Gardner is an operating and service manual published by Gardner Denver. EX-1011, 1. The manual is for a well servicing pump, model GD-2500Q Quintuplex. *Id.* The GD-2500Q is a quintuplex pump with a stroke length of 8.0 inches and a variety of plunger diameters, including 4.5 inches. *Id.*, 20. The GD-2500Q has an input power of 2200 or 2500 bhp and a rated brake horsepower of 2500 bhp. *Id.* But the Petition does not contend that Gardner discloses a VFD that performs “*electric motor diagnostics*” or includes “*heat sinks having thermal sensors.*”

C. Toshiba (EX-1006)

Toshiba is an operation manual for a G7 True Torque control Adjustable Speed Drive (“ASD”), EX-1006, 1, which Petitioner contends is a variable

frequency drive. Pet. at 10. Toshiba's ASD is a "solid-state AC drive" and uses a "Vector Control Algorithm [that] enables the motor to develop high starting torque and provide compensation for motor slip." *Id.*, 2. The G7 also includes a "user-friendly Electronic Operator Interface (EOI)" to access "many monitoring and programming features of the G7." *Id.*

These monitoring features include alarms and ASD fault codes displayed on the EOI during the operation of the G7 ASD. *See* EX-1006, 180–86. Alarms for the ASD include, for example, communication errors (*id.*, 180), overheat (*id.*), and timer (*id.*). Toshiba lists 46 fault codes for the ASD that occur for various reasons, such as "CPU Fault" (*id.*, 183), "RAM" or "ROM Fault[s]" (*id.*, 185), ASD Overload (*id.*, 182) and "communication error" (*id.*). Contrary to what is alleged in the Petition, and as explained further below, none of the fault codes or alarms disclosed in Toshiba satisfy the claimed "*electric motor diagnostics*."

One such alarm code is "overheat" (*id.*, 180), which is triggered whenever the "ASD ambient temperature is excessive." Toshiba explains that this alarm code may be triggered for five various reasons, such as when the "[c]ooling fan is inoperative" or when the "[i]nternal thermistor is disconnected." *Id.* To help dissipate heat, Toshiba's G7 ASD also includes a heat sink. *Id.*, 14 ("heat sink and other components may become extremely hot to touch"); 204 ("cooling capacity of the heatsink"). Although Toshiba includes both a heat sink and thermistor (i.e.,

temperature sensor), nothing in Toshiba describes that the thermistor is located on the heat sink as the claims require—that is, “*heat sinks having thermal sensors.*”

D. Horikoshi (EX-1008)

Horikoshi “relates to a motor driving apparatus having a fault diagnostic function.” EX-1008, [0002]. Horikoshi recognizes that typical driving apparatus include a DC/AC converter having only two current sensors to reduce cost, resulting in circumstances where an overcurrent due to a ground fault cannot be detected and, if an overcurrent is detected, it cannot be determined whether the cause is a ground fault or a short circuit. *Id.*, [0004]–[0005]. Horikoshi purports to improve upon known driving apparatus by including a fault diagnostic function capable of detecting a ground fault and a short circuit. EX-1008, [0011]. The motor driving apparatus includes an AC/DC converter that converts supplied three-phase AC power into DC power output into a DC/AC converter that converts the DC power into frequency-variable three-phase AC power. *Id.*, [0027]. The driving apparatus includes a zero-phase current detector at the supply input of the AC/DC converter and current sensors to detect two of the three-phase AC currents output from the DC/AC converter. *Id.*, [0028]. A determining unit uses signals input from these components to determine whether a detected overcurrent is a short circuit or a ground fault. *Id.*, [0029]. Horikoshi does not expressly disclose a variable frequency drive

used in hydraulic fracturing, let alone one that includes “*heat sinks having thermal sensors.*”

E. Loucks (EX-1009)

Loucks is related to measuring changes in cooling performance for server IT equipment. *See* EX-1009, Fig. 1; Abstract. Figure 1 of Loucks depicts the cooling operation in an equipment room in a typical data center 100:

