

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 B2

PATENT OWNER'S RESPONSE

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PATENT OWNER'S EXHIBIT LIST

Exhibit No.	Description
2001	Excerpt from Webster's New World College Dictionary, 5th ed. (2016)
2002	Declaration of Dr. Michael Nikolaou
2003	Deposition of Dr. Robert Durham
2004	C.V. of Dr. Michael Nikolaou

I. INTRODUCTION

Petitioner has not met its burden to demonstrate unpatentability of the challenged claims 1–16.

Concerning claims 1–6, Petitioner fails to show the prior art—a *Toshiba Manual* and *Horikoshi*—discloses “*electric motor diagnostics*.” For example, *Toshiba Manual* describes variable frequency drive (“VFD”) faults, but those are not “*electric motor diagnostics*.” And *Horikoshi* discloses only one “*electric motor diagnostic*”—not the multiple “*diagnostics*” required by the claim. Petitioner also fails to show that a POSITA would have been motivated to combine the references.

Petitioner's analysis of claims 7–16 is similarly deficient. For example, claim 7 recites a VFD having thermal sensors monitored to prevent damage caused by excessive heat. But none of the prior art discloses that feature, and in any event, Petitioner provides no reason why a POSITA would have combined the prior art to arrive at the invention described in claim 7.

For the reasons demonstrated in detail below, the Board should determine that Petitioner failed to meet its burden to show claims 1–16 are unpatentable.

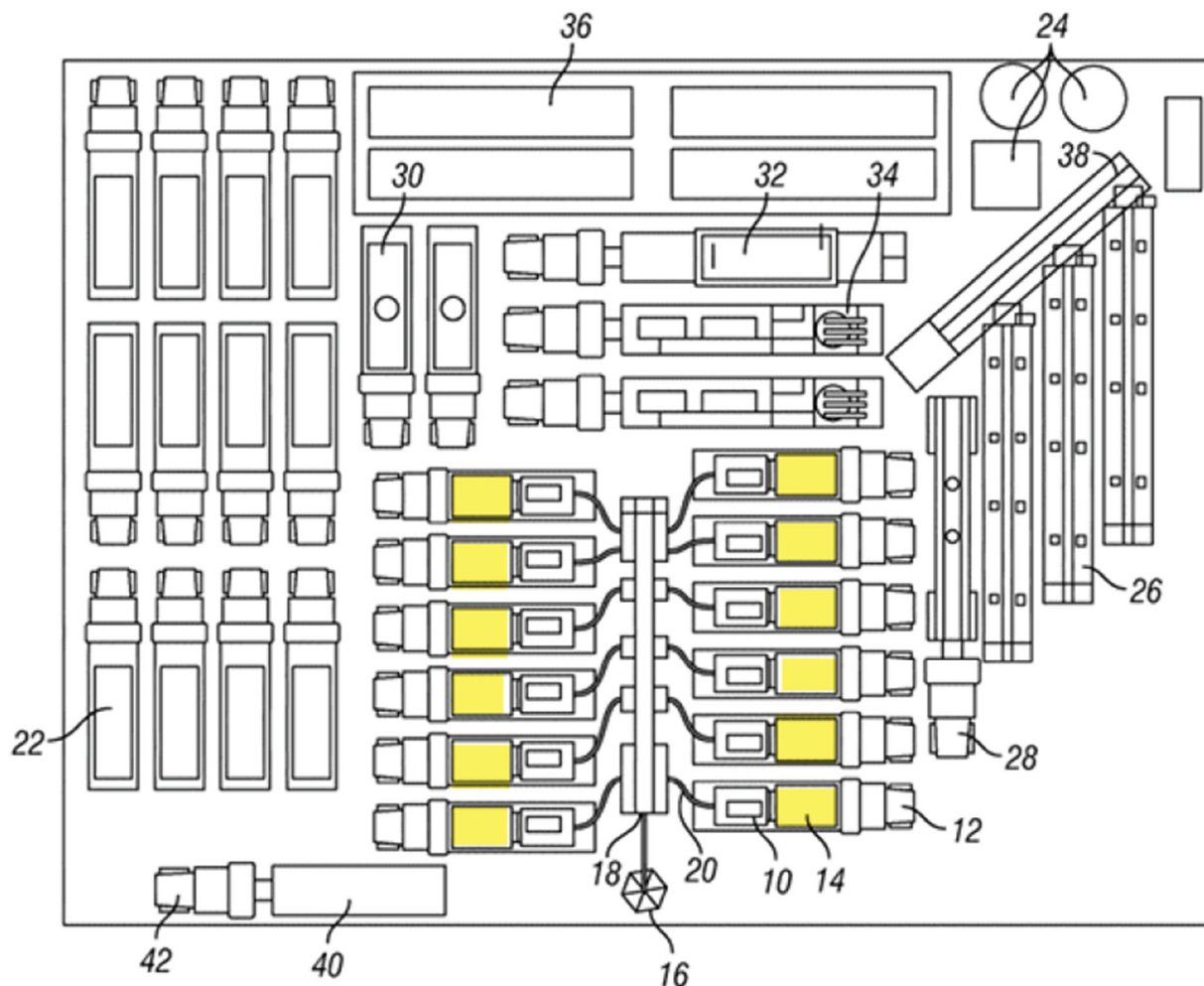
II. CHALLENGED U.S. PATENT NO. 11,136,870

A. Overview of '870 Patent

The effective filing date for the '870 Patent is November 16, 2012, which Petitioner does not dispute.

The '870 Patent is directed 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—they are expensive to repair and hard to move. *Id.*, 1:42–51.

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



EX-1001, Fig. 1 (annotated); 3:59–62 (“[E]ach 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 VFD also “frequently perform[s] electric motor diagnostics to prevent damage to the electric motor if it becomes grounded or shorted.” *Id.*, 2:36–39. It also explains that a VFD 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. The Examiner Identified the two Key Limitations that Overcame All Cited Prior Art During Prosecution.

The Examiner allowed the challenged claims over the prior art of record because the claims recited the following novel features: (i) “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).

III. ASSERTED PRIOR ART

A. *Coli* (EX-1005)

Coli is directed 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], and 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]. The *Coli* inventors contend that this use of electric components beneficially reduces the amount of infrastructure, makes control safer

and easier, facilitates synchronizing 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.

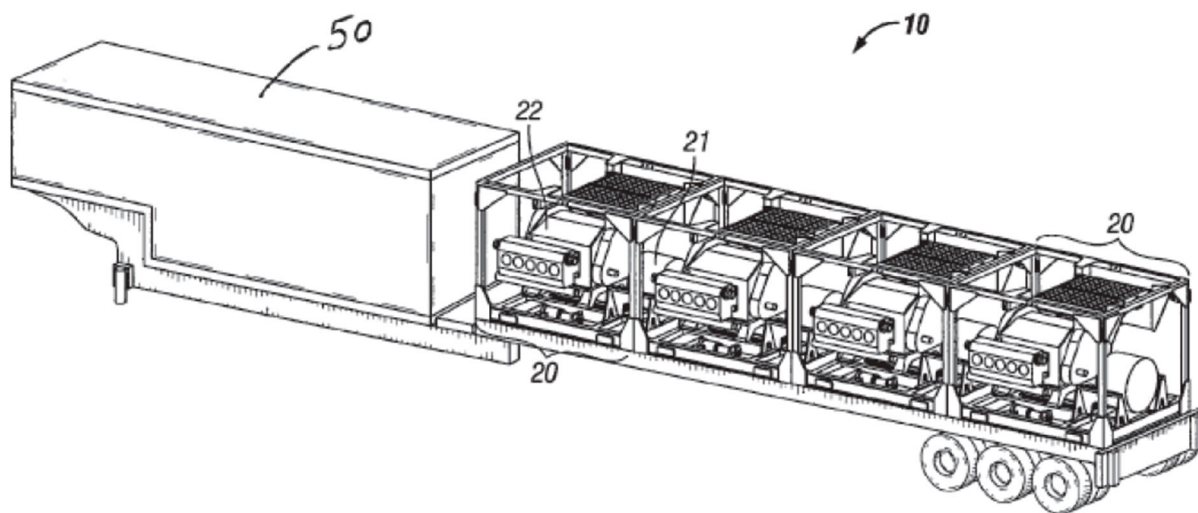


FIG. 3

In particular, Figure 3 is a schematic diagram of trailer 10 housing four fracturing modules 20. EX-1005, [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]. Importantly, Petitioner 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, 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.* Like *Coli*, Petitioner does not contend that Gardner discloses a VFD that performs "electric motor diagnostics" or includes "heat sinks having thermal sensors."

