

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LIBERTY ENERGY, INC. AND LIBERTY OILFIELD SERVICES LLC
Petitioners,

v.

U.S. WELL SERVICES, LLC
Patent Owner.

Case No. IPR2024-01274
Patent 11,091,992

**PETITIONERS' OPPOSITION TO PATENT OWNER'S REVISED
NON-CONTINGENT MOTION TO AMEND**

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PETITIONER’S UPDATED EXHIBIT LIST

Exhibit No.¹	Description
1001	U.S. Patent No. 11,091,992 by Joel Broussard <i>et al.</i> entitled “System for Centralized Monitoring and Control of Electric Powered Hydraulic Fracturing Fleet” (the “’992 Patent”).
1002	File History for U.S. Patent No. 11,091,992.
1003	Declaration of Dr. Robert Durham.
1004	U.S. Patent Publication No. 2012/0255734 by Coli <i>et al.</i> , “Mobile, modular, electrically powered system for use in fracturing underground formations” (“ <i>Coli</i> ”), filed April 6, 2012 and published October 11, 2012.
1005	U.S. Patent No. 5,606,853 to Birch <i>et al.</i> , “Gaseous Fuel Compression and Control System for Gas Turbine Engine,” (“ <i>Birch</i> ”) filed April 28, 1995 and issued on March 4, 1997.
1006	U.S. Patent Publication No. 2008/0236818 by Dykstra, “Method and Apparatus for Controlling the Manufacture of Well Treatment Fluid,” (“ <i>Dykstra</i> ”) filed March 27, 2007 and published on October 2, 2008.
1007	U.S. Patent Publication No. 2008/0288115 by Rusnak <i>et al.</i> , “Intelligent Pump System,” (“ <i>Rusnak</i> ”) filed May 14, 2007 and published November 20, 2008.
1008	U.S. Patent Publication No. 2010/0038907 by Hunt <i>et al.</i> , “Power Generation,” (“ <i>Hunt</i> ”) filed April 30, 2009 and published February 18, 2010.

¹ Citations to patents are made by column and line cite; citations to patent publications are made by paragraph number; citations to Exhibit 1002 are made with reference to the Bates-stamped pagination; citations to other exhibits are made to the page number of the document itself.

Exhibit No. ¹	Description
1009	IEEE100: The Authoritative Dictionary of IEEE Standards Terms, 7th ed. (IEEE Press: 2000), ISBN: 0-7381-2601-2 (“ <i>IEEE Standards Dictionary</i> ”).
1010	U.S. Patent No. 9,410,410 by Broussard <i>et al.</i> , “System for Pumping Hydraulic Fracturing Fluid Using Electric Pumps,” (“ <i>Broussard410</i> ”), filed November 16, 2012 and published August 9, 2016.
1011	U.S. Patent No. 9,970,278.
1012	Chart Comparing Claims of the ’992 Patent and the ’278 Parent Patent.
1013	Complaint, <i>U.S. Well Services, LLC et al. v. Liberty Energy, Inc. et al.</i> , No. 4:24-cv-00839 (S.D. Tex. March 6, 2024).
1014	Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (June 21, 2022).
1015	Federal Court Management Statistics (June 30, 2024), available at < https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_appprofile0630.2024.pdf >
1016	Lionel B. Roe, Practices and Procedures of Industrial Electrical Design (McGraw-Hill: 1972), ISBN: 0-07-053390-3 (“ <i>Roe</i> ”)
1017	John A. Camara, Electrical Engineering Reference Manual for the Electrical and Computer PE Exam, 6th ed. (Professional Publications, Inc.: 2002), ISBN: 1-888577-56-8 (“ <i>EE-Reference</i> ”).
1018	U.S. Patent No. 1,743,771 to Hall <i>et al.</i> , entitled “System of Electric Distribution” (filed March 25, 1926 and issued January 14, 1930) (“ <i>Hall</i> ”).
1019	Donald G. Fink, Standard Handbook for Electrical Engineers, 13th ed. (McGraw-Hill, New York: 1993), ISBN: 0-07-020984-7 (“ <i>Fink</i> ”).
1020	U.S. Patent Publication No. 2011/0241590 to Horikoshi <i>et al.</i> , entitled “Motor Driving Apparatus Having Fault Diagnostic