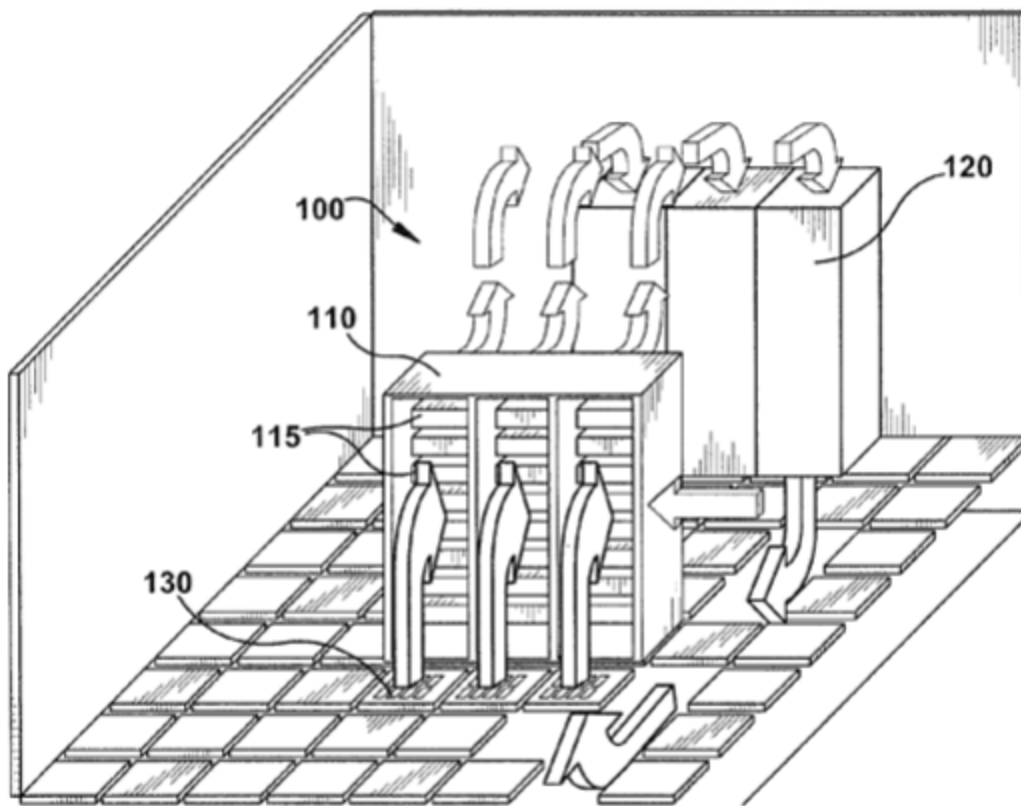


Fig. 1

EX-1009, Fig. 1; [0025] (“data center 100 houses multiple racks or enclosures 110 of IT equipment 115, such as servers, routers, switches, and circuit protection devices.”) As shown above, “[a] computer room air conditioner 120 intakes heated air from the room, cools it, and circulates the cooled air through the room as shown by the arrows.” *Id.* Loucks discloses a method for monitoring the “operating cooling efficiency” of such equipment based on “a ratio between equipment electrical power consumption and a temperature differential between the equipment and an ambient temperature.” EX-1009, Abstract. Notably, the Petition does not contend that Loucks discloses a variable frequency drive, let alone one that performs “*electric motor diagnostics*” or includes “*heat sinks having thermal sensors.*”

F. Vliet (EX-1010)

Vliet discloses a fuel-delivery system for use in a fracturing operation that is portable and transportable to various well sites. EX-1010, [0014]. For example, the fuel delivery system may be contained on a single wheeled or skidded trailer. *See id.* The Petition does not, however, contend that Vliet discloses a variable frequency drive that performs “*electric motor diagnostics*” or includes “*heat sinks having thermal sensors.*”

IV. Skill Level of a POSITA

For purposes of this preliminary response only, Patent Owner applies the skill level proposed by Petitioner. *See Pet.* at 20.

V. Claim Construction

Petitioner has not proposed any construction for the terms of the '870 patent. Pet. at 20–21. Patent Owner agrees, at this stage, that no terms require a construction. Patent Owner reserves the right to propose constructions for any claim terms if the Board institutes a proceeding.

VI. **The Petition has not shown a reasonable likelihood of prevailing as to any claim given Toshiba does not disclose key limitations in the independent claims and the remaining grounds include non-analogous prior art.**

Grounds 1, 4A, and 5A are based on the combination of Coli and Toshiba. In these Grounds, the Petition's reliance on Toshiba's variable frequency drive ("VFD") fault to satisfy the claimed "*electric motor diagnostics*" in independent claims 1 and 4 is misplaced. And for independent claim 7, the Petition relies on unsupported expert testimony to stitch together unrelated disclosures regarding Toshiba's heat sink and thermistor in an attempt to render obvious the limitation "*one or more power semiconductor heat sinks having thermal sensors*" even though that same testimony is contradicted by other Petitioner exhibits.

As for the remaining Grounds 2, 3, 4B, and 5B, they rely on section 103 combinations that require two non-analogous prior art references: Horikoshi (EX-1008) and Loucks (EX-1009). In doing so, these remaining Grounds are also fatally flawed.

A. The intrinsic evidence shows the claimed “*diagnostics*” must be for the “*electric motor*,” not the “*variable frequency drive*”

Challenged independent claims 1 and 4 require a “*variable frequency drive* [that] *performs electric motor diagnostics*.” EX-1001, claims 1 and 4. The claims and specification show that the electric motor and variable frequency drive are separate and distinct components of the claimed hydraulic fracturing system. The intrinsic record is clear that the claimed “*diagnostics*” must be for the claimed “*electric motor*,” not the “*variable frequency drive*.”

The claims recite the “*electric motor*” and “*variable frequency drive*” as separate and distinct components of the claimed system. Claim 1, for example, recites that the variable frequency drive is connected to the “electric motor,” showing that these claimed components cannot be the same:

1. 1. 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:

 . . . *one or more electric motors* . . . and

 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.

EX-1001, Claim 1 (emphases added); *see id.*, Claim 4 (also separately requiring an “electric motor” and a “variable frequency drive”). The claims likewise require that

these components perform separate and distinct functions—that is, the “*electric motor*” powers the claimed “*pumps*,” whereas the “*variable frequency drive*” “*control[s] the speed*” of the “*electric motor*.” EX-1001, claim 1; claim 4. Based on the claim language alone, the “*electric motor*” and “*variable frequency drive*” must be separate and distinct claim components.