C. *Toshiba Manual* (EX-1006)

Toshiba Manual is an operation manual for a G7 True Torque control Adjustable Speed Drive ("ASD"), EX-1006, 1–2, which Petitioner contends is a VFD. Pet., at 10. *Toshiba Manual*'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." EX-1006, 2. The G7 also includes a "user-friendly Electronic Operator Interface (EOI)" to access "many monitoring and programming features of the G7." *Id.*

The G7's monitoring features include alarms and ASD fault codes displayed on the EOI during the operation of the ASD. See EX-1006, 180–86. Alarms for the

ASD include, for example, communication errors, overheat, and timer. *Id.*, 180. *Toshiba Manual* lists 46 fault codes for the ASD that occur for assorted 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 by Petitioner, and as explained further below, none of the fault codes or alarms disclosed in *Toshiba Manual* satisfy the claimed “*electric motor diagnostics*.”

For example, one such alarm code is “overheat” (*id.*, 180), which is triggered whenever the “ASD ambient temperature is excessive.” *Toshiba Manual* 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 Manual*’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 Manual* includes both a heat sink and thermistor (i.e., temperature sensor), nothing in *Toshiba Manual* describes the thermistor as 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 VFD used in hydraulic fracturing, let alone one that includes “*heat sinks having thermal sensors.*”

E. *Loucks* (EX-1009)

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

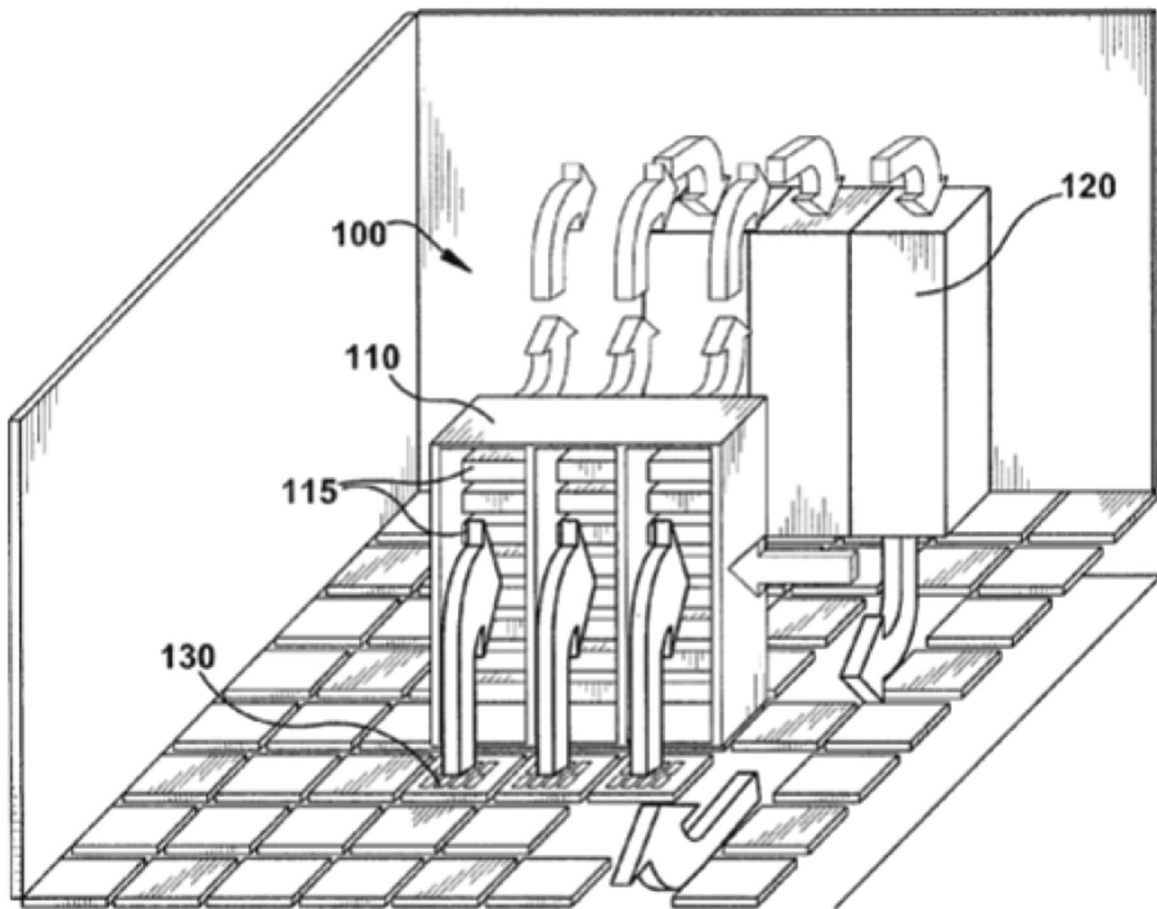


Fig. 1

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, “[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. *Loucks* briefly mentions “a variable frequency drive,” but those drives have many different uses beyond those for an electric pump motor. As explained below, *Loucks* discloses neither “electric motor diagnostics” nor a VFD including a “heat sink having thermal sensors,” *see* §VI.B.

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. *Id.* Petitioner does not, however, contend that *Vliet* discloses a VFD that performs “electric motor diagnostics” or includes “heat sinks having thermal sensors.”

IV. SKILL LEVEL OF A POSITA

Patent Owner applies the same definition of a POSITA proposed by the Petitioner. *See* Pet., at 20. Dr. Michael Nikolaou qualifies as a POSITA based on this skill level. *See* EX-2002, ¶¶ 4-18; EX-2004.

V. CLAIM CONSTRUCTION

Petitioner has not proposed any construction for the terms of the '870 Patent. Pet., at 20–21.

In light of the Board's assertion that Patent Owner is advancing an “implicit claim construction of the term ‘electric motor diagnostics’ that would require the

VFD to interrogate the motor itself in order to perform the diagnostics,” an express claim construction for the term “*electric motor diagnostics*” would be beneficial. *See* Dec., 19. In view of the specification and file history, the phrase “*electric motor diagnostics*” means “diagnostics for an electric motor alone.” EX-2002, ¶ 38.

To clarify, Patent Owner does not contend that “*electric motor diagnostics*” necessarily requires the VFD to interrogate the motor itself to perform the diagnostics (although that is one possible way to perform “*electric motor diagnostics*”). Rather, Patent Owner disputes that “*electric motor diagnostics*” can encompass “*diagnostics*” of anything other than the “*electric motor*.” The prefix “*electric motor*” must necessarily limit the claimed “*diagnostics*”—any construction failing to do so would effectively eliminate the term “*electric motor*” from “*electric motor diagnostics*” and therefore be unreasonable.

In addition, both experts agree that “*electric motor*” limits the claimed “*diagnostics*.” For example, Dr. Durham explained the following at his deposition:

Q: The terms electric motor in front of diagnostic,. . . how does that limit the claim?

A: It limits by saying the variable[] frequency drive has to perform a diagnostics or analysis on the electric motor detecting a problem with the electric motor at least.

EX-2003, 35:10–15. Dr. Nikolaou also agrees that the “*diagnostics*” are limited by the phrase “*electric motor*.” EX-2002, ¶ 39.

VI. PETITIONER FAILS TO SHOW THAT CLAIM 7-16 ARE UNPATENTABLE BECAUSE NONE OF THE PRIOR ART DISCLOSES “A VARIABLE FREQUENCY DRIVE” “HAVING HEAT SINKS HAVING THERMAL SENSORS”

Claim 7 recites “*a variable frequency drive. . . having one or more power semiconductor heat sinks having thermal sensors.*” EX-1001, claim 7. Initially, Petitioner concedes that its principal prior art *Coli* does not satisfy this limitation of claim 7, *see* Pet., at 36–37, so it instead relies on two references which, as demonstrated below, also do not disclose it.