Exhibit No. ¹	Description
	Function” (“ <i>Horikoshi</i> ”), filed February 11, 2011 and published October 6, 2011.
1021	IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book), 1986, ANSI/IEEE Std 141-1986: 1-609 (“ <i>Red Book</i> ”).
1022	Second Declaration of Dr. Robert Durham.
1023	Deposition Transcript of Dr. Michael Nikolaou in IPR2024-01274.
1024	U.S. Patent Pub. No. 2014/0138079 by Broussard <i>et al.</i> , “System for Pumping Hydraulic Fracturing Fluid Using Electric Pumps,” (“ <i>Broussard079</i> ”), filed November 16, 2012, published May 22, 2014.
1025	U.S. Patent No. 8,789,601 by Broussard <i>et al.</i> , “System for Pumping Hydraulic Fracturing Fluid Using Electric Pumps,” (“ <i>Broussard601</i> ”), filed February 26, 2014, published June 26, 2014, and issued July 29, 2014.
1026	U.S. Patent No. 5,790,972 by <i>Kohlenberger</i> , “Method and Apparatus for Cooling the Inlet Air of Gas Turbine and Internal Combustion Engine Prime Movers,” (“ <i>Kohlenberger</i> ”), filed August 24, 1995, and issued August 4, 1998.
1027	U.S. Patent No. 8,747,533 by <i>Ekanayake</i> and Scipio, “Systems and Methods to Determine Fouling in a Gas Turbine Filter,” (“ <i>Ekanayake</i> ”), April 30, 2013, and issued June 10, 2014.
1028	U.S. Patent No. 8,552,728 by Weiher, “Sluggish Circuit Breaker Detection System and Method,” (“ <i>Weiher</i> ”), filed November 30, 2010, and issued October 8, 2013.
1029	European Patent No. 0023879 by Newman, “Engine module life tracking system,” (“ <i>Newman</i> ”), filed August 4, 1980, and published January 30, 1985.
1030	Rosemount Model 3051 Transmitter Product Manual, available as of March 22, 2012, at https://web.archive.org/web/20120322124738/http://www2.emer

Exhibit No. ¹	Description
	sonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00809-0100-4774.pdf.
1031	Rosemount 848T High Density Temperature Transmitter Reference Manual, available as of January 18, 2012, at https://web.archive.org/web/20120118001644/http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00809-0100-4697.pdf .
1032	Declaration of Mina Ching, Internet Archive
1033	U.S. Patent App. Pub. No. 2009/0188682 by Gensel <i>et al.</i> , “Fire Extinguishing System for a Casing,” (“ <i>Gensel</i> ”), filed March 31, 2009, and published Jul. 30, 2009.
1034	Whitaker, “AC Power System Handbook,” 3rd ed., CRC Press (2007).
1035	U.S. Patent No. 1,717,071, by Smith and Smith, “Shutting Down Means for Hydraulic Turbines,” (“ <i>Smith</i> ”), filed May 4, 1925, issued June 11, 1929.
1036	U.S. Patent No. 3,605,919, by Bromell and Homanick, “Drilling Rig Control” (“ <i>Bromell</i> ”), filed May 16, 1969, issued September 20, 1971.
1037	U.S. Patent App. Pub. No. 2009/0181582 by Thompson, “Enhanced Cable for Field Data Distribution System” (“ <i>Thompson</i> ”), filed January 16, 2009, published July 16, 2009.
1038	U.S. Patent No. 7,949,483 by Discenzo <i>et al.</i> , “Integration of Intelligent Motor with power Management Device,” (“ <i>Discenzo</i> ”), filed September 30, 2005, issued May 24, 2011.
1039	U.S. Patent App. Pub. No. 2013/0142601 by McIver and Cunningham, “Fracture Sand Silo System and Methods of Deployment and Retraction of Same” (“ <i>McIver</i> ”), filed October 23, 2012, published June 6, 2013.
1040	International Publication No. WO2016/019219 by Omont <i>et al.</i> , “Monitoring Health of Additive Systems,” (“ <i>Omont</i> ”), filed July 31, 2015, published February 4, 2016.

