UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HALLIBURTON ENERGY SERVICES, INC.

Petitioner

v.

U.S. WELL SERVICES, LLC

Patent Owner

Case No. IPR2023-00558

Patent No. 11,136,870

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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I. INTRODUCTION

Patent Owner ("PO") attacks the Petition by misconstruing the evidence and Petitioner's arguments. None of these tactics refute Petitioner's application of the prior art to the '870 Patent claims.

Regarding claims 1-6, PO continues to advocate an improperly narrow construction of "electric motor diagnostics," which the Board has repeatedly rejected. Having no intrinsic evidence to support it, PO now mischaracterizes expert testimony that rejects PO's construction. PO also mischaracterizes expert testimony regarding how a person of ordinary skill in the art ("POSITA") would combine *Toshiba Manual* with *Coli*. The record confirms what the Board has already found: *Toshiba Manual* and *Horikoshi* disclose "electric motor diagnostics" and would have been obvious to combine with *Coli*.

Regarding claims 7-16, PO focuses on irrelevant strawmen in its attempt to distinguish *Loucks*—mischaracterizing Petitioner's application of *Loucks* to claim 7, limiting *Loucks* to a different field of endeavor, and analogizing *Loucks* to a different reference in another IPR. None of these attacks refute that *Loucks* teaches "heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat," and would have been obvious to combine with *Coli*. Moreover, a POSITA would understand that *Toshiba Manual* discloses "heat sinks having thermal sensors" (*i.e.*, thermal sensors associated with the heat sink).

For these reasons and those in the Petition, claims 1-16 are unpatentable.

II. CLAIM CONSTRUCTION

The Board has already rejected PO's attempt to construe "electric motor diagnostics" to require the variable frequency drive ("VFD") to interrogate the motor. Paper 7 (Institution Decision, "ID"), 10, 19. Even worse, PO's construction—"diagnostics for an electric motor ***alone***"[1]—would require that the electric motor is the ***sole*** target of the diagnostics to the ***exclusion*** of other components. The Board should continue to reject this construction.

PO notably cites no intrinsic evidence to support its construction. Nor could it. The '870 Patent simply states that the VFD can frequently perform electric motor diagnostics to prevent damage to the electric motor if it becomes grounded or shorted. Ex.1001, 2:36-39, 4:20-23. The claim's plain language does not require "electric motor diagnostics" to identify problems only with the electric motor. When the Board evaluated this same term in an IPR on related U.S. Patent No. 8,789,601 ("IPR2021-01033"),[2] the Board determined that "at best," the specification "appears to suggest that the 'electric motor diagnostics' can be performed on any motor component affecting 'drive internal operations.'" Ex.1048, 26.

[1] Paper 11 (PO Response, "POR"), 10-11.

[2] The '601 Patent (Ex.1049) and the '870 Patent share an identical specification.

Without any supporting intrinsic evidence, PO relies on out-of-context extrinsic evidence. PO selectively quotes from Dr. Durham's testimony that "electric motor" limits "diagnostics" because the VFD "has to perform a diagnostics or analysis on the electric motor detecting a problem with the electric motor ***at least***." POR 11, (citing Ex.2003, 35:10-15). PO omits the testimony immediately before and after this quote explaining why diagnostics of other components also fall within the claims' scope (emphasized below):

> Q. And ***do the claimed diagnostics in independent Claims 1 and 4 pertain only to the electric motor***?
>
> A. ***No, sir.***
>
> ***Q. How so?***
>
> ***A. Well, they certainly pertain to the variable frequency drive because the variable frequency drive is what is performing the electric motor diagnostics.***
>
> ***Q. ...Would the electric motor diagnostics be satisfied by diagnostics for the VFD?***
>
> A. Can you explain what you mean by "for the VFD"?
>
> Q. Any diagnostic that is only determined using sensors inside the VFD.
>
> ***A. Yes. The claim language would be satisfied by sensors--by diagnostics using sensors inside the VFD, yes, sir.***
>
> Q. The terms electric motor in front of diagnostic, what do you

think--how does that limit the claim?

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

Q. So would diagnostics unrelated to the electric motor satisfy this claim?

A. It doesn't--the claim does not exclude those. Certainly, if you're doing diagnostics on the electric motor and doing something else, yes, that would be satisfied.

Ex.2003, 34:8-35:22. Dr. Durham opined that "electric motor diagnostics" do not exclude diagnostics on the electric motor ***and*** on something else. *Id.* He rejected PO's construction, and the Board should continue to do the same.