Claims 1 and 4 also require that the claimed “*diagnostics*” are for the “*electric motor*”—not the “*variable frequency drive*.” These independent claims specifically recite “*electric motor diagnostics*.” EX-1001, claim 1 (“wherein the variable frequency drive performs *electric motor diagnostics* to prevent damage to the one or more electric motors”); claim 4 (“wherein the variable frequency drive performs *electric motor diagnostics* to prevent damage to the electric motor.”) (emphases added). Notably, neither claim recites diagnostics (or faults) for the system generally or specifically for the variable frequency drive. Claims 1 and 4 further require that the claimed diagnostics are used “*to prevent damage to the one or more electric motors*,” which confirms that the diagnostics must be for the “*electric motor*” and not the “*variable frequency drive*.” Accordingly, the plain reading of the claim requires that the claimed “*diagnostics*” are for “*electric motor*” alone.

Moreover, the ’870 patent specification distinguishes “*electric motor diagnostics*” from other system faults. The specification recites both electric motor diagnostics along with VFD and general fault indicators, but does not equate the

diagnostics and faults. EX-1001, 2:36–39 (“In another embodiment, variable frequency drive can frequently perform electric motor diagnostics to prevent damage to the electric motor if it becomes grounded or shorted.”); *id.*, 5:42–46 (“Other pump control and data monitoring equipment can include pump throttles, ***a pump VFD fault indicator*** with a reset, ***a general fault*** indicator with a reset, a main estop, a programmable logic controller for local control, and a graphics panel.”) (emphases added). By not equating the claimed electric motor diagnostics with other system faults, the ’870 patent confirms that the claimed “*electric motor diagnostics*” must be different from faults related to other system components (e.g., system faults or VFD faults) expressly identified in the specification.

Therefore, both the claims and specification are clear that the claimed “*diagnostics*” must be for the claimed “*electric motor*” and not for other system components, such as the “*variable frequency drive*.”

B. All of the Grounds relying on Toshiba fail because neither Coli nor Toshiba disclose key limitations required by independent claims 1, 4 and 7

Grounds 1, 4A, and 5A rely on two different teachings from Toshiba to satisfy two limitations: “*electric motor diagnostics*” and “*one or more power semiconductor heat sinks having thermal sensors*.” See Pet. at 31–32, 34–35, 36–38. Neither is correct. First, the Petition maps Toshiba’s VFD faults to the “*electric motor diagnostics*” even though these faults have no nexus to an “*electric motor*.” Second,

the Petition relies on unsupported expert testimony to support the argument that Toshiba’s internal thermistor (a thermal sensor) is located on a heat sink. But Petitioner’s other exhibits show that thermal sensors may be placed in multiple locations internally—not just on the heat sink. Toshiba provides no disclosure at all regarding where the thermistor is located and the Petition includes no rationale explaining why a POSITA would have found it obvious to place a thermistor on a heat sink. Consequently, this latter argument lacks necessary proof and is facially deficient as a result.

1. The Petition fails to show that Coli or Toshiba discloses “*electric motor diagnostics*” as required by claims 1–6.

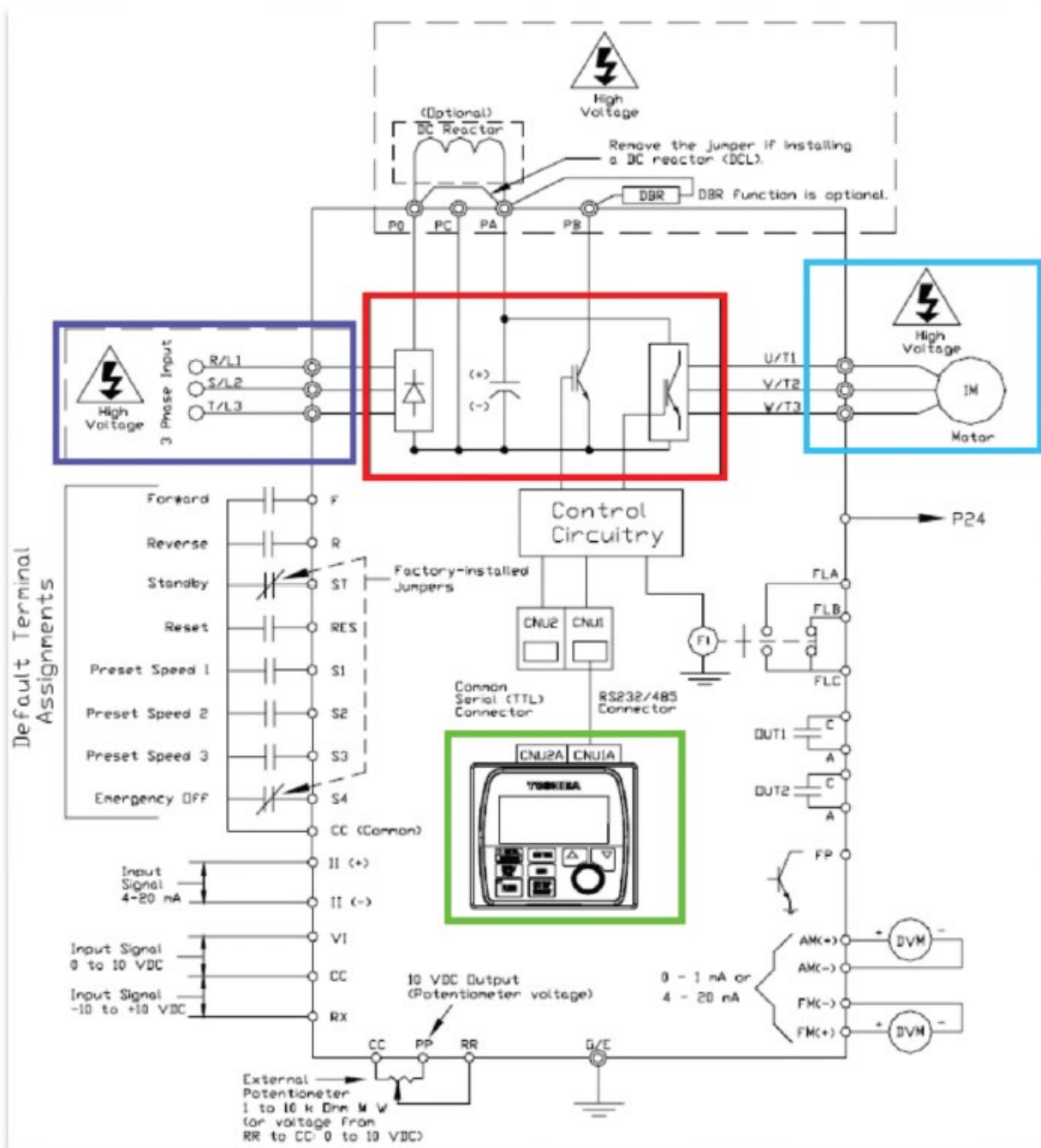
Independent claims 1 and 4 recite a “*variable frequency drive [that] performs electric motor diagnostics.*” EX-1001, claims 1 and 4. Claims 2–3 and 5–6 depend from claims 1 and 4, respectively. *See id.*, claims 2–3 and 4–6. The Petition concedes that Coli does not disclose this limitation and instead relies on the VFD faults in Toshiba (EX-1006) to satisfy the claimed “*electric motor diagnostics.*” Pet. at 30–32. But this argument fails because Toshiba’s VFD faults cannot satisfy the claimed “*diagnostics*” for an “*electric motor.*”