The first reference Petitioner relies on is the *Toshiba Manual*. Petitioner points to *Toshiba Manual*'s internal thermistor to satisfy the claimed “*thermal sensor.*” Pet., 11. But, as Patent Owner explained in its Preliminary Response, although *Toshiba Manual* discloses both a thermistor and a heat sink, it does not disclose that the **thermistor is located on the heat sink**. Prelim. Resp. 1–2, 8–9, 12, 15–16, 24–28 (citing EX-1006, 2, 14, 42–43, 180–86, 204) (emphasis added). Of course, Petitioner recognizes this deficiency and attempts to fix it with conclusory testimony from its Expert—to no avail. *See* EX-1002, ¶124. Instead, the Board correctly found that the Petitioner failed to advance sufficient evidence to disclose “*semiconductor heat sinks having thermal sensors,*” Dec., 25, and should so find the same here again.

Petitioner also relies on *Loucks* to assert that the claimed “*variable frequency drive. . . having one or more power semiconductor heat sinks having thermal sensors*” is obvious. But *Loucks* has the same fatal deficiency as *Toshiba*: it separately discloses a VFD and a “power electronics heat sink temperature sensor 510,” **but does not disclose that the VFD includes such a sensor** as the claim requires. Moreover, as Petitioner's Expert Dr. Durham admits, *Loucks*'s cooling efficiency monitoring technique does not even use heat sink thermal sensors or alarm limits. EX-2003, 65:4–20; *see id.*, 59:8–15 (admitting that Figure 2 illustrates *Loucks*'s cooling efficiency monitoring technique). Thus, a VFD having “*semiconductor heat sinks having thermal sensors*” cannot be rendered obvious by “employ[ing] *Loucks*'s cooling efficiency monitoring techniques to ‘detect problems’ with *Coli*'s VFD,” Pet., at 54, as Petitioner contends.

A. Ground 1 is Deficient Because Petitioner Fails to Demonstrate that *Toshiba Manual* Discloses a VFD That Includes a Heat Sink Having Thermal Sensors.

The Board correctly determined that the Petitioner fails to show that *Toshiba Manual* discloses that its VFD includes “*heat sinks having thermal sensors*” as required by claim 7 (emphasis added). *See* Dec., 26. Although Patent Owner does not dispute that *Toshiba Manual* includes a heat sink and an internal thermistor, Petitioner identifies no evidence that *Toshiba*'s thermistor is located on the heat sink. Instead, it cites only Dr. Durham's conclusory testimony in asserting that the heat

sinks “would necessarily have sensors (e.g., thermistors) to report the temperature measurements.” Pet., at 37–38 (citing EX-1002, ¶186). The Board considered this argument at Institution and correctly determined that the Petition insufficiently fails to demonstrate Toshiba “associates its heat sinks with its thermal sensors.” Dec. at 26 (“Thus, based on the present record, Petitioner’s assertion that Toshiba Manual inherently associates its heat sinks with its thermal sensors is not supported by the evidence.”) For the reasons explained below, the Board should not depart from its decision.

Claim 7 requires that the claimed VFD has “*one or more power semiconductor heat sinks having thermal sensors[.]*” EX-1001, claim 7. But the *Toshiba Manual* disclosures relied on by Petitioner never explain that the internal thermistor is located on the heat sink as required by the claim. At best, Dr. Nikolaou explains that the *Toshiba Manual* discloses that its ASD [VFD] separately 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”). EX-2002, ¶¶ 64-65. However, nothing in *Toshiba Manual*, however, shows that the internal thermistor is located on the heat sink, as the claim requires (i.e., “one or more power semiconductor heat sinks having thermal sensors.”). EX-2002, ¶ 64-65.

Attempting to close this evidentiary gap, Petitioner 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, does not support that testimony with underlying evidence that *Toshiba*’s thermal sensor would necessarily be placed on the heat sink—instead, he merely concludes—without more—that it must be 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.”); *Continental Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1269 (Fed.Cir.1991) (“Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.”); *In re Buchner*, 929 F.2d 660, 661, (Fed. Cir. 1991) (Stating that an “expert’s opinion on [an] ultimate legal conclusion must be supported by something more than a conclusory statement”)

Dr. Durham’s testimony—which lacks any “technical detail, explanation, or statements supporting why” the heatsink would necessarily have sensors—should be given no weight. *TQ Delta, LLC v. CISCO Systems, Inc.*, 942 F.3d 1352, 1359 (Fed. Cir. 2019) (“‘Rejections on obviousness grounds,’ in particular, ‘cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.’”) (citing *KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007); *see also Xerox*

Corp. v. Bytemark, Inc., IPR2022-00624, Paper 12 (on Director Review) at 5 (PTAB February 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.”).

Moreover, Dr. Nikolaou identifies other evidence cited in the Petition expressly contradicts Dr. Durhams’s testimony:

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); EX-2002, ¶ 68. In particular, Dr. Nikolaou explains that a POSITA would have understood that thermal sensors in a system like that described in *Toshiba Manual* may be placed in various other internal locations of an electrical component, not necessarily on the heat sink. EX-2002, ¶ 68. Dr. Nikolaou also explains *Toshiba Manual*’s internal thermistors are used to measure ambient temperature, and the other internal placements identified in Loucks are better situated for doing so than on the heat sink. EX-2002, ¶ 69.

In addition, 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). But 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]; EX-2002, ¶ 69.

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. EX-2002, ¶ 69 (citing, *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.”).

Thus, other locations for *Toshiba Manual'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. EX-2002, ¶ 69.

Accordingly, Petitioner's Grounds 1, 4A, and 5A fail to demonstrate that the prior art discloses "*one or more power semiconductor heat sinks having thermal sensors*" obvious. EX-2002, ¶¶ 64-70.

B. Grounds 3, 4B, and 5B Are Deficient Because the Petitioner Fails to Show that Loucks Discloses a VFD Having "Heat Sinks Having Thermal Sensors Monitored. . . to Prevent Damage Caused By Excessive Heat."

Petitioner also relies on *Loucks* to attempt to render the claim limitation "heat sinks having thermal sensors" obvious. But *Loucks* has the same fatal deficiency as the Toshiba Manual: *Loucks* separately discloses a VFD and a "power electronics heat sink temperature sensor 510," but does not disclose that the VFD includes such a sensor.

Loucks discloses a power electronics heat sink temperature sensor. In describing Figure 5, *see* EX-1009, [0061], *Loucks* explains that its specific exemplary cooling efficiency monitoring system includes multiple temperature sensors, including "a power electronics heat sink temperature sensor 510." EX-1009, [0063]; EX-2002, ¶ 71. But nothing in the description of Figure 5 (or in the figure itself) mentions or illustrates a VFD. *See* EX-1009, [0063], Fig. 5; EX-2002, ¶ 71.

Loucks provides only two disclosures about a VFD, but neither discloses that the VFD includes a heat sink:

As electrical equipment converts electrical energy to heat,
the amount of heat produced will be related to the

electrical energy consumed by the equipment. Certain equipment (such as computers) convert[s] essentially 100% of the electrical energy into heat. Other devices such as transformers, circuit breakers, uninterruptible power supplies (UPSs) or ***variable frequency drives (VFDs)*** are more efficient consumers of electrical energy, a certain percentage of energy consumed is converted into heat.

Id., [0036]

The cooling efficiency techniques and systems described herein may be used on any device that consumes electrical energy and exhausts waste heat. Examples of such devices include: circuit breakers (open or enclosed), fuses and fused switches, ***variable or adjustable frequency drives***, reduced voltage soft starters, uninterruptible power supplies, transformers, electrical assemblies and structures including switchboards, switchgear and motor control centers and components such as switched mode power supplies providing power to servers, networking equipment, programmable logic controllers, storage devices, and telephone systems.