III. CLAIMS 1-6 ARE UNPATENTABLE BECAUSE THE PRIOR ART DISCLOSES "ELECTRIC MOTOR DIAGNOSTICS.

A. *Horikoshi* discloses "electric motor diagnostics".

PO recognizes that *Horikoshi* discloses an electric motor diagnostic with its "fault diagnostic function," even under PO's erroneous construction. Ex.1008, ¶¶2, 11. PO half-heartedly argues that *Horikoshi* does not disclose plural "electric motor diagnostics." POR, 44. But PO fails to clarify what it means by "more than one diagnostic" or how *Horikoshi* fails to disclose it. PO suggests that "electric motor diagnostics" requires multiple different types of diagnostics simply because the word "diagnostics" is plural. But the record does not support this narrow interpretation.

First, the Board already found *Horikoshi* discloses "electric motor diagnostics" in IPR2021-01033, and should do the same here.[3] Ex.1048, 23-29. *Horikoshi* also discloses "plural" "electric motor diagnostics" because it discloses performing its electric motor diagnostic multiple times. *Horikoshi* performs its "fault diagnostic function" "during operation," Ex.1008, ¶11, so *Horikoshi* must perform the fault diagnostic more than once over the life of the VFD, Ex.1002, ¶¶86, 129, 215-217. Dr. Nikolaou agreed. Ex.1054, 255:21-258:9 ("it's another instance of the diagnostic….[T]he output of this diagnostic was one the first day, it was different the second day").

Moreover, claims 1-6 are system claims. *Horikoshi* discloses a VFD that "performs electric motor diagnostics" because it discloses a VFD capable of doing so. Therefore, even if "electric motor diagnostics" refers to plural actions, *Horikoshi* need not describe electric motor diagnostics being performed multiple times. *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990) ("[A]pparatus claims cover what a device *is*, not what a device *does*.").

B. *Toshiba Manual* discloses "electric motor diagnostics".

Toshiba Manual's VFD fault conditions satisfy "electric motor diagnostics." PO primarily disputes this based on its improper construction in §II, *supra*. For

[3] The '601 Patent claims a VFD "frequently performing electric motor diagnostics," Ex.1049, cl.1, which means the diagnostics are performed more than once.

instance, PO argues that *Toshiba Manual*'s faults have possible causes "without any nexus to an electric motor" while ignoring the causes that ***are*** related to the motor. POR, 41-42 (not emphasizing, *e.g.*, "Motor is locked," "Motor/machine jammed," "Ground fault at the motor"). Dr. Nikolaou admits that these faults have causes related to the motor. Ex.1054, 234:6-246:22. In purportedly reproducing *Toshiba Manual*'s disclosure, PO conveniently omits "Motor" from its "***Motor*** Overload" fault. POR 41 ("Overload"); Ex.1006, 184.

PO argues that *Toshiba Manual*'s fault conditions are distinct from the claimed diagnostics because the '870 Patent purportedly distinguishes VFD faults (Ex.1001, 5:42-46) from "electric motor diagnostics" (*id.*, 2:36-39, 4:16-25). POR 41. Nothing in the '870 Patent indicates that VFD faults generally—or those in *Toshiba Manual*—cannot be "electric motor diagnostics". Indeed, Dr. Nikolaou confirmed that the same "pump control and data monitoring equipment" that shows VFD faults is "at least part of" the same equipment that "monitor[s] and protect[s] drive internal operations," *e.g.*, by performing electric motor diagnostics. Ex.1054, 30:4-13; Ex.1001, 4:16-20. Dr. Durham only confirmed that VFD faults are not specifically claimed in the '870 Patent, not that "electric motor diagnostics" exclude them. Ex.2003, 34:2-6.

PO also argues that Dr. Durham's testimony identifying "electric motor diagnostics" is conclusory. POR 38-40. PO ignores Dr. Durham's explanation of

how *Toshiba Manual*'s VFD faults are electric motor diagnostics. As Dr. Durham stated, "*Toshiba Manual* expressly discloses that the Electronic Operator Interface [] 'may be used to monitor system functions, input data into the system, or ***perform diagnostics***.'" Ex.1002, ¶117. He lists several examples of these diagnostics, including overload and over-current protection, and the possible causes of each fault relating to preventing damage to an electric motor. *Id.*, ¶¶117-119, 150, 166. Dr. Durham's testimony cannot be conclusory when he cites and explains numerous disclosures from *Toshiba Manual* to support his opinion. *Id.* (citing Ex.1006, 19, 22, 160-63, 166-68, 179, 182-86); *TQ Delta, LLC v. CISCO Sys., Inc.*, 942 F.3d 1352, 1361-62 (Fed. Cir. 2019).