Toshiba’s VFD fault conditions represent errors in the VFD—***not*** the electric motor. Consequently, Toshiba’s VFD fault conditions cannot satisfy “*electric motor diagnostics*” as these fault conditions are for a claim limitation different from the electric motor—that is, the “*variable frequency drive.*” *See* EX-1001, claim 1

(reciting the “variable frequency drive” and “electric motor” as separate and distinct components). Moreover, and as explained above, the intrinsic evidence distinguishes VFD faults from electric motor diagnostics and does not equate them. EX-1001, 2:36–39; 5:42–46. Fault conditions merely represent that an error condition occurred. The claimed “*diagnostics*,” in contrast, determine the underlying cause of the problem or error to prevent damage to a motor. See EX-2001, Webster’s New World College Dictionary, 5th ed. (2016) at 406 (“diagnostic. . . 3. Comput. a routine for testing a piece of hardware or for locating an error in a program”); EX-1001, 4:20–23 (“motor diagnostics can be performed frequently (e.g., on the application of power, or with each start) to prevent damage to a grounded or shorted electric motor.”). Accordingly, the claims and specification of the ’870 patent confirm that Toshiba’s VFD faults cannot satisfy the claimed “*electric motor diagnostics*.”

The Petition relies primarily on two sections from Toshiba to show how Toshiba’s VFD Faults allegedly satisfy a “*electric motor diagnostics*.” Pet. at 31. Neither section does so. First, the Petition cites a sentence stating that the VFD can “perform diagnostics.” EX-1006, 43 (“[The electronic operator interface of the VFD (also referred to as ASD] may be used to monitor the system functions, input data into the system, or perform diagnostics.”). Nothing in this cited sentence, however, mentions an “*electric motor*” generally or “*electric motor diagnostics*” specifically. See *id.* Further, Toshiba only mentions “diagnostics” twice in its 221-page disclosure

and never mentions that those diagnostics relate to any “motor.” EX-1006, 42 (“LCD Display — Displays configuration information, performance data (e.g., motor frequency, bus voltage, torque, etc.), and diagnostic information.”); *id.*, 43 (“The EOI may be used to monitor system functions, input data into the system, or perform diagnostics.”). One annotated drawing by Petitioner’s expert shows that the electric motor (blue box) is located outside the VFD (also referred to as an ASD in Toshiba):



EX-1002, ¶ 116 (“Toshiba Manual provides a schematic, showing the components of a quintessential VFD, including: “3 Phase Input” of electricity (purple box); an AC/DC/AC converter (including a rectifier circuit and inverter circuit) to convert fixed-frequency input AC electricity to DC and then to variable-frequency AC (red

box); and output of that converted AC electricity to an electric motor (blue box).”) Stated otherwise, Petitioner’s expert admits the Toshiba’s VFD and the electric motor are separate and distinct components. Thus, any sentence in Toshiba referring to “diagnostics” refers to diagnostics for the VFD, not an “*electrical motor*.”