Id., [0060] (emphasis added). Accordingly, Loucks does not disclose a “*variable frequency drive. . . having one or more power semiconductor heat sinks having thermal sensors.*” EX-2002, ¶¶ 71-72.

Nevertheless, even assuming that Loucks discloses a VFD “*having one or more power semiconductor heat sinks having thermal sensors,*” those thermal sensors are not “*monitored by a microprocessor to prevent damage caused by excessive heat*” as the claim requires. EX-2002, ¶¶ 73-74. For example, Petitioner relies on Louck’s high temperature limits and alarms described in paragraph 18 for

this limitation. But, Petitioner's Expert Dr. Durham, admitted under cross-examination that *Loucks* high temperature limits and alarms are not part of its "cooling efficiency monitoring technique" as shown in Figure 2 and incorporated into its VFD:

Q: Okay. So the alarm limits and a high temperature limit described in paragraph 18 [of *Loucks*] are not the same limits or are even disclosed in Figure 2 of *Loucks*. Is that correct?

A: They're completely different. They're complete[ly] different units. You can't compare temperature alarm limits to the baseline minus operating greater than threshold in Figure 2. They're just different.

Q: And when you say they're different, is it because the units that they measure are temperature units and degrees of Celsius or Fahrenheit? Is that correct?

A: Temperature limits would be more likely than not a degree measurement. Nothing in Figure 2 is in units of degrees.

EX-2003, 65:4–20; *see id.*, 59:8–15 (admitting that Figure 2 illustrates *Loucks*'s cooling efficiency monitoring technique). Because the high temperature limits or alarms are not incorporated in *Loucks*'s VFDs, this is an additional reason that the Petition fails to provide any evidence that *Loucks* discloses 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." EX-2002, ¶¶ 73-75; EX-1009, [0018], [0048]-[0049].

Accordingly, the combination of *Coli* and *Loucks* also does not disclose this limitation. EX-2002, ¶¶ 71-75.

VII. GROUNDS 1 AND 3-5 ARE DEFICIENT BECAUSE THE PETITIONER FAILS TO DEMONSTRATE THAT A POSITA WOULD HAVE COMBINED THE PRIOR ART

The rationales advanced in the Petition for combining the prior art are deficient. When considering Dr. Durham's testimony along with other passages from Petitioner's exhibits, the prior art cannot be combined as proposed in the Petition, or it otherwise teaches away. The Board's previous decision (EX-1048) on relevant claims cited by Petitioner also supports that claims 7-16 are non-obvious, as explained below. *See* EX-1048 at 45–49.

A. Grounds 1, 4A, and 5A are Deficient Because the Petitioner's Proposed Combinations of *Coli* and *Toshiba* are Flawed

The Petitioner presents two different combinations for how a POSITA would have modified the system in *Coli* using the VFD described in the *Toshiba Manual*: (1) “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*,” Pet., 25 and 31, or (2) “a POSITA would have been motivated to enhance the VFD of *Coli* with the diagnostic and temperature monitoring functionality described in the *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 CFD in *Toshiba Manual*) to predictably improve a similar system (i.e., the VFD of *Coli*) in the same way,” Pet., 25 and 31. As demonstrated below, neither of these combinations have merit.

1. Dr. Durham admitted that a POSITA cannot simply substitute *Coli*'s VFD for *Toshiba Manual*'s VFD.

With respect to the motivation underlying its first combination, *see* Pet., at 25, 31, Petitioner relies on the following testimony from Dr. Durham: “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. This cited paragraph cites no evidence nor provides any explanation, so it should be given no weight. *TQ Delta, LLC v. CISCO Systems, Inc.*, 942 F.3d 1352, 1359 (Fed. Cir. 2019); *see also Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 12 (on Director Review) at 5 (PTAB February 10, 2023).

In addition, during his deposition, Dr. Durham admitted that a POSITA could not simply substitute *Coli*'s VFD for the VFD described in the *Toshiba Manual*. Toshiba's VFD lacks the necessary horsepower requirements for *Coli*'s pump—that is, a “true 2500 hp” to each pump. EX-2002, ¶¶ 78-81; EX-1047, 1

(stating *Toshiba Manual's* VFD has maximum continuous power of 800 hp); EX-1005, [0049] (stating *Coli's* “present system can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.”); *see* EX-1001, Claims 14–15; *see* EX-2003, 88:4–89:3 (explaining maximum horsepower of single *Toshiba Manual* VFD can be up to 1040 horsepower.). Indeed, Dr. Durham admitted as much:

Q: So the example provided in *Coli* that requires the present system to deliver a true 2500 horsepower directly to each pump could not be used with a single *Toshiba Manual* GX7 described in Exhibit 1006 and 1047. Is that correct?

A: Yes, that specific embodiment and limited the GX7 to a single one as specified in 1047 and 1006, they would not work.

EX-2003, 89:13–20. Consequently, the Petitioner's proposed substitution of the VFD of *Coli* with the underpowered VFD described in *Toshiba Manual* “would not work,” EX-2003, 89:13–20, without affecting other functionalities of *Coli*, like “deliver[ing] a true 2500 hp directly to each pump,” EX-1005, [0049]. EX-2002, ¶¶ 80-81.

In fact, *Toshiba Manual* warns against using its VFD to power a pump requiring 2400 horsepower like the one disclosed in *Coli*: “[d]o not use an ASD with a motor that has a power rating that is higher than the rated output of the ASD.” EX-1006 at 24. Dr. Nikolaou confirms that such a warning would teach

against using *Toshiba Manual's* VFD with *Coli's* pump. EX-2002, ¶ 83. When asked about *Toshiba's* warning, Dr. Durham continually answered that he would need additional information or data to answer the questions about combining *Coli* and *Toshiba Manual*:

Q: The sentence that reads, "Do not use an ASD with a motor that has a power rating that is higher than the rated output of the ASD."

To deliver 2400 true horsepower to a pump as mentioned in paragraph 49 of *Coli*, would you need a motor that has a power rating higher than the rated output of the Toshiba GX7 ASD described in Exhibit 1006?

A: No, I don't believe so. That's something I would want to talk to Toshiba about.

Q: So you could use a motor providing 2400 true horsepower with a Toshiba GX7, with a single GX7 ASD. Is that correct?

A: We don't have enough data to answer your question the way you asked it.

Q: Let's turn back to paragraph 155 [of your declaration]. Do you have enough data to determine whether a POSITA would have been motivated to simply substitute the VFD in *Coli* for a single VFD of Toshiba in the *Toshiba Manual*?

A: No.

EX-2003, 92:7–93:8. Given this warning in *Toshiba Manual*, a POSITA would have understood that the *Toshiba Manual* teaches away from simply substituting the VFD of *Coli* for the VFD of *Toshiba Manual*. EX-2002, ¶ 84. *Allergan, Inc. v. Sandoz Inc.*, 796 F.3d 1293, 1305 (Fed. Cir. 2015) (Prior art teaches away when “a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.”) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)).

Dr. Durham's admissions, Dr. Nikolaou's testimony, and the *Toshiba Manual's* warning all support that a POSITA would not have been motivated to simply substitute the VFD of *Coli* for the VFD of *Toshiba Manual*. EX-2002, ¶¶ 77-85.

2. Dr. Durham's Remaining Motivations to Combine *Coli* and *Toshiba Manual* are Conclusory and Should Be Given No Weight.

With respect to the motivation underlying its second combination, *see* Pet., at 25, 31, Petitioner also relied on the following testimony from Dr. Durham:

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 EX-1006 at 182-85 (Table 12, listing trips from diagnostics). The results of the combination would have been predictable and obvious to a POSITA.

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 IGBT power electronics. The results of the combination would have been predictable and obvious to a POSITA.

Alternatively, a POSITA would have been motivated to enhance the VFD of Coli with the diagnostic and temperature monitoring/protection functionality of Toshiba Manual because such an improvement represents the mere application of a known technique (i.e., the fault detection and temperature monitoring/protection including heat sinks of Toshiba Manual) to predictably improve a similar system (i.e., the VFD of Coli) in the same way.