Exhibit No. ¹	Description
1041	Gardner Denver GD-2500 Quintuplex Well Servicing Pump Operating and Service Manual, captured by the Internet Archive on Sep. 17, 2005, available at < https://web.archive.org/web/20120917102614/http://www.quincieoilfield.com/pdf/3.0%20Gardner%20Denver/2500/GD2500Q%20Op%20&%20Service%20Manual.pdf >
1042	Tutterow, V. and McKane, A. T., “Variable Speed Pumping: A Guide to Successful Applications,” Europump and Hydraulic Institute, 2004.
1043	Mark’s Standard Handbook for Mechanical Engineers, Eleventh Edition, McGraw-Hill Companies, New York, 2007.
1044	Langewis, Jr., C. and Gleeson, C. W., “Practical Hydraulics of Positive Displacement Pumps for High-Pressure Waterflood Installations,” Society of Petroleum Engineers, February 1971.
1045	Email from the Board RE: IPR2024-01274 – Additional Pages Request, dated September 3, 2025.
1046	NFPA 79, “Electrical Standard for Industrial Machinery” National Fire Protection Association, Quincy, Mass, 1962-2007.
1047	Pearson, “Proposed HSE guidelines on emergency shutdown systems,” 1989 A First International Conference on the Use of Programmable Electronic Systems in Safety Related Applications Computers and Safety, 1989, pp. 55-58.
1048	Gilson, Bill. "Fast Response System for Large-Volume Acid Stimulation." Paper presented at the Offshore Technology Conference, Houston, Texas, May 1996. doi: https://doi.org/10.4043/8096-MS
1049	Rex Burgos; Marc Allcorn; Robin Mallalieu; Jorge Vicens “Eliminating Human Error during Coiled Tubing Operations,” SPE Production & Operations 22 (03) (June 2006): 335–338. DOI: 10.2118/100164-PA.
1050	J. J. Sammarco, “Programmable electronic and hardwired emergency shutdown systems: a quantified safety analysis,” Fortieth IAS Annual Meeting. Conference Record of the

Exhibit No. ¹	Description
	Industry Applications Conference, 2005, pp. 210-217 Vol. 1, doi: 10.1109/IAS.2005.1518312.
1051	Kurz, Rainer, and Robert C. White. "Modeling Emergency Shutdowns of Centrifugal Compressors." Paper presented at the PSIG Annual Meeting, Galveston, Texas, May 2009.
1052	Third Declaration of Dr. Robert Durham, dated December 1, 2025.
1053	Deposition Transcript of Dr. Michael Nikolaou, dated November 20, 2025 in IPR2024-01274.
1054	International Application No. WO 2004/099587 (" <i>Armstrong</i> "), filed March 24, 2004, published November 18, 2004.
1055	U.S. Patent No. 7,909,585 (" <i>Clancy</i> "), filed March 28, 2007, published November 22, 2007.
1056	WO Pub. No. 2016/044509 (" <i>Trobaugh</i> "), filed September 17, 2015, published March 24, 2016.
1057	European Patent Application EP 1380740 (" <i>Teets</i> "), filed December 3, 1997, published January 14, 2004.
1058	U.S. Patent No. 6,576,849 (" <i>Bliss</i> "), filed December 1, 2000, published June 10, 2003.
1059	U.S. Patent No. 7,455,138 (" <i>Delaney</i> "), filed November 10, 2006, published November 25, 2008.
1060	Weir SPM General Catalog (2009) (" <i>Weir</i> ")
1061	Declaration of Nathaniel E. Frank-White, dated September 20, 2022.
1062	U.S. Patent Application Publication No. 2016/0258267 (" <i>Payne</i> "), effectively filed March 4, 2015, published September 8, 2016.
1063	Provisional App. No. 62/128,291 (" <i>Payne Provisional</i> "), filed March 4, 2015.
1064	U.S. Patent 9,523,312 (" <i>Allam</i> "), filed Nov. 1, 2012, and published May 2, 2013.