Next, the Petition primarily relies on Table 12 from Toshiba that lists “5 pages of faults that are diagnosed.” Pet. at 31. But none of these listed faults show a fault directed toward an “*electric motor*” only. Relevant portions of Table 12 from Toshiba are reproduced below. *See* EX-1006, 182–86. Notably, the Petition fails to specifically identify which VFD faults listed in Table 12 are motor faults, or explain how any of those faults satisfy the claimed “*electric motor diagnostics*.” *See* Pet. at 31. Indeed, many VFD faults listed in Table 12 do not even mention a motor and plainly have nothing to do with one, such as “Communication Error,” “DC Fuse Open,” “Gate Array Fault,” “RAM fault,” and “ROM Fault.” EX-1006, 182–86. Even the few faults that mention a “motor” explain that possible causes for those faults are unrelated to the motor. Specifically, the Petition appears to identify the following VFD faults as satisfying the “*electric motor diagnostics*,” *see* Pet. at 31, even though all these faults have possible causes (emphasized below) without any nexus to an electric motor:

Fault Screen Display	Possible Causes [of Fault]
Overload (EX-1006, 184)	<ul style="list-style-type: none"> • V/f setting needs to be adjusted. • Motor is locked. • <i>Continuous operation at low speed.</i> • Load requirement exceeds ability of the motor. • <i>Startup frequency setting adjustment required.</i>
Overcurrent (EX-1006, 184)	<ul style="list-style-type: none"> • V/f setting needs to be adjusted. • Restart from a momentary power outage. • The ASD is starting into a rotating motor. • ASD/Motor not properly matched. • Phase-to-phase short (U, V, or W). • <i>Accel time too short.</i> • <i>Voltage Boost setting is too high.</i> • Motor/machine jammed. • <i>Mechanical brake engaged while the ASD is running.</i> • <i>ASD current exceeds 340% of the rated FLA on ASDs that are 100 HP or less during acceleration. On ASDs that are greater than 100 HP, this fault occurs when the ASD current exceeds 320% of the rated FLA during acceleration.</i> • <i>Deceleration time is too short.</i>

Fault Screen Display	Possible Causes [of Fault]
	<ul style="list-style-type: none"> • Load fluctuations. • <i>ASD is operating at an elevated temperature.</i>
Overtorque (EX-1006, 185)	<ul style="list-style-type: none"> • A torque requirement by the load in excess of the setting of F616 or F617 for a time longer than the setting of F618. • <i>The ASD is improperly matched to the application.</i> • <i>The load is obstructed.</i>
Short Circuit (EX-1006, 186)	<ul style="list-style-type: none"> • <i>Low impedance at the U lead of the ASD output.</i> • <i>Low impedance at the V lead of the ASD output.</i> • <i>Low impedance at the W lead of the ASD output.</i>
Earth Faults (EX-1006, 183)	<ul style="list-style-type: none"> • Ground fault at the motor. • <i>Ground fault at the output of the ASD.</i> • <i>Current leakage to Earth Ground.</i>

The Petition fails to show how any of Toshiba’s VFD faults, listed above, satisfy performing the claimed “*electric motor diagnostics*,” especially given that these faults have possible causes unrelated to an electric motor and the Petition lacks any explanation regarding *how* any of the above faults satisfy the claimed “*electric motor diagnostic*.” Accordingly, Petitioner’s proof for this claim element is deficient. *See AI23 Sys., LLC v. Long Hua Tech. Co. LTD.*, Case IPR2021-00894, Paper 12 at 18

(PTAB Oct. 18, 2021) (denying institution where Petitioner failed to show where in the cited reference each claim element was disclosed).

Finally on this point, the Petition relies on limited expert testimony to support how Toshiba allegedly discloses the “*electric motor diagnostics*” limitation. Pet. at 31 (citing EX-1002, ¶¶ 117, 150, 166). The cited expert testimony provides no additional explanation and rehashes the same evidence shown above, *see* EX-1002, ¶¶ 117, 150, or merely parrots the Petition, *id.*, ¶ 166. This lack of technical detail and explanation is insufficient. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 12 (on Director Review) at 5 (PTAB Feb. 10, 2023) (precedential) (“[T]he Board was correct in giving little weight to Petitioner’s expert because the expert declaration merely offered conclusory assertions without underlying factual support and repeated, *verbatim*, Petitioner’s conclusory arguments.... The declaration does not provide any technical detail, explanation, or statements supporting *why* the expert determines that the feature in question was required or would have been obvious based on the prior art disclosure.”); *see also InfoBionic, Inc. v. Braemer Mfg., LLC*, IPR2015-01704, Paper 11 at 6, 13 (PTAB Feb. 16, 2016) (expert testimony that “merely repeats the Petitioner’s conclusory argument, adding the phrase ‘[i]n my opinion,’” is not “persuasive or helpful as it . . . offers little or no elaboration”). By doing so, Petitioner’s expert testimony provides little to no probative value beyond Petitioner’s attorney argument. *See Kinetic Techs., Inc. v.*

Skyworks Sols., Inc., IPR2014-00529, Paper 8 at 15 (PTAB Sept. 23, 2014) (“Merely repeating an argument from the Petition in the declaration of a proposed expert does not give that argument enhanced probative value.”).

At bottom, the Petition fails to (and cannot) show how Toshiba’s VFD faults satisfy the claimed “*electrical motor diagnostic*.”

2. The Petition fails to show that Coli or Toshiba discloses “*heat sinks having thermal sensors*” as required by claims 7–16.

Claim 7 recites “*one or more power semiconductor heat sinks having thermal sensors*.” EX-1001, claim 7. Claims 8–16 depend from claim 7. *Id.*, claims 8–16. The Petition appears to concede that Coli does not disclose this feature, *see* Pet. at 36–37, and instead relies on Toshiba’s internal thermistor to satisfy the claimed “*thermal sensor*.” But the Petition fails to show that Toshiba’s thermistor is located on the claimed “*heat sink*” or advance any argument about why it would be obvious for the “*heat sink*” to have a “*thermal sensor*.” Grounds 1, 4A, and 5A thus fail to show how the combination of Coli and Toshiba renders obvious “*one or more power semiconductor heat sinks having thermal sensors*.”