EX-1002, ¶¶153–54, 156. But paragraph 153 cites only two pieces of evidence that, at best, faults prevent damage to the VFD—not the “electric motor” are required by the claim. EX-1006, 182 (“Trip is a safety feature that disables the ASD system in the event that a subsystem of the ASD is malfunctioning.”); EX-2002, ¶ 87. Consequently, none of the cited evidence shows how faults that “prevent damage to the electric motor” like Dr. Durham contends. EX-2002, ¶ 87. Dr. Durham’s declaration provides no additional explanation. Paragraphs 154 and 156 cite no evidence nor provides any explanation.

Further, and as the Board noted at institution for claim 7, the statements above are contradicted by the fact that the Petition failed to provide evidence showing that *Toshiba Manual's* thermal sensor is located on the “heat sink.” Dec. at 26 (“based on the present record, we find that *Toshiba Manual* does not specify a particular location within the VFD for the thermal sensors to be located.”), Pet., at 37–38 (“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 (stating the same without evidence).

For the above reasons, these remaining motivations to combine the prior art are insufficient by being unsupported by any evidence. *See Xerox*, IPR2022-00624, Paper 12 at 5 (PTAB February 10, 2023) (precedential); *see also InfoBionic, Inc. v. Braemer Mfg., LLC*, IPR2015-01704, Paper 11 at 6, 13 (PTAB February 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 making conclusory statements, Dr. Durham’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 September 23, 2014) (“Merely repeating an argument from the Petition in the declaration of a proposed expert does not give that argument enhanced probative value.”); EX-2002, ¶¶ 86-89.

B. Grounds 3, 4B and 5B are Deficient Because The Petition failed to show a POSITA Would Have Combined *Coli* and *Loucks*

The Petitioner's proposed combination of *Coli* and *Loucks* fails for three reasons. First, *Loucks* is not analogous art and thus a POSITA would not have considered it as prior art in combination with *Coli*. Second, *Coli* teaches away from the proposed combination and the Petition's proposed rationales fail to overcome this fact. Third, the Board's previous IPR decision cited by Petitioner supports the non-obviousness of claim 7.

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). In fact, Petitioner 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). The field of endeavor for the '870 Patent is hydraulic fracturing. *See* EX-1001, 1:23–26; *see also* Pet., at 4 (“The '870 Patent relates to hydraulic fracturing operations.”). As shown below, *Loucks* is not analogous art because it is not in the same field of endeavor as the challenged patent. Thus, Petitioner has not established that a POSITA would have sufficient

reason to combine the teachings of *Loucks* with any other cited reference. Consequently, Petitioner has not proved by a preponderance of the evidence that the challenged claims would have been obvious over any combination of prior art relying on *Loucks*. *In re Nat. Alternatives, LLC*, 659 F. App'x 608, 614 (Fed. Cir. 2016) (reversing PTAB for failing to explain why a person of ordinary skill in the art would have found the prior art to be reasonably pertinent to the problem with which the inventor was concerned).

1. *Loucks* is Not Analogous Art to the Claimed Invention.

In its Institution Decision, the Board correctly determined that *Loucks* fails the first prong of the *In re Bigio* test by not being in the same field of endeavor as the challenged Patent. Dec. 41 (“Nonetheless, this is not the same field of endeavor as the ’870 patent, so we conclude the first prong of the Bigio test is not satisfied, based on the present record.”). *Loucks* is 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; EX-2002, ¶ 100.

Regarding the second prong, Petitioner fails to identify any problem addressed by the inventors of the ’870 Patent, let alone provide an explanation of how such

problem is addressed by *Loucks*. Pet., at 14–15, 51–57. Accordingly, Petitioner has presented no evidence or argument for how *Loucks* is analogous art to the challenged Patent. *Sanofi-Aventis Deutschland GmbH v. Mylan Pharms. Inc.*, 66 F.4th 1373, 1380 (Fed. Cir. 2023) (remanding to the PTAB for determining a prior reference was analogous when Petitioner made such an argument).

Despite no contrary evidence from Petitioner, the Board disagreed with Patent Owner's characterization that the '870 Patent is drawn only to "the problems associated with diesel pumps," which are addressed by using a "pump system for hydraulic fracturing fluid" that includes a VFD and electric motor. EX-1001, 1:23–26; 1:44–54. This problem, however, is the only problem identified by the inventors of the 870 patent. EX-1002, ¶40 (citing EX-1001, 1:52–54; 1:25–26); EX-2002, ¶ 101. Dr. Nikolaou also explains that any additional problem would be limited to those problems when implementing a portable VFD. *See* EX-1001, Fig. 1, 1:40–51, 3:38–63; EX-2002, ¶ 101.

Loucks is not reasonably pertinent to either problem described above. EX-2002, ¶ 102. *Loucks* addresses the problem of detecting cooling problems in the environment in room and/or data centers. EX-1009, [0018]; [0024]; [0026]. Because *Loucks* does not describe any portable equipment, Dr. Nikolaou explains that that an inventor considering the problem addressed in the '870 patent would not be motivated to turn to *Loucks*, particularly given that *Loucks* addresses a

fundamentally different problem—detecting cooling problems in an environment for room containing electrical equipment, such as server IT equipment—than the problem addressed in the '870 Patent (problems associated with portable VFDs or problems associated with VFDs and electric motors replacing portable diesel-powered pumps). EX-2002, ¶ 102. As Dr. Nikolaou explains, an inventor considering these problems addressed in the '870 patent would not be motivated to turn to *Loucks*, especially given it is directed to adjusting the environment in a room with electrical equipment without any mention of mobile electrical equipment. EX-2002, ¶ 102.

In its Institution Decision, the Board incorrectly reached the conclusion that “*Loucks* is reasonably pertinent to those problems, because it discusses the need to cool VFDs, and provides a method for doing so.” Dec. at 42. The Board's only nexus between the problem it defined and *Coli*'s disclosures is that *Coli* includes a VFD—nothing more. See Dec. at 42 (citing EX-1001, 1:24–26, 1:52–54, 2:5–7, 2:21–22, 4:8–25). Using a VFD is insufficient to show prior art is analogous given VFDs are ubiquitous. EX-2003, 10:13–11:1 (“You almost can't buy an appliance anymore without a direct drive variable frequency drive on it,” such as “washers, dryers, refrigerators, freezers, air conditioners, pool pumps.”); *id.*, 7:16–13:8 (explaining various uses of VFDs). Nothing in these disclosures, however, mentions that the VFD needs to be cooled. “Even if a reference is analogous to one problem

considered in another reference,” such as cooling electronics in *Loucks*, “it does not necessarily follow that the reference would be analogous to the problems of the challenged patent.” *Sanofi-Aventis Deutschland GmbH v. Mylan Pharms. Inc.*, 66 F.4th 1373, 1378 (Fed. Cir. 2023).

Notably, the '870 Patent's only mention of temperature is that VFD needs to be monitored against “excessive heat” —not to be kept cool. EX-1001, 4:10–16. Other disclosures in the '870 Patent describe the extreme temperature conditions that these pumping systems operate in: “electric motors 14 of the present technology can include class H insulation and high temperature ratings, such as about 375 degrees F. or more.” EX 1001, 4:1–3. *Coli* likewise explains that electric pumps “significantly” reduce “the need for cooling systems.” EX-1005, [0039]. Based on these disclosures, nothing in the '870 Patent would have conveyed to a POSITA that the VFDs described in the '870 Patent (or *Coli*) need to be cooled.

Accordingly, the only evidence of record conclusively demonstrates that *Loucks* is non-analogous art. EX-2002, ¶¶ 100-102.

2. Petitioner's Reasons to Combine *Coli* and *Loucks* are Flawed.

Notwithstanding the fact that *Loucks* is non-analogous art, the Petitioner also fails to show that a POSITA would have combined *Coli* and *Loucks* to arrive at the invention of claim 7. In fact, *Coli* teaches away from using implementing a cooling system, like that described in *Loucks*, in its system. EX-2002, ¶¶ 94-95.