Exhibit No.¹	Description
1065	IEEE100: The Authoritative Dictionary of IEEE Standards Terms, 7th ed. (IEEE Press: 2000), ISBN: 0-7381-2601-2.
1066	U.S. Patent Pub. No. 2013/0306322 (“ <i>Sanborn</i> ”), filed December 7, 2012, and published November 21, 2013.
1067	S.V. Stephenson et al., “Fracturing Process and Control Automation: Phase 2,” SPE 26220 (1993) (“ <i>Stephenson</i> ”).
1068	U.S. Patent Pub. No. 2008/0183415 (“ <i>Dykstra415</i> ”), Filed January 31, 2007, and published July 31, 2008.
1069	What is LNG?, available at: https://web.archive.org/web/20040712131010/http://fossil.energy.gov/features/lng/whatisit.html .
1070	Merriam Webster, Definition of “Fouling,” available at: https://web.archive.org/web/20111018124705/http://www.merriam-webster.com/dictionary/fouling
1071	Tomlinson, H.L. et al., “Fracturing Process Control and Automation,” SPE 17315 (1988)
1072	Excerpts from NFPA 79, “Electrical Standard for Industrial Machinery” National Fire Protection Association, Quincy, Mass, 1962-2007.

In its Revised Motion to Amend (Paper 21, “RMTA”), Patent Owner (“PO”) replaces Original Claims (“OC”) 1-20 with Substitute Claims (“SC”) 41-59. The Substitute Claims are unpatentable.

I. THE SUBSTITUTE CLAIMS ARE UNPATENTABLE

A. Substitute Claims 45-46 and 54-59 are Indefinite.

The ’992 Patent’s specification and prosecution history provide no objective standard for ascertaining the scope of “*substantially immediately*,” a subjective term of degree. EX1052, ¶¶69-80; *see Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1371 (Fed. Cir. 2014). There is no objective standard for determining how quickly power must be cut for it to be “substantially immediately.” EX1052, ¶¶75-77. The specification does not provide any objective baseline to enable a POSITA to differentiate “*substantially immediately*” from other durations, such as “immediately.” *Id.* “Terms of degree are problematic if their baseline is unclear.” *See Liberty Ammunition, Inc. v. United States*, 835 F.3d 1388, 1395 (Fed. Cir. 2016).

PO’s Expert Dr. Nikolaou could provide no restrictions or bounds on the length of time that would be “substantially immediately,” and instead testified that it is a matter of “engineering judgment” and “[t]here is no specific number assigned to it.” EX1053, 91:6-18. This confirms the scope is subjective. *See Datamize, LLC v. Plumtree Software, Inc.*, 417 F.3d 1342, 1350-51 (Fed. Cir. 2005) (finding term indefinite that depends “on the unpredictable vagaries of any one person’s opinion”);

Intellectual Ventures I LLC v. T-Mobile USA, Inc., 902 F.3d 1372, 1381 (Fed. Cir. 2018) (finding a term of degree indefinite because it was user-defined).

Dr. Nikolaou further testified that “substantially immediately” depends on “the configuration of the system, the risk for letting power continue before it gets shut off,” “on the particular situation [and] the design of the unit,” and that “‘substantially’ is used in the context of the specific system.” EX1053, 84:14-95:15. “Substantially immediately” thus may be different in different contexts, and yet the patent fails to provide guidance on how to determine what duration is considered “substantially immediately” in any given context. EX1052, ¶80; *see Halliburton Energy Servs., Inc. v. M-I LLC*, 514 F.3d 1244, 1255 (Fed. Cir. 2008).