Finally, PO argues that the Board's preliminary finding that *Toshiba Manual* discloses "electric motor diagnostics" was not presented in the Petition. POR 43-44; ID 19. The Board's finding does not raise a new unpatentability theory. Rather, it relies on the same overload (and overcurrent) protection that the Petition raises. ID 19 (citing Paper 1 ("Pet."), 10-11, 22, 31-32). The Board's finding that the Toshiba 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" is supported by the same pages of *Toshiba Manual* that the Petition and Dr. Durham cited. ID 19; Ex.1006, 19, 22, 160; Ex.1002, ¶¶117, 150, 166; Ex.1006, 19 ("The overload current level is

a percentage of the rating of the motor. This function protects the motor from overload.").

IV. A POSITA WOULD HAVE BEEN MOTIVATED TO COMBINE *COLI* AND *TOSHIBA MANUAL*.

A POSITA would have been motivated to combine *Coli* and *Toshiba Manual* for two independent reasons: (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*"; and (2) a POSITA would have been motivated to enhance *Coli*'s VFD with the "diagnostic and temperature monitoring functionality" from *Toshiba Manual* because this improvement applies a known technique to predictably improve a similar system in the same way. Pet. 25, 31-32. PO's responses to each of these reasons fail.

A. A POSITA would have substituted *Coli*'s VFD for *Toshiba Manual*'s VFD.

PO baldly asserts that Dr. Durham's testimony on substituting *Coli*'s VFD for *Toshiba Manual*'s VFD is conclusory. POR 22. But substituting one known element for another is a "textbook" example of "combin[ing] familiar elements according to known methods that do[] no more than yield predictable results." *Agrizap, Inc. v. Woodstream Corp.*, 520 F.3d 1337, 1344 (Fed. Cir. 2008); Ex.1002, ¶32.

PO questioned Dr. Durham about this substitution but again takes his testimony out of context to suggest that *Toshiba Manual*'s VFD would not work with *Coli* based on *Coli*'s horsepower requirements. POR 22-23. Dr. Durham never stated that Toshiba's VFD lacks the necessary horsepower for *Coli*'s pump. Instead, PO asked whether a ***single*** Toshiba VFD (having up to 1040 hp) is compatible with one example of a 2500-hp pump in *Coli*. But neither *Coli* nor the '870 Patent requires using only a ***single*** VFD, and PO's attempt to require a one-for-one substitution imposes an improper bodily incorporation requirement. *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012). A POSITA would understand how to combine the references' teachings without focusing on whether a single Toshiba VFD could be used with *Coli*'s 2500-hp pump. And a POSITA would understand how to run multiple Toshiba VFDs in parallel to achieve the desired horsepower. Ex.2003, 93:4-10, 100:13-102:16; Ex.1002, ¶155. Dr. Nikolaou did not dispute Dr. Durham's testimony on this point. Ex.1054, 126:13-129:6 (Dr. Nikolaou did not consider whether multiple VFDs could be used).

PO also focuses on *Toshiba Manual*'s warning against using an ASD (a VFD) with a motor having a power rating higher than the ASD's rated output. Ex.1006, 24. According to PO, *Coli*'s VFD cannot be substituted for a Toshiba VFD because *Coli* discloses an example of a VFD with 2500 hp. POR 23-24. But *Coli*'s 2500-hp VFD is simply one example. *Coli* also teaches fracturing pumps requiring less horsepower,

Ex.2003, 103:7-18, and PO does not dispute that it would have been obvious to use a Toshiba VFD in those applications. The combination of *Coli* and *Toshiba Manual* need not work for every example in *Coli* for a POSITA to find it obvious. That is, a POSITA would be motivated to combine *Coli* with *Toshiba Manual* even if *Coli* includes an example where the combination may not work. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1298 (Fed. Cir. 2012) ("A reference must be considered for everything that it teaches, not simply the described invention or a preferred embodiment.").

B. A POSITA would have enhanced *Coli*'s VFD with *Toshiba Manual*'s disclosed functionality.

PO argues that a POSITA would not have been motivated to enhance *Coli*'s VFD with *Toshiba Manual*'s diagnostic- and temperature-monitoring functionalities. Although PO asserts that Dr. Durham's testimony is conclusory, its explanation merely restates PO's prior (and incorrect) argument that *Toshiba Manual* does not disclose the claimed limitations. POR 26. Whether a POSITA would be motivated to use *Toshiba Manual*'s functionalities in *Coli*'s VFD is a different inquiry from whether *Toshiba Manual* discloses the claimed limitations. PO does not address the former. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 419-20 (2007). Regardless, Dr. Durham explains how *Toshiba Manual*'s VFD faults disclose "electric motor diagnostics," *supra* §III.B, and why its thermal sensor is on the heat sink. *Infra* §V.B.

Accordingly, PO does not meaningfully dispute that a POSITA would have been motivated to use *Toshiba Manual*'s functionality in *Coli*'s VFD.