Specifically, *Coli* explains that “by removing diesel prime movers, all associated machinery necessary for power transfer can be eliminated, such as the transmission, torque converter, clutch, drive shaft, hydraulic system, etc. . . ., and ***the need for cooling systems***, including circulating pumps and fluids, ***is significantly reduced.***” EX-1005, [0039]. As Dr. Nikolaou explains, this disclosure would persuade a POSITA to not modify *Coli* to incorporate *Loucks*’s cooling efficiency monitoring system because such a combination would require a larger on-site footprint and more infrastructure, which *Coli* warns against. EX-2002, ¶ 95; see EX-1005, [0039]; *Allergan, Inc. v. Sandoz Inc.*, 796 F.3d 1293, 1305 (Fed. Cir. 2015). Because *Coli* teaches away from adding a cooling system, a POSITA would not modify *Coli* to incorporate *Loucks*’s heat sinks and associated temperature sensors to arrive at the claimed invention of the ’870 Patent. EX-2002, ¶ 95

Ignoring this express warning in *Coli*, Petitioner presents effectively two different proposed combinations about how a POSITA would combine *Coli* and *Loucks*: (1) adding power semiconductor heat sinks and associated temperature sensors to the VFD of *Coli* and (2) employed the cooling efficiency monitoring technique (or thermal management technique) of *Loucks* to enhance the VFD of *Coli*. Pet., at 51–55 (citing EX-1002, ¶¶232–237). Both are similarly flawed.

First, *Loucks* does not disclose that the “power semiconductor heat sink temperature sensor 510” is, as claim 7 requires, “*monitored by a microprocessor to prevent damage caused by excessive heat.*” Rather, *Loucks* discloses this temperature sensor, among numerous other temperature sensors, are used in its cooling efficiency monitor system to “calculate the cooling efficiency indicator:”

Multiple temperature sensors are utilized, including a breaker trip unit temperature sensor 530, a power electronics heat sink temperature sensor 510, and a microprocessor temperature sensor 520 that are installed within the enclosure, as well as an ambient temperature sensor 540. ***Each temperature sensor within the enclosure is matched with an ambient sensor external to the enclosure and this, along with the kW input to the enclosure can be used to calculate the cooling efficiency indicator.***

EX-1009, [0063] (emphasis added). The cooling efficiency indicator is not the “alarm” or “high temperature limit” mentioned in *Coli* that “may result in equipment damage” if reached. *See id.*, [0018]. Consequently, *Loucks* has no disclosure that the “power semiconductor heat sink temperature sensor 510” are used to monitor a high temperature limit, especially given that *Loucks* discloses multiple other temperature sensors. EX-2002, ¶ 91. Without doing so, the proposed combination of *Coli* and *Loucks* does not teach “one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat.” EX-2002, ¶ 91.

Second, Petitioner's proposed combination of employing the thermal management techniques of *Loucks* in the VFD of *Coli* is similarly flawed. EX-2002, ¶ 92. Dr. Durham admitted that the both the "alarm" or "high temperature limit" are not included in *Loucks*'s cooling efficiency monitoring technique:

Q: Okay. So the alarm limits and a high temperature limit described in paragraph 18 [of *Loucks*] are not the same limits or are even disclosed in Figure 2 of *Loucks*. Is that correct?

A: They're completely different. They're complete[ly] different units. You can't compare temperature alarm limits to the baseline minus operating greater than threshold in Figure 2. They're just different.

Q: And when you say they're different, is it because the units that they measure are temperature units and degrees of Celsius or Fahrenheit? Is that correct?

A: Temperature limits would be more likely than not a degree measurement. Nothing in Figure 2 is in units of degrees.

EX-2003, 65:4–20; *see id.*, 59:8–15 (admitting that Figure 2 illustrates *Loucks*'s cooling efficiency monitoring technique). Consequently, Petitioner's proposed combination would not include either of *Loucks*'s alarm or high temperature limit by using *Loucks*'s cooling efficiency monitoring technique in *Coli*'s VFD. EX-2002, ¶ 92. Without these alarms or limits, the Petition's combination of *Loucks* and *Coli* does not include an alarm 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.” EX-1009, [0018]; EX-2002, ¶ 92. Thus, the proposed combination of *Coli* and *Loucks* fails to render the claim obvious.

For the above reasons, the proposed combination of *Coli* and *Loucks* does not render obvious “one or more power semiconductor heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat.” EX-2002, ¶¶ 90-93

3. The Petitioner's Citations to Other IPRs Undermine Its Obviousness Argument about a VFD Having Heat Sink Having Thermal Sensors

Petitioner cites the Board's Final Written Decision in *Halliburton Energy Services, Inc. v. U.S. Well Services, LLC*, IPR2021-01033, Paper 41 at 23–29 (PTAB January 4, 2023), as supporting Petitioner's unpatentability theory in the present proceeding. *See* Pet., at 36 (citing EX-1048); *see also* Dec. at 27. But that decision actually undermines Petitioner's challenge that the claims are obvious.

The Board's Final Written Decision in IPR2021-01033 supports how claim 7 is not obvious over the *Coli* and *Loucks*. The Board found that Petitioner failed to show claim 16 was unpatentable over four prior art references, including *Coli*. EX-1048 at 77–78. Claim 16 recited the same limitation at issue in this case: “wherein the variable frequency drive includes power semiconductor heat sinks having one or more thermal sensors monitored by a microprocessor to prevent semiconductor damage caused by excessive heat.” EX-1048 at 45. Like Petitioner did with *Loucks's*

cooling efficiency monitoring technique, shown above §VI.B, the Board found that “Petitioner [did] not explain how such coolers necessarily include the use of a refrigerant or how any such refrigerant would be used with the variable frequency drives” in *Coli*, EX-1048, 48, especially given that *Coli* teaches away from using a cooling system. EX-1005, [0039]. Because of this failure, the Board should reach a similar decision in this case as it did in IPR2021-01033: conclude that Petitioner has not shown by a preponderance of the evidence, that the limitations of the challenged claims are disclosed or rendered obvious by the combination of the prior art.

VIII. THE PETITIONER FAILS TO SHOW CLAIMS 1-6 ARE UNPATENTABLE BECAUSE THE PETITION FAILED TO RENDER OBVIOUS “ELECTRIC MOTOR DIAGNOSTICS

The Petitioner acknowledges that *Coli* does not disclose this limitation, and instead relies on *Toshiba Manual* and *Horikoshi* to render obvious “*electric motor diagnostics*.” Both references fail to do so.

For the *Toshiba Manual*, Petitioner's expert testimony provides no explanation of how certain VFD faults satisfy the claimed “*electric motor diagnostics*.” And yet, in its Institution Decision, the Board articulated a theory regarding how *Toshiba Manual* satisfies the claimed “*electric motor diagnostics*” that the Petitioner never made. When considering the unpatentability theory actually advanced by Petitioner, the record fails to demonstrate that the *Toshiba Manual* reference discloses “*electric motor diagnostics*.”

For Horikoshi, the Board never considered that it discloses only a single, “*electric motor diagnostic*.” Because the claims require multiple “*diagnostics*,” *Horikoshi* also fails to render this claim obvious.

A. Grounds 1, 4A, and 5A are Deficient Because the Petitioner Fails to Show How the Prior Art Discloses “*Electronic Motor Diagnostics*”

The Petitioner advances only two “arguments” to address how *Toshiba Manual* discloses “*electric motor diagnostics*”¹:

- *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. Pet., at 22 citing EX-1006 at 19, 22, 160–163, 165, 180; EX-1002, ¶¶117, 150.

¹ The Petitioner appears to contend in the second sentence that a subset of these electric motor diagnostics “prevent various types of damage to the electric motor,” which is required by the claim—that is, “*electric motor diagnostics to prevent damage to the electric motor*.” Regardless of whether Petitioner’s theory included all examples from *Toshiba Manual* or a subset of examples, no explanation is provided.

- *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, [sic] short circuit, and earth faults. Pet., at 31 *citing* EX-1007 at 162; EX-1002, ¶¶117, 150, 166.