B. Substitute Claims 44 and 50 Lack Written Description

SC 44: The specification does not reasonably convey to a POSITA that the inventor has possession of [44b]’s “the system further comprising a hydraulic system.” EX1052, ¶¶81-86. None of PO’s identified passages disclose a “hydraulic system” or its components. RMTA, 22; EX2005, ¶¶44-46, 59; EX1001, 9:4-18, 10:30-34; EX1052, ¶¶85-86. Rather, they at best disclose a hydraulic motor’s monitored operating characteristics, and do not provide written description support for “a hydraulic system” itself. *See id.* Dr. Nikolaou could not identify where the specification described the components of the “hydraulic system,” admitting “there is no detailed description of the hydraulic system.” EX1023, 100:8-101:19.

SC 50: The specification does not reasonably convey to a POSITA that the inventor has possession of [50a]’s “controlling compression of the liquefied natural gas.” EX1052, ¶¶87-92. The specification only discloses compressing natural gas in its gaseous state. EX1001, 1:53-56, 5:31-33, 5:58-61, 7:26-29, 7:40-41. The specification only references “liquefied natural gas” in relation to vaporization, which a POSITA would have understood to be the opposite of “compression.” EX1052, ¶¶88-92; EX1069; EX1001, 4:34-37.

C. The Substitute Claims are Obvious.

The Substitute Claims would have been obvious under 35 U.S.C. §103 in view of the following grounds. Limitations from the OC are addressed in the Petition.

Ground	Subst. Cl.	Prior Art
12A	41, 42	<i>Coli, Birch, Rusnak, Armstrong, Clancy, Trobaugh, Teets, and Broussard</i> ⁰⁷⁹
12B	41, 42	Ground 12A references and what is otherwise available to the public
13A	43	<i>Coli, Birch, Rusnak, Armstrong, Clancy, Trobaugh, Teets, Hunt, and Gensel</i>
13B	43	Ground 13A references and what is otherwise available to the public
14A	45, 46	<i>Coli, Birch, Hunt, Rusnak, Armstrong, Clancy, Trobaugh, Teets, Smith, Bromell, and Thompson</i>
14B	45, 46	Ground 14A references and what is otherwise available to the public
15A	47-49, 52, 54 56-57, 59	<i>Coli, Birch, Rusnak, Ekanayake, Bliss, Broussard</i> ⁰⁷⁹ , and <i>Gensel</i>

15B	47-49, 52, 54 56-57, 59	Ground 17A references and what is otherwise available to the public
16A	50	<i>Coli, Birch, Rusnak, Ekanayake, Bliss, Broussard079, Allam</i>
16B	50	Ground 16A references and what is otherwise available to the public
17A	51	<i>Coli, Birch, Rusnak, Hunt, Ekanayake, Bliss, Broussard079, Kohlenberger, Weiher, and Newman</i>
17B	51	Ground 21A references and what is otherwise available to the public
18A	53	<i>Coli, Birch, Rusnak, Ekanayake, Bliss, and Discenzo</i>
18B	53	Ground 18A references and what is otherwise available to the public
19A	55	<i>Coli, Birch, Rusnak, Hunt, Ekanayake, Bliss, Broussard079, and Thompson</i>
19B	55	Ground 19A references and what is otherwise available to the public
20A	44	<i>Coli, Birch, Rusnak, Armstrong, Clancy, Trobaugh, Teets, Hunt, Gensel, Delaney, and Weir</i>
20B	44	25A references and what is otherwise available to the public
21A	58	<i>Coli, Birch, Rusnak, Hunt, Bliss, and McIver</i>
21B	58	26A references and what is otherwise available to the public