V. CLAIMS 7-16 ARE UNPATENTABLE BECAUSE THE PRIOR ART DISCLOSES A VFD HAVING HEAT SINKS HAVING THERMAL SENSORS.

A. *Loucks* teaches a VFD having "heat sinks having thermal sensors monitored by a microprocessor to prevent damage caused by excessive heat," as recited in claim 7[e] (Grounds 3, 4B, and 5B).

PO concedes that *Loucks* discloses a heat sink having thermal sensors, *i.e.*, the "power electronics heat sink temperature sensor 510" in Figure 5, but argues that *Loucks* does not specifically disclose sensor 510 in a VFD. POR 18. First, even if *Loucks* does not disclose sensor 510 in a VFD, at minimum, a POSITA would have found it obvious to implement *Loucks*' system to include sensor 510 in a VFD, *e.g.*, the VFD of *Coli*. PO does not rebut this argument. *See* Pet. 52-55; Ex.1002, ¶¶235-237, 242; *compare* Ex.1007pt.1, 20 (cited in Ex.1002, ¶120), *with* Ex.1009, Fig. 5.

But *Loucks* discloses more. Figure 5 is "a functional block diagram of a cooling efficiency monitoring system installed on an equipment enclosure", and *Loucks* states that such systems may be installed on a VFD. Ex.1009, [0015], [0060]. PO interprets Figure 5 in a vacuum, assuming (incorrectly) that it is a complete depiction of the equipment where the system is installed. Because Figure 5 is a generic "functional block diagram" of the cooling efficiency monitoring system, that diagram would not enumerate details of the equipment on which it is installed.

Loucks' description of Figure 5 is silent on what type of "equipment" is shown as "equipment enclosure 505", but that does not mean Figure 5 fails to disclose any equipment. A POSITA would have understood that Figure 5 describes the cooling efficiency monitoring system—including its heat sink having thermal sensors—in a generic piece of "equipment", which expressly includes VFDs. Ex.1002 ¶¶233-236; Ex.1054, 169:17-170:9 (Dr. Nikolaou had not "checked" whether enclosure 505 could be a VFD enclosure); *cf. Bristol-Myers Squibb Co. v. Ben Venue Laby's, Inc.*, 246 F.3d 1368, 1380 (Fed. Cir. 2001) ("[T]he disclosure of a small genus may anticipate the species of that genus even if the species are not themselves recited.").

Next, PO argues that *Loucks*' sensor 510 is not monitored by a microprocessor "to prevent damage caused by excessive heat," because *Loucks*' monitoring technique using the sensor does not incorporate the "high temperature limits and alarms" described in paragraph 18. POR 19-20. But PO's argument starts with a false premise. The relevant grounds of the Petition do not, as PO asserts, "rel[y] on *Loucks*' high temperature limits and alarms described in paragraph 18" for any of the '870 Patent claims' limitations. That paragraph (reproduced below) describes the problems in ***conventional*** systems that *Loucks*' methods avoid.

> The large number of issues and causes of air flow problems means that fully instrumenting each device that may affect cooling performance can become cost prohibitive. However, ***since electrical or electronic equipment can malfunction due to over-temperature,*** detecting these

> problems is important. Unfortunately, for a variably loaded system, ***simply waiting for a high temperature limit to be reached may result in equipment damage that occurs in the time it takes to resolve the cooling problem. Thus it is desirable to detect problems before temperatures reach alarm limits***.…

Ex.1009, [0018]. To that end, *Loucks* discloses monitoring sensor 510 to calculate a "cooling efficiency indicator" and triggering a notification if that indicator is outside a specified range. *Id.*, [0049], [0063], Fig. 2; Ex.1002, ¶¶132-133, 241-242. PO does not dispute these disclosures. As Dr. Durham explained, *Loucks*' methods improve cooling to ***avoid*** excessive heat that could trigger the temperature alarms or limits described in paragraph 18. Ex.2003, 69:22-71:10. Thus, paragraph 18 simply confirms that *Loucks*' methods monitor the sensor 510 to prevent damage that could result from excessive heat if the alarms or limits were reached.[4] PO does not dispute that this satisfies limitation 7[e].

[4] To the extent PO argues that high temperature limits and alarms are completely unrelated to *Loucks*' methods, Dr. Durham's testimony does not support such an argument. Dr. Durham's testimony cited at POR, 20 only states that the ***units*** of the temperature limits would be different from the units of "cooling efficiency" in Figure 2. But Dr. Durham subsequently clarified that *Loucks*' methods are still related to temperature limits in that a temperature measurement provides an input for calculating the "cooling efficiency indicator" that can trigger a notification. Ex.2003, 66:2-14.