Neither “argument” provides any explanation of how these disclosures satisfy an “*electric motor diagnostic*.” 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. For example, paragraph ¶117 from Dr. Durham’s declaration simply lists the exemplary “faults” without explanation:

- Overload protection (EX-1006 at 19)
- Over-current protection (EX-1006 at 22)
- Electronic Thermal Protection (EX-1006 at 160)
- Overcurrent Stall Level (EX-1006 at 160)
- Motor 150% OL Time Limit (EX-1006 at 161)
- Short Circuit Test (EX-1006 at 162)
- Overtorque trip (EX-1006 at 163)
- Earth Fault Trip (EX-1006 at 166)

EX-1002, ¶117. This lack of technical detail and explanation is insufficient to show *Toshiba Manual* discloses “electric motor diagnostics.” 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”). Without any explanation, 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.”). *Toshiba Manual’s* VFD fault conditions represent faults in the VFD—not the electric motor. EX-2002, ¶ 58. Consequently, *Toshiba Manual’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); EX-2002, ¶ 58.

Moreover, the intrinsic evidence distinguishes VFD faults from electric motor diagnostics. EX-1001, 2:36–39; 5:42–46 (referring to a “pump VFD fault indicator.”); EX-2002, ¶¶ 51-55. During his deposition, Dr. Durham acknowledged that the claims do not mention VFD faults. EX-2003, 34:2–6 (Q: Did the claims mention variable frequency drive faults A: No, sir. I don’t see VFD faults in the claim language of any of the claims.); *see also id.*, 29:7–18 (agreeing that VFD Fault indicator in the green box in paragraph 116 of his declaration would map to the pump VFD fault indicator in the ’870 patent).

Petitioner merely contends 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, [*sic*] short circuit, and earth faults.” But all of 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)	• 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>

Fault Screen Display	Possible Causes [of Fault]
Overcurrent (EX-1006, 184)	• 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> • Load fluctuations. • <i>ASD is operating at an elevated temperature.</i>
Overtorque (EX-1006, 185)	• 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)	• <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)	• Ground fault at the motor. • <i>Ground fault at the output of the ASD.</i> • <i>Current leakage to Earth Ground.</i>

EX-2002, ¶ 59. Consequently, these VFD faults cannot satisfy the construction that

for “electronic motor diagnostics”: “diagnostics for the electric motor alone.” See

§V above. The Petitioner fails to explain how any of *Toshiba Manual's* VFD faults, listed above, satisfy the claimed “*electric motor diagnostics.*” EX-2002, ¶ 59. 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) (Petitioner failed to show where in the cited reference each claim element was disclosed).

B. The Board's Explanation of *Toshiba Manual's* Overload Protection was Never Presented in the Petition

In its Institution Decision, the Board found:

the Toshiba G7 VFD monitors the electric current being delivered to a motor by the VFD, to determine whether that current exceeds a pre-set percentage of the current rating of the motor, in order to protect the motor from overload. See, e.g., EX-1006, 19, 22, 47, 58, 160. Therefore, the present record supports Petitioner's contention that the Toshiba G7 VFD performs electric motor diagnostics to prevent damage to the motor, as recited in claim 1. See Pet. 10–11, 22, 31–32 (citing, e.g., EX-1006 at pages 19, 22, 160).

Dec. at 19. But, as shown above, Petitioner did not provide any explanation as to how *Toshiba Manual's* overload protection satisfies the claimed “*electronic motor diagnostics.*” The Board cannot “raise, address, and decide unpatentability theories never presented by the petitioner and not supported by record evidence.” *In re Magnum Oil Tools International, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016). Because the Petitioner never provided the explanation described in the Board

decision, such an explanation introduces a different unpatentability theory never addressed by the Petition and that is unsupported by expert testimony. *SAS Institute, Inc. v. Iancu*, 138 S. Ct 1348 at 1356 (“[T]he petitioner’s petition, not the Director’s discretion, is supposed to guide the life of the litigation.”).

C. Ground 2 is Deficient Because Horikoshi Also Fails to Show “*Electronic Motor Diagnostics*”

As the Board concluded at Institution, the claims require “*electric motor diagnostics*” (plural). Dec. at 21 (“We therefore presently conclude that *Toshiba Manual* teaches performance of electric motor diagnostics (plural) as recited in claim 1. *Horikoshi*, however, discloses only a single fault diagnostic for an electric motor. EX-2002, ¶ 61; *see* EX-1008, [0002] (“The present invention relates to a motor driving apparatus having a *fault diagnostic* function.”), [0011] (“Accordingly, it is an object of the present invention to achieve, while minimizing an increase in cost, 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.”). Consequently, the proposed combination *Coli* and *Horikoshi* fails to render obvious the claimed “*electric motor diagnostics*” requiring more than one diagnostic. EX-2002, ¶ 61.

IX. DEPENDENT CLAIMS 13 AND 15-16 ARE NOT UNPATENABLE FOR ADDITIONAL REASONS

In addition to the above reasoning, claims 13 and 15–16 are valid because Petitioner did not show disclosure of additional limitations.

A. Claim 13 Is Valid Because There Is No Express Disclosure of Five Or More Axles

Claim 13 recites “[t]he system of claim 12, wherein the vehicle is a truck having at least five axles.” EX-1001, 8:50–51. Petitioner argues that because *Coli* depicts a trailer 10 with three axles, *Coli* discloses the limitation “wherein the vehicle is a **truck** having at least five axles.” *See* Pet., 41–43; *see also* EX-1001 8:50–51.

1. A “Truck” is distinct from a “Trailer”

Petitioner argues that because a truck pulling the trailer in *Coli* would have at least two axles, “*Coli* discloses a vehicle that is a truck-trailer configuration with a total of 5 axles.” Pet., 42. Unlike Claim 1, Claim 13 does not recite a “*truck-trailer configuration*,” but rather “*wherein the vehicle is a truck having at least five axles*.” EX-1001, 8:50–51 (emphasis added).

“*Truck*” is a claim term in both claim 1 and claim 13. EX-1001, 7:51, 8:51–52. In claim 1, a “*trailer*” is attached to a “*truck*,” which demonstrates those two terms recite are two distinct claim elements. *See Id.*, 7:51. No such trailer is recited in claim 1. *Id.*, 8:51–52. And as Dr. Nikolaou explains, the term “*truck*” has the same meaning in claims 1 and 13. EX-2002, ¶¶104, 107.

However, Dr. Durham contends that “*truck*” has a different meaning in claim 1 than the term has in claim 13. EX-2003, 55:10–56:4 (“Q: Does truck mean something different in Claim 1 than truck means in Claim 13? A: I think it can, yes. Q: So a claim term can have different meanings in different claims? A: Yes.”) (objection omitted). Specifically, Dr. Durham appears to believe that a trailer is read into the word truck because claim 13 is not dependent on claim 1, but rather from claim 7. EX-2003, 53:15–54:2 (“Q: Claim 1 specifically recites a trailer. Is that correct? A: Correct. Q: Okay. Let’s turn to Claim 13. A: Okay. Q: Does Claim 13 recite a trailer? A: I think it – yes, you could read a trailer into the word truck. Claim 13 is not dependent in Claim 1. It depends from Claim 7.”) (objection omitted), 54:9–13 (“Q: What do you mean by a trailer can be part of a truck in Claim 13? A: A tractor trailer is referred to as a truck, and there’s nothing that I recall in the ’870 Patent that excludes that.”)

Dr. Durham’s apparent interpretation of the claim term “*truck*” is contrary to basic principles of claim construction. The same claim term in different claims of the same patent nearly always has the same meaning, with the rare exception of where it is clear that the same phrase has different meanings in different claims, such as with inherently contradictory claim context. *See In re Varma*, 816 F.3d 1352, 1363 (Fed. Cir. 2016) (“the principle that the same phrase in different claims of the same patent should have the same meaning is a strong one, overcome only if “it is

clear” that the same phrase has different meanings in different claims.”) (citing *Fin Control Sys. Pty, Ltd. v. OAM, Inc.*, 265 F.3d 1311, 1318 (Fed. Cir. 2001); see *Digital–Vending Servs. Int’l, LLC v. Univ. of Phoenix, Inc.*, 672 F.3d 1270, 1275 (Fed. Cir. 2012); *American Piledriving Equip., Inc. v. Geoquip, Inc.*, 637 F.3d 1324, 1333 (Fed. Cir. 2011); *PODS, Inc. v. Porta Stor, Inc.*, 484 F.3d 1359, 1366 (Fed. Cir. 2007)); see also *HaemoneticsCorp. v Baxter Healthcare Corp.*, 607 F.3d 776, 782 (Fed. Cir. 2010) (“Haemonetics argues, and the district court concluded, that because the vessel with the tubing is larger than the vessel alone, construing ‘centrifugal unit’ in the context of the dimensional limitations to include the tubing ‘would yield an absurdity.’ Maybe so, but we do not redraft claims to contradict their plain language in order to avoid a nonsensical result”). Given that Dr. Durham incorrectly construed the term “truck” in his analysis, the Petitioner fails to show how *Coli* expressly discloses that the claimed “vehicle is a truck having at least five axles.” EX-2002, ¶¶ 104-106.