Claim 7 requires that the claimed VFD have “*one or more power semiconductor heat sinks having thermal sensors*[.]” EX-1001, claim 7. Petitioner cobbles together limited disclosures from Toshiba with unsupported expert testimony in an attempt to render this limitation obvious. Initially, the Petition identifies Toshiba’s heat sink as the claimed “*heat sink*.” Pet. at 37 (citing EX-1006,

14). The Petition next notes that Toshiba mentions an “overheat error,” which occurs when the “ASD ambient temperature is excessive.” Pet. at 37 (citing EX-1006, 2; 42–43; 180). Relying on Dr. Durham’s testimony, the Petition then concludes that a POSITA would have understood that the heat sinks “would necessarily have sensors (e.g., thermistors) to report the temperature measurements.” Pet. at 37–38 (citing EX-1002, ¶ 186). Predicated on Dr. Durham’s testimony, the Petition concludes that this limitation is obvious. *See* Pet. at 38. The Petition provides no other obviousness analysis as to this limitation beyond the conclusory allegation that it would have been obvious, based on Dr. Durham interpretation of Toshiba’s limited disclosure regarding an internal thermistor being used to measure ASD ambient temperature.

The limited Toshiba disclosures cited in the Petition never say that the internal thermistor is located on the heat sink as required by the claim (i.e., *one or more power semiconductor heat sinks having thermal sensors*). At most, Toshiba discloses that the ASD [VFD] includes a heat sink, *see* EX-1006, 14 (“[t]he heat sink . . . may be extremely hot to the touch”), and an internal thermistor, *see id.*, 180 (“[i]nternal thermistor is disconnected”). Nothing in Toshiba, however, shows that the internal thermistor is located on the heat sink, as required by the claim (i.e., “*one or more power semiconductor heat sinks **having** thermal sensors.*”).

In attempting to close this evidentiary gap, the Petition relies solely on Dr. Durham’s unsupported and incorrect testimony stating that a POSITA would have

understood that the heat sinks “would necessarily have sensors (e.g., thermistors) to report the temperature measurements.” Pet. at 37–38 (citing EX-1002, ¶ 186). Dr. Durham, however, offered no cited evidence to support his opinion that Toshiba’s thermal sensor would necessarily be placed on the heat sink. Instead, he merely concluded that it was so. *See* EX-1002, ¶ 186 (“A POSITA would further understand that in order to protect against overheating, the heatsink would necessarily have sensors which would report to the CPU (microprocessor) temperature data.”).

This opinion testimony, lacking as it does any “technical detail, explanation, or statements supporting why” the heatsink would necessarily have sensors, fails to satisfy Petitioner’s burden. *See Xerox, supra*. Moreover, other evidence relied on by Petitioner (Loucks (EX-1009)) contradicts Dr. Durhams’s conclusory testimony by showing that thermal sensors typically have a variety of internal locations in a system:

Traditional methods of detecting these problems include monitoring rotational velocity of fans, measuring air flow rates with damper switches or pressure sensors or *heated sensors*, and *measuring the temperature of inlet air, exhaust air, heat sinks, or other areas of equipment*.

EX-1009, [0003] (emphasis added). Accordingly, Loucks shows that Toshiba’s internal thermistor may be located at other places besides only on the heat sink. Given that Dr. Durham cites no evidence for his conclusion that a “heat sink would necessarily have [thermal] sensors,” and other evidence that he relied on shows this

is not always true, his testimony should be given no weight for this conclusion. *See* 37 C.F.R. § 42.65(a).

Further, Toshiba's internal thermistors are used to measure ambient temperature, and the other internal placements mentioned in Loucks are better situated for doing so than on the heat sink. Dr. Durham testified that the internal thermistors measure when the "ASD ambient temperature is excessive." EX-1002, ¶ 186 (citing EX-1006, 2; 42–43; 180). Other internal placements of the thermistor, such as at the inlet or exhaust air, would measure ASD ambient temperature much more accurately than a thermistor located on a semiconductor heat sink. EX-1006, 180; EX-1009, [0003]. Dr. Durham also testified that the internal thermistor might become disconnected. EX-1002, ¶ 186 (citing EX-1006, 180). But this scenario contradicts his other testimony that internal thermistors are typically soldered on heat sinks so they cannot be disconnected. *See, e.g.,* EX-1002, ¶ 93 ("Hilbert monitored the internal temperature of the heat sink by use of a type T (copper-constantan) thermocouple located inside a hole drilled into the solder interface between the chip and heat sink at the center of the heat sink base[.]") (internal quotes omitted); *id.*, ¶ 94 (describing, in the background, a TTC1406 heatsink with thermal sensors); EX-1035, 10 (stating that "[t]he thermal component models are connected to the IGBT thermal terminal to form electro-thermal networks."). The other locations for Toshiba's thermistor suggested by Loucks are more consistent with

Toshiba’s disclosures than Dr. Durham’s opinion that the thermistor would necessarily be on the heat sink.

To summarize, Dr. Durham provides no objective evidence to support his statement that Toshiba’s thermal sensor would necessarily be placed on the heat sink. Nor does he offer any opinion regarding why a POSITA would have been motivated to include a thermal sensor on the heat sink rather than at other potential known locations, such as the ones identified in Loucks. Given that other evidence contradicts Dr. Durham’s unsupported testimony and the Petition grounds are predicated on such testimony, the Petition’s Grounds 1, 4A, and 5A are fatally flawed in rendering “*one or more power semiconductor heat sinks having thermal sensors*” obvious.