B. *Toshiba Manual* discloses "heat sinks having thermal sensors" (Grounds 1, 4A, and 5A).

PO argues that *Toshiba Manual* does not disclose this element because it "never explain[s] that the internal thermistor is located on the heat sink as required by the claim." POR 13-14. PO goes too far. Claim 7 does not state that the thermal sensors are located ***on*** the heat sink, and the ID did not construe claim 7 to require that location.[5] Rather, the ID states that *Toshiba Manual* did not "inherently ***associate***[] its heat sinks with its thermal sensors." ID 26. A closer review of the evidence confirms that *Toshiba Manual*'s thermistor is associated with the heat sink.

As Dr. Durham explained, because the heat sink is the main heat-dissipating device in the Toshiba VFD, protecting against an "overheat" condition in that VFD must involve measuring the heat sink's temperature. Ex.1002, ¶¶122-123, 186. Thus, Dr. Durham asserted that *Toshiba Manual* discloses a power semiconductor heat sink having thermal sensors. *Id.* Although PO disagrees with Dr. Durham's testimony as "conclusory," at least two pieces of evidence support it. First, the "standard specifications" for *Toshiba Manual*'s GX7 VFD—published at the same

[5] No intrinsic evidence supports such a construction. The '870 Patent's only description of a heat sink having thermal sensors parrots the claim language. Ex.1001, 2:39-42. Nor does PO offer any other evidence that a POSITA would interpret it in that manner. Dr. Nikolaou did not consider whether claim 7 requires the thermal sensor to be located on the heat sink, and interpreted it more broadly. Ex.1054, 44:13-19.

website as *Toshiba Manual*—expressly refer to the only "Overheat" function of that system as "***Heatsink*** Overheat." Ex.1007pt.1, 15, 23; Ex.1002, ¶¶122, 186 ("'protective function' of '***heatsink*** overheat'"). Dr. Nikolaou confirmed that a POSITA would have understood "heat sink overheat" to involve overheat of the heat sink itself. Ex.1054, 84:19-85:18. Moreover, the drawings and equipment list for Toshiba's VFD refer to the only thermistor in that device as the "***heatsink*** thermistor."

PAGE No.	DEVICE	DESCRIPTION	TYPE FORM
8	(1) MCCB1	MOLDED CASE SWITCH	SQD PJL36000S12–RE10
	8FU1, 2	CPT1 PRIMARY FUSE	CRF ATQR 6
	8FU3	CPT1 SECONDARY FUSE	GLD TRM 12
	FR, FS, FT	SEMICONDUCTOR FUSE	CRF 6,9URD33TTF0700
	BFI	BLOWN FUSE INDICATOR	CRF MS3V1–5BS
	CPT1	CNTL. PWR. TRANSFORMER	GTI
	ACL1~3	OUTPUT LINE REACTOR	TCI KDRG1C
	HCTU, V, W	HALL CT	LEM HAX1000–S
9	MS1	SOFT START CONTACTOR	TMQ LC1F4004U7
	MS2	CAP DISCHARGE CONTACTOR	CLK 7001–5150–21
	OH1T~3T	T–STAT 75°C FIXED N.C.	TKN OHD3–75B
	OH1B~3B	T–STAT 90°C FIXED N.C.	TKN OHD3–90B
	THR1	HEATSINK THERMISTOR	FEN 590–32BP01–203
	R1	SOFT START RESISTOR	PWO WR33
	R2	CAP DISCHARGE RESISTOR	PWO SXR2–500
	REC1M~6M, 1A~6B	DIODE PACK	EUP DD600N16K
	SA1~3	SURGE SUPPRESSOR	EPC B40K750

Ex.1007pt.2, 251 (excerpt highlighted above), 264, 279-80; *see also* Ex.1002, ¶120. This evidence confirms that *Toshiba Manual*'s thermistor is at least associated with the heat sink. *See Monsanto Tech. LLC v. E.I. DuPont de Nemours & Co.*, 878 F.3d

1336, 1345 (Fed. Cir. 2018) ("reliance on extrinsic evidence is proper in an inherency analysis"). Neither PO nor its expert addressed this evidence.

To the extent the Board maintains that *Toshiba Manual* does not disclose that its heat sink has thermal sensors, a POSITA would have deemed that obvious. In addition to the argument above, the Petition asserts, and PO does not dispute, that monitoring the temperature of heat sinks in VFDs was known in the art. Pet. 38; *see* Ex.1002, ¶¶87-95. Dr. Durham also testified that a POSITA would have understood that *Toshiba Manual* teaches "a power semiconductor heat sink having thermal sensors" based on its disclosure "***as well as general engineering knowledge*** regarding the operation of ASDs, power semiconductors[], heat sinks" and other components. *Id.*, ¶124. Dr. Nikolaou testified that the sole purpose of the heat sink in Toshiba's VFD is to dissipate heat, and he did not consider any other components that dissipate heat. Ex.1054, 74:5-76:20. Regarding the location of the thermal sensor, Dr. Nikolaou also conceded that a POSITA would have understood that *Toshiba Manual*'s thermistor could be located on the heat sink (Ex.2002, ¶63), but does not identify anywhere else the thermistor would be located. Indeed, as discussed above, documentation for *Toshiba Manual*'s VFD expressly describes the thermistor as a "heatsink thermistor". Thus, of the limited number of locations in *Toshiba Manual*'s VFD cabinet where the thermistor could be located, the heat sink would be at least an obvious design choice that would have been routine for a

POSITA to implement. *Cf.* Ex.1007pt.1, 20 (showing cabinet); Ex.1002, ¶236 (discussing, as one example, the *Loucks* design); *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1340 (Fed. Cir. 2020).