2. Petitioner’s Obviousness Rationales are Insufficient

Petitioner also argues that a truck with five axles would have been obvious to a POSITA because a POSITA would have known that the semi-trailer of *Coli* could be permanently attached to the tractor portion of a truck:

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.

Pet., 42. Dr. Durham's declaration parrots the same analysis. EX-1002, ¶¶198–99.

But Evidence of what could be done is not evidence of obviousness. *See Polaris Indus., Inc., v. Arctic Cat, Inc.*, 882 F.3d 1056 at 1069 (Fed. Cir. 2018) (“[T]he Board [incorrectly] focused on what a skilled artisan would have been able to do, rather than what a skilled artisan would have been motivated to do at the time of the invention.”); *see also InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014) (concluding that a party's expert “succumbed to hindsight bias in her obviousness analysis” where such analysis “primarily consisted of conclusory references to her belief that one of ordinary skill in the art **could** combine these references, not that they would have been motivated to do so”). Accordingly, Petitioner fails to demonstrate a “unitary” truck is obvious based on this rationale.

Petitioner also argues that a POSITA would have understood that a truck with five axels is a “simple design choice”—but its only evidence are conclusory statements from its Expert. Pet., 43 (citing EX-1002, ¶200). Dr. Durham's declaration again parrots the Petition without any additional explanation or

evidence. *See* EX-1002, ¶ 200. Accordingly, his testimony should be entitled to no weight, especially given his misunderstanding of the claim term “truck” above. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 12 (on Director Review) at 5 (PTAB Feb. 10, 2023) (precedential); *InfoBionic, Inc. v. Braemer Mfg., LLC*, IPR2015-01704, Paper 11 at 6, 13 (PTAB Feb. 16, 2016). Petitioner's expert testimony here 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).

B. Claim 15 Is Valid Because Petitioner Did Not Show Disclosure Of “Maximum Continuous Power Output”

Claim 15 requires, “*wherein the electric motor has a **maximum continuous power** output of about 1750 brake horsepower or more.*” EX-1001, 8:55–58. Petitioner fails to show *Coli* satisfies the “*maximum continuous power output.*”

Petitioner presents a cursory explanation of how the prior art supposedly discloses claim 15. *See* Pet., at 44. Petitioner's “analysis” constitutes quoting a single disclosure from *Coli* that the motor “can deliver a true 2500 hp directly to each pump 22 because pump 22 is directly coupled to electric motor 21.” *Id.* at 44 (citing EX-1005, [0049]).

Like the Petition, Dr. Durham contends that *Coli* discloses the limitation of claim 15 solely based on this single one sentence. *See* EX-1002, ¶203. The entirety of Dr. Durham's opinion for this claim is as follows:

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.” I further understand that the Board found a substantially similar claim of the '601 Patent to be disclosed by Coli. EX-1048 at 41.

EX-1002, ¶203. But this quote from *Coli* does not disclose the “*maximum continuous power*” of *Coli*'s motor, but rather only the maximum instantaneous power, or peak power. EX-2002, ¶109. The word “*continuous*” is not present in the quoted language, and Dr. Nikolaou explains that there is a significant difference between maximum horsepower and maximum continuous horsepower. EX-2002, ¶109—a critical fact here that Dr. Durham agreed to during his cross-examination:

Q: I would like to turn to the – or draw your attention to the next paragraph. It says, “However, the ASD may be operated at 110 percent of the specified output-current range continuously or at 150 percent for a limited amount of time as indicated.” Is there a difference between running the ASD continuously at a certain amount versus what appears to be its maximum at 150 percent for a limited amount of time?

A: Well, yes.

Q: Can you explain the difference between horsepower and energy?

A: Power is – your horsepower is your instantaneous power that's being used or delivered. Energy is the amount of energy you use over time. They relate to each other by time.

Q: Does an ASD have a maximum current range that's different for continuous operation versus a maximum current range generally?

A: There are, just like motors, this particular ASD has different current ranges for different amount of times.

Q: So would motors have similar limits on how much they could run continuously versus how much they could run as a maximum?

A: Yes.

EX-2003, 42:4–14, 44:9–12, 42:17–43:1 (objection omitted), 44:15–18. These limits are, as Dr. Durham himself explains, functions of input current. *See* EX-2003, 43:19–21 (“it’s i^2t , current squared times time. If you have a higher current, you can only run that higher current for a shorter period of time.”) After explaining how motors have different current limits for continuous and instantaneous use, Dr. Durham admits that the instantaneous horsepower and continuous horsepower would have different values:

“Q: Does an electric motor have a limit on its input current for continuous operation that is different than a limit or a [*sic*] instantaneous or short time period operation? A: Yes, sir, it does. Q: Okay. So using those different limits applied to the same electric motor, would there be a

difference in horsepower at the continuous limit and the limit for a shorter period of time? A: All else being equal, those are likely to be different horsepowers.”

EX-2003, 46:8–18. Indeed, while a maximum continuous power is available for a long period of time, a maximum power is only available for a short period of time. *See* EX-2003, 88:10–16 (“A: We know, for example, in the GX7 that an 800 horsepower GX7 can power a 1200 horsepower pump at least for a period of time. Q: Can it power that pump continuously? A: No. Q: I believe the GX7 mentioned a period of time for about 120 seconds on Exhibit 1047.”); EX1047, 1 (explaining different overload ratings for short time periods and continuous); EX-2002, ¶113.

Accordingly, Petitioner failed to show how Coli discloses “*maximum continuous power output*” as recited in claim 15. EX-2002, ¶¶108-115.

C. Claim 16 Is Valid Because Petitioner Did Not Show Disclosure Of “Maximum Continuous” Torque

Claim 16 recites “*wherein the electric motor has a maximum continuous torque of about 8750 lb-ft or more.*”

As it did for claim 15, Petitioner again presents a cursory argument with little analysis or evidentiary support. *See* Pet., 44–45. For example, for this claim limitation, Petitioner only quotes the disclosure that the motor “can be capable of operation in the range of up to 1500 rpms and up to 20,000 ft/lbs of torque.” *Id.* at 44 (citing EX-1005, [0011]). But nothing in that citation—“up to 20,000 ft/lbs of

torque”—is a disclosure of a maximum continuous torque rather than a maximum torque at an instant. EX-2002, ¶ 118. Further, “up to” 20,000 ft/lbs of torque strongly suggests that this is the maximum torque, not the maximum continuous torque. EX-2002, ¶118. Moreover, Dr. Durham admitted that, like power, torque is a function of input current. EX-2003, 47:10–11 (“Assuming a constant speed and all else being equal, yes, the torque would increase as current increase.”) The sentence cited by Petitioner only addresses maximum torque and says nothing about maximum continuous torque. EX-2002, ¶120.

Accordingly, Petitioner failed to show how *Coli* discloses “*maximum continuous power output*” in claim 16. EX-2002, ¶¶ 116-121.

X. CONCLUSION

For the above reasons, the Board should find each of Patent Owner's claims valid.

Dated: December 1, 2023

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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 11,515 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.

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CERTIFICATE OF SERVICE

I hereby certify that on this 1st day of December, 2023, I caused to be served a true and correct copy of the foregoing "Patent Owner's Response" and accompanying exhibits by electronic mail on the following:

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