C. The remaining grounds fail because the Petition relies on non-analogous prior art.

For the remaining Grounds 2, 3, 4B, and 5B, the Petition relies on either Horikoshi (EX-1008) or Loucks (EX-1009)—neither of which is analogous art to the challenged ’870 patent.

Petitioner has the burden to show that all prior art used in a combination is analogous prior art. 35 U.S.C. § 316(e); *see also Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1379 (Fed. Cir. 2015) (“[Petitioner] had the burden of persuasion to prove unpatentability by a preponderance of the evidence, and this

burden never shifted.”). To do so, the Petition must show that the prior art satisfies one of two tests from *In re Bigio*:

Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.

In re Bigio, 381 F. 3d 1320, 1325 (Fed. Cir. 2004). But here, the Petition is silent as to the field of endeavor for the ’870 patent or any problem addressed by it. As shown below, neither Horikoshi nor Loucks is analogous art to the claimed invention and thus Petitioner has not established that a POSITA would have sufficient reason to combine the teachings of Horikoshi or Loucks with any other cited reference. Consequently, Petitioner has not demonstrated a reasonable likelihood of prevailing in demonstrating the challenged claims would have been obvious over any combination of prior art relying on Horikoshi or Loucks. *The Chamberlain Grp., LLC, v. Overhead Door Corp.*, IPR2022-00842, Paper 9 at 37 (PTAB Oct. 25, 2022) (denying institution because one of the two grounds relied on non-analogous prior art); *In re Nat. Alternatives, LLC*, 659 F. App’x 608, 614 (Fed. Cir. 2016)).

1. The Petition fails to include any argument or cited evidence showing how Horikoshi and Loucks are analogous to the challenged patent.

The Petition fails to address whether Horikoshi and Loucks are analogous art to the challenged patent. The Petition does not even address whether Horikoshi and

Loucks are analogous art, whether those references are in the same field of endeavor, or whether those references are reasonably pertinent to the problems addressed by the '870 patent. Accordingly, the Petition fails to address, or even mention, whether either reference is (1) in the same field of endeavor as the '870 patent or (2) reasonably pertinent to the problems addressed by the '870 patent.

At most, the Petition merely states that Horikoshi (EX-1008) is “highly relevant” to the '870 patent:

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.

Pet. at 13–14 (emphasis added). Nothing in this passage, however, specifies the field of invention of the '870 patent or a problem reasonably pertinent to the inventors of the '870 patent. Simply because a reference is highly relevant to some aspect of a challenged patent does not necessarily mean that the reference is in the same field of endeavor or reasonably pertinent to the problems addressed by the '870 patent. For example, prior art directed to brakes may be generally relevant to a patent directed to electric vehicles, but that does not mean that the braking prior art is in the same field as electric vehicles or reasonably pertinent to any problems addressed in the electric vehicle patent. Without showing that Horikoshi (and Loucks) satisfy either analogous art test, the Petition fails to show how these references are

analogous art to the challenged patent and thus Grounds relying on these references are fundamentally flawed.

2. Horikoshi is not analogous art to the claimed invention.

Horikoshi is not in the field of hydraulic fracturing operations, which the parties agree is the field of art for the '870 patent. *See* EX-1001, 1:23–26 (“This technology relates to hydraulic fracturing in oil and gas wells. In particular, this technology relates to pumping fracturing fluid into an oil or gas well using pumps powered by electric motors.”); *see also* Pet. at 4 (“The '870 Patent relates to hydraulic fracturing operations.”). Rather, Horikoshi is drawn to the field of endeavor of “a motor driving apparatus having a fault diagnostic function.” EX-1008, [0002]. Horikoshi is therefore not in the same field of endeavor as the '870 patent.

Turning to the second part of the *In re Bigio* test, the Petition fails to identify any problem addressed by the '870 patent addressed by Horikoshi. *See* Pet. 12–14, 45–51. The specification and claims of the '870 patent are drawn to “the problems associated with diesel pumps,” which are addressed by using a “pump system for hydraulic fracturing fluid” that includes a variable frequency drive and electric motor. EX-1001, 1:23–26, 1:44–54 (explaining that some of the problems with diesel pumps are that they are “very heavy,” which makes transporting them “expensive and inefficient”; require a “high level of expensive maintenance”; and

require the use of expensive diesel fuel). In contrast, Horikoshi addresses the problem of detecting, during the operation of an electric motor, a ground fault and phase-to-phase short circuit and distinguishing between these faults. *See* EX-1008, [0002]. Thus, Horikoshi is not reasonably pertinent to “the problems associated with diesel pumps” addressed by the ’870 patent.

Although Horikoshi and the ’870 patent both refer to electric motors, that does not mean they are in the same field of endeavor, especially given the broad applications of electric motors in varying industries. Petitioner’s expert testified that he implemented ASDs and electric motors for various industries, including those outside oil and gas. EX-1002, ¶ 70 (“I continued to design and oversee installation of increasingly small[er] ASDs for various applications including in power generation, petrochemical, and commercial environments. ASD technology has progressed to the point that even small, integer horsepower motors in residential applications, such as HVAC blowers and pool pumps, have come to be controlled by ASDs.”); *see id.*, ¶ 65 (explaining ASD and electrical motors were used in industries such as petro/chem and textiles); ¶ 66 (same). Nothing in Horikoshi mentions the use of electric motors in fracturing operations or the petrochemical industry. *See generally* EX-1002. Accordingly, the fact that both Horikoshi and the ’870 patent mention electric motors does not mean they are analogous art.