VI. A POSITA WOULD HAVE BEEN MOTIVATED TO COMBINE *COLI* AND *LOUCKS*.

A. *Loucks* is analogous art to the '870 Patent.

As the Board has already found, *Loucks* is reasonably pertinent to the problem addressed in the '870 Patent, satisfying the second prong of the *Bigio* test.[6] The '870 Patent addresses implementing VFDs and electric motors in the field of hydraulic fracturing. Ex.1001, 1:24-26, 2:5-7, 4:8-25; Ex.1002, ¶¶ 40-41. Prior-art techniques for implementing VFDs and electric motors in other fields, including those of *Loucks*, would have been reasonably pertinent to that problem. *Id.*, ¶¶ 132, 234-235. Indeed, during the '870 Patent's prosecution, PO cited another reference related to cooling systems for VFDs in data centers. Ex.1055; Ex.1003, 98 (citing Ex. 1055 as reference No.1). Nor is *Loucks* only relevant to data centers or "server IT equipment" as PO argues. *Loucks* states that its methods "may be used on ***any*** device that consumes electrical energy and exhausts waste heat," and specifically mentions devices in telephone systems, wiring closets, and electrical rooms. Ex.1009, [0060].

[6] As demonstrated below, the record supports this finding, and Petitioner need not have anticipated or expressly rebutted PO's arguments to the contrary in its Petition. *Corephotonics, Ltd. v. Apple Inc.*, 84 F.4th 990, 1009 (Fed. Cir. 2023).

PO does not dispute that such systems would be reasonably pertinent to the problem addressed in the '870 Patent. At most, using VFDs in many fields (POR 31) may indicate that *Loucks* is not in the same field of endeavor as the '870 Patent. But that is not relevant to the second prong of the *Bigio* test.

PO previously argued that the '870 Patent only addresses problems in hydraulic fracturing operations, which the Board rejected. ID 42-43. PO now repackages that argument, asserting that the '870 Patent only addresses problems pertaining to "a portable VFD." POR 30. Nothing in the '870 Patent requires the VFD to be "portable," or suggests that it is more "portable" than the equipment of *Loucks*. Dr. Nikolaou admitted as much. Ex.1054, 120:8-121:3. Although the '870 Patent describes transporting VFDs on trailers or trucks in certain embodiments, *Loucks*' equipment could be transported in a similar manner. *Cf. id.*, 122:5-126:10, 163:17-164:19.

PO also attempts to distinguish "cooling" in *Loucks* from "monitor[ing] against 'excessive heat'", asserting that "nothing in the '870 Patent would have conveyed to a POSITA" that its VFDs need to be cooled. POR 32. This illusory distinction fails for several reasons. First, *Loucks* is directed to methods of ***monitoring*** cooling efficiency, not methods of cooling themselves. Ex.1009, Title; Ex.2002, ¶102 ("*Loucks* addresses the problem of detecting cooling problems"). Moreover, the '870 Patent does not disclose how its thermal sensors are "monitored

by a microprocessor to prevent damage caused by excessive heat," much less in a way that distinguishes it from the monitoring in *Loucks*. A POSITA also would have understood that VFDs, including those in the '870 Patent and *Coli*, give off heat and therefore should be cooled. Ex.1002, ¶¶87-95; Ex.1009, [0060]. Indeed, the '870 Patent claims a heat sink that dissipates heat from the VFD, which is a form of cooling. Ex.1002, ¶87; Ex.1054, 36:17-37:7 (claim 7 indicates that "***there may be a need for cooling and that's why it states there will be heat sinks***…"). As discussed below, nothing in *Coli* departs from this widely accepted principle or suggests that its VFD does not need cooling.

B. *Coli* does not teach away from combination with *Loucks*.

PO argues that *Coli* teaches away from *Loucks* based on its disclosure that "the need for cooling systems…is significantly reduced" "by removing diesel prime movers." Ex.1005, [0039]. Nothing in *Coli* suggests that cooling systems would be eliminated altogether, or that any remaining cooling systems should not be monitored, *e.g.*, using the systems of *Loucks*. In contrast, *Coli* teaches in that same paragraph that other equipment, *i.e.*, machinery for transferring power from diesel prime movers to pumps, is "eliminated." *Id.* At most, *Coli* teaches that its methods may not require pumps, fluids, or other large-footprint equipment used in forced

cooling techniques,[7] or may require less of such equipment. However, *Coli* does not teach away from ***all*** cooling systems, such as *Loucks*'s heat sink. Nor does PO cite any evidence that *Loucks*' heat sink or monitoring systems would increase footprint or infrastructure in a manner like the equipment called out in *Coli*. Electric motors and VFDs are still used in *Coli*, and a POSITA would recognize that those systems need to be cooled. Ex.1002, ¶¶82, 87-95.

Finally, Petitioner's grounds involving *Loucks* do not require "adding a cooling system" to *Coli*'s VFD. POR 33. *Coli* is silent on cooling systems in its VFD, and *Loucks* further describes the components of a cooling system (*e.g.*, heat sinks) and monitoring system that could be used in that VFD. Ex.1002, ¶¶233-237. Although Petitioner need not establish that *Loucks*' system could be "bodily incorporated" into *Coli*'s VFD,[8] PO does not rebut the evidence that a POSITA would have understood how to do so. *Id.* ¶¶236-237; *compare* Ex.1007pt.1, 20, *with* Ex.1009, Fig. 5.

[7] PO conflates "cooling" generally—which may be accomplished using a heat sink—with "forced cooling" techniques that use circulating pumps, fluids, or fans. Ex.1002, ¶95.

[8] *Mouttet*, 686 F.3d at 1332.

Otherwise, PO simply reiterates that *Loucks* does not disclose limitation 7[e]. POR 33-35. These arguments do not rebut that it would be obvious to combine *Loucks* with *Coli*, and fail for the reasons discussed in §V.A, *supra*.

C. The Board's prior decision is not relevant to combining *Coli* with *Loucks.*

PO incorrectly analogizes *Loucks* to a different reference that the Board found would not have been obvious to combine with *Coli* in IPR2021-01033. Specifically, PO faults Petitioner for not explaining how refrigerants would be used with *Coli*'s VFDs, as the Board found in IPR2021-01033. POR 37 (citing Ex.1048, 48). There, Petitioner sought to combine *Coli* with U.S. Patent No. 6,116,040 ("*Stark*"), which involved a VFD for a refrigerator compressor and included a heat sink cooled by fluid refrigerant flowing through internal flow channels. Ex.1048, 17. Unlike *Stark*, *Loucks* does not require refrigerants, and *Loucks* describes applications in electrical equipment enclosures like *Toshiba Manual*. *Compare* Ex.1007pt.1, 20, *with* Ex.1009, Fig. 5. Notably, PO's expert never discussed *Stark*, much less any similarities between *Stark* and *Loucks*. Therefore, the Board's prior findings regarding the *Coli-Stark* combination have no bearing on the *Coli-Loucks* combination.[9]

[9] In contrast, Petitioner cited Ex.1048 to support combinations of *Coli* with *Horikoshi*, *Gardner*, and *Vliet*, all of which were at issue in IPR2021-01033.

VII. DEPENDENT CLAIMS 13 AND 15-16 ARE UNPATENTABLE.

A. Claim 13: *Coli* discloses and renders obvious "a truck having at least five axles."

PO does not contest that *Coli* discloses a truck-trailer with five axles. Ex.1005, [0037]; [0007]; [0039]; [0078]. Instead, PO argues that it is not a "truck" because a "truck" is distinct from a "trailer." POR 45-47. But PO has not asserted that "truck" needs to be construed, in claim 13 or elsewhere, so the plain meaning applies. Ex.2002 ¶104. The claims' plain language only requires all the components be mounted on "a vehicle" that "is a truck." Ex.1001, cls.12-13. The '870 Patent does not illustrate a truck differently from a truck-trailer.

As Dr. Durham explained, a POSITA would understand *Coli*'s truck-trailer as falling within the plain and ordinary meaning of a truck. Ex.1002, ¶198. Dr. Nikolaou likewise explained that "truck" is readily understood, and did not provide any defining characteristics of a "truck" other than its "size" and "ability to carry things." Ex.1054, 259:16-260:10. *Coli*'s truck-trailer has both the "size" and "ability to carry things" necessary for the pumps to be "mounted on [the] vehicles," *i.e.*, trucks. Ex.1001, 2:7-10. Neither PO nor Dr. Nikolaou explains why *Coli*'s truck-trailer is not a truck. Ex.2003, 54:9-13.

PO raises another red herring—accusing Dr. Durham of construing "truck" differently in different claims. PO again takes his testimony out of context. PO's questions related to claim 1, which recites a "truck" and a "trailer" separately.