An inventor considering the problem addressed in the '870 patent would not be motivated to turn to Horikoshi at the time of the invention, particularly since ASDs and electric motors have broad applications in various industries outside fracturing operations or the petrochemical industry. Horikoshi would not have logically commended itself to the attention of the '870 patent's inventor. *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992) (when a reference “is directed to a different purpose, the inventor would accordingly have had less motivation or occasion to consider it.”). Instead, given the harsh environment that an electric motor used in the '870 patent invention would have faced, as well as the power required by such a motor to drive the fracturing pumps (*see* EX-1001, 3:51-4:7), an inventor would have instead looked to electric motor references specific to fracturing operations. *Airbus S.A.S. v. Firepass Corp.*, 941 F.3d 1374, 1381 (Fed. Cir. 2019) (concluding PTAB determination that prior art was not directed toward same field of endeavor was supported by substantial evidence when “(1) the challenged claims are expressly directed to a fire-preventive and fire-suppressive system, and (2) [the prior art reference] does not even recite the word “fire” once throughout the entirety of its disclosure,” and stating “a reasonable mind could conclude that the [challenged] patent and [prior art reference] are directed to different fields of endeavor—especially for a ‘common sense’ inquiry like this.”).

3. Loucks is also not analogous art to the claimed invention.

Loucks is also not in the field of hydraulic fracturing operations—that is, the field of art for the '870 patent. *See* EX-1001, 1:23–26; *see also* Pet. at 4 (“The '870 Patent relates to hydraulic fracturing operations.”). Rather, Loucks is drawn to the field of endeavor of measuring changes in cooling performance for server IT equipment. *See* EX-1009, Fig. 1; Abstract. Consequently, Loucks is not in the same field of endeavor as the '870 patent.

As mentioned above, the Petition fails to name a problem addressed by the '870 patent addressed by Loucks. *See* Pet. at 14–15, 51–57. As explained above, the specification and claims of the '870 patent are drawn to “the problems associated with diesel pumps,” which are addressed by using a “pump system for hydraulic fracturing fluid” that includes a variable frequency drive and electric motor. EX-1001, 1:23–26; 1:44–54. Loucks, on the other hand, addresses the problem of detecting cooling problems in server rooms and/or data centers. EX-1009, [0018]; [0024]; [0026]. Therefore, Loucks is not reasonably pertinent to “the problems associated with diesel pumps” addressed by the '870 patent.

An inventor considering the problem addressed in the '870 patent would not be motivated to turn to Loucks at the time of the invention, especially given it is directed toward server IT equipment without any mention of fracturing operations.

Therefore, Loucks also would not have logically commended itself to the attention of the '870 patent's inventor. *In re Clay*, 966 F.2d at 659.

VII. Conclusion

For the above reasons, the Board should decline to institute *inter partes* review.

Date: May 22, 2023

Respectfully submitted,

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)

Reg. No. 36,801

Matthew Hopkins (backup counsel)

Reg. No. 76,273

WINSTON & STRAWN LLP

1901 L Street, N.W.

Washington, D.C. 20036

T: 202-282-5276

beferguson@winston.com

mhopkins@winston.com

PGR-Profrac-USWell@winston.com

J. Tyler Boyce

Reg. No. 77,570 (backup counsel)

WINSTON & STRAWN LLP

800 Capital Street, Suite 2400

Houston, TX 77002

T: 713-651-2600

tboyce@winston.com

Attorneys for Patent Owner

CERTIFICATE OF COMPLIANCE

The undersigned certifies that this response complies with the word-count limitations of 37 C.F.R. § 42.24(b)(1). This response contains 7,019 words as calculated by the Word Count feature of Microsoft Word, the word processing program used to create it.

The undersigned further certifies that this petition complies with the typeface requirements of 37 C.F.R. § 42.6(a)(2)(ii) and typestyle requirements of 37 C.F.R. § 42.6(a)(2)(iii). This petition has been prepared in a proportionally spaced typeface using Microsoft Word in Times New Roman 14-point font.

Dated: May 22, 2023

Respectfully submitted,

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)

Reg. No. 36,801

WINSTON & STRAWN LLP

1901 L Street, N.W.

Washington, D.C. 20036

T: 202-282-5276

beferguson@winston.com

PGR-Profrac-USWell@winston.com

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing PATENT OWNER PRELIMINARY RESPONSE and Exhibit 2001 were served electronically via email on May 22, 2023, in their entirety on the following counsel of record:

Brandon Chen (brandon.chen@bakerbotts.com);
Christian Taylor Tatum (ctatum@mwe.com);
David Genender (dgenender@mwe.com);
David Tobin (dtobin@mwe.com);
Jennifer Carter (jennifer.carter@bakerbotts.com);
Mark Siegmund (msiegmund@cjsjlaw.com);
Michael Hawes (michael.hawes@bakerbotts.com);
Susan Kennedy (susan.kennedy@bakerbotts.com);
Syed Fareed (sgareed@mwe.com);
Roger Fulghum (roger.fulghum@bakerbotts.com)

DLHalliburton870-871IPR@bakerbotts.com

/s/ Brian E. Ferguson

Brian E. Ferguson (lead counsel)

Reg. No. 36,801

WINSTON & STRAWN LLP

1901 L Street, N.W.

Washington, D.C. 20036

T: 202-282-5276

beferguson@winston.com

PGR-Profrac-USWell@winston.com