Ex.2003, 53:15-54:2, 54:9-13. But, as Dr. Durham explained, the scope of "truck" and the application of *Coli* to it may be different in claim 1 since claims 1 and 13 do not share a common dependency. *Id.*, 55:10-56:8. Even if *Coli* does not disclose a truck carrying the claimed equipment, a POSITA would have found it obvious that *Coli*'s three-axle semi-trailer could be attached to and pulled by a tractor ("tractor-trailer truck"), and the number of axles on the tractor trailer is simply a design choice. Ex.1002 ¶¶199-200. Like the truck-trailer, a "tractor trailer" also reads on to the plain and ordinary meaning of a "truck." Ex.2003, 57:3-8; Ex.1002, ¶199. PO's only response is that Dr. Durham's testimony is conclusory. But Dr. Durham explained that "the use of trucks to transport trailers to and from oil and gas well sites has been well-known for decades," and a POSITA would have understood that *Coli*'s semi-trailer was "intended to be attached to and pulled by a tractor." Ex.1002, ¶¶161, 198-200. Therefore, a POSITA would have been motivated to make this simple design choice. *Id.*; *Uber Techs.*, 957 F.3d at 1340.

B. Claim 15: *Coli* discloses an electric motor having "a maximum continuous power output of about 1750 brake horsepower or more."

PO fails to dispute that *Gardner* discloses claim 15. *See* Pet. at 9, 16, 61, 63; Ex.1002, ¶¶18, 109, 146, 254.

PO also argues that *Coli*'s disclosure of "true 2500 hp" refers to "maximum instantaneous power" or "peak power" rather than "maximum continuous power

output." POR 49-52. First, to invalidate this system claim, *Coli* need not disclose a method where a specific "maximum continuous power output" is achieved. Instead, a POSITA need only understand *Coli* to disclose a system in which the motor could achieve the claimed maximum continuous power output. *Hewlett-Packard*, 909 F.2d at 1468.

PO's argument is also based on another implicit and incorrect claim construction. PO would exclude *Coli*'s "true 2500 hp" because *Coli* does not state that it is maintained during the entire fracturing operation. But PO fails to clarify how long "continuous" requires. Dr. Nikolaou testified that a fracturing pump need not operate at a single horsepower throughout the entire operation, Ex.1054, 264:1-16 ("answer…is not one size fits all"), confirming that PO's interpretation is too narrow. And shorter time periods described in *Toshiba Manual* VFDs fall within the plain meaning of "continuous." Ex.2003, 88:10-16.

Regardless, *Coli* discloses a maximum continuous power output of 1750 brake horsepower or more. For instance, claim 28 describes a motor "capable of operating at 2500 hp ***during fracturing operation***," *i.e.*, continuously, even under PO's interpretation. Ex.1005, cl.28. *Coli* also discloses that conventional diesel systems typically "only provide 1800 hp" to pumps after parasitic losses. *Id.*, [0049]. *Coli*'s system, however, reduces those losses, such that it "can deliver a true 2500 hp directly to each pump." *Id.* Thus, a POSITA would have understood that *Coli*'s

motor can output its full 2500-hp rating. Ex.1002, ¶203. Indeed, the Board previously decided that *Coli* discloses a similar limitation based on this disclosure. Ex.1048, 41 (*Coli* discloses "maximum continuous power output of about 1500 horsepower or more").

C. Claim 16: *Coli* discloses an electric motor having a "maximum continuous torque of about 8750 lb-ft or more."

PO argues that *Coli* does not disclose a "maximum continuous torque" based on the same improper construction of "continuous" discussed in §VII.B, *supra*. As Dr. Nikolaou admits, *Coli*'s electric motor must have a "maximum continuous torque"; he understands that it "wouldn't be higher than 20,000" but could not further limit it. Ex.1054, 273:5-276:1. *Coli* states that its electric motor can operate in the range of "up to 20,000 ft/lbs of torque", disclosing the claimed "maximum continuous torque." Ex.1005, [0011], cl.27; Ex.1002 ¶204. The Board has previously decided that *Coli* discloses this limitation based on that disclosure. Ex.1048, 41-42.

VIII. CONCLUSION

Petitioner respectfully requests that the '870 Patent claims be cancelled as unpatentable under 35 U.S.C. §318(b).

Respectfully submitted,
BAKER BOTTS L.L.P.

February 23, 2024
Date

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. § 42.6(e), the undersigned certifies that on February 23, 2024, a complete and entire copy of this PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE and Exhibits 1054-1055 were served on Patent Owner via electronic mail at the following addresses:

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CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE REQUIREMENTS

1. This Petitioner's Reply to Patent Owner's Response complies with the type-volume limitation of 5,600 words, comprising 5,568 words, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petitioner's Reply complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word in 14-point Times New Roman.

Respectfully submitted,
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