Each reference is in the same field of endeavor (controlling and/or monitoring industrial equipment) and/or is reasonably pertinent to the problem addressed by the '992 Patent (controlling and/or monitoring industrial equipment from a centralized location). EX1052, ¶¶95-113, 304, 324, 327, 329, 371-374, 482-483, 498-502, 548, 579, 593-597, 638. The references are prior art at least under: **35 U.S.C §102(a)(1)**: *Broussard079* (published 5/22/14). **35 U.S.C §§102(a)(1)-(2)**: *Kohlenberger* (filed 8/24/95, issued 8/4/98); *Ekanayake* (filed 4/30/13, issued 6/10/14); *Weiher* (filed 11/30/10, issued 10/8/13); *Newman* (filed 8/4/80, published 1/30/85); *Gensel* (filed

3/31/09, published 7/30/09); *Smith* (filed 5/4/1925, issued 6/11/1929); *Bromell* (filed 5/16/69, issued 9/20/71); *Thompson* (filed 1/16/09, published 7/16/09); *Discenzo* (filed 9/30/05, issued 5/24/11); *McIver* (filed 10/23/12, published 6/6/13); *Armstrong* (filed 3/24/04, published 11/18/04); *Clancy* (filed 3/28/07, issued 3/22/11), *Teets* (filed 12/3/97, published 1/14/04); *Bliss* (filed 12/1/00, issued 6/10/03); *Delaney* (filed 11/10/06, issued 11/25/08) *Weir* (published 1/6/10); *Steffen* (filed 11/1/12, published 5/2/13); *Allam* (filed 11/1/12, published 5/2/13). **35 U.S.C. §102(a)(2):** *Trobaugh* (filed 9/17/15).

1. Ground 12A: Substitute Claims 41-42 are obvious.

SC 41: *See* Pet., 19-39 (OC 1, 2). *Coli*'s "control center 40" "monitors" and "controls" "the entire fracturing operation," which would include *Armstrong*'s FCS (gas filtration skid), and the gas compressor. EX1004, [0072]; EX1052, ¶¶137, 178, 203. *Armstrong*'s "programmable logic controller (PLC)" controls the FCS. EX1054, 19:19-22. *Clancy*'s distributed control system (DCS) controls its system. EX1055, [0003]. It would have been obvious to monitor/control [41i], [41k], and [41n]'s characteristics in view of these disclosures, and because it was known and/or obvious to do so. EX1052, ¶¶24-26, 115-233; EX1053, 43:10-12, 44:16-19. Doing so applies known techniques (monitoring/controlling a gas filtration skid and compressor) to a known system (*Coli*/*Armstrong*'s control system) ready for improvement. EX1052, ¶¶114-123. A POSITA would have been motivated to

monitor/control the characteristics to ensure proper functioning. EX1053, 62:2-63:4.

[41g]: *Armstrong's* fuel-conditioning skid (“FCS”) (gas filtration skid) conditions fuel (gas) to remove contaminants/particulates for a natural gas turbine generator. EX1054, 1:8-23, 8:18-20, 9:6-12, 9:20-23, 15:17-21, Fig. 3; EX1052, ¶¶131-135; EX1053, 9:19-10:14. A POSITA would have been motivated to apply *Armstrong's* FCS to *Coli's* system to remove contaminants to render the gas suitable for the generator. EX1052, ¶¶114-117; EX1053, 12:21-13:12. Doing so applies known techniques (gas filtration/conditioning) to a known system (hydraulic fracturing system with natural gas turbine) ready for improvement (condition/filter gas to remove contaminants). *Id.*, ¶¶117, 133; EX1053, 10:15-11:2, 11:11-17.

[41h]-[41i]: ***Water separator status.*** *Armstrong* discloses “[a] liquid drain arrangement” “used to drain liquid” from the “separator tank 10.” EX1054, 8:14-16, 9:20-22, 9:25-10:2, 13:15-21, 14:19-23; EX1053, 21:14-22; EX1052, ¶¶139-142. *Armstrong* discloses “[a] float switch and/or a pressure switch 17” that sends an alarm or stop signal to the FCS “to reduce the likelihood of liquid slipping past the separator 10 in the event that the drain system fails to remove sufficient moisture from the separator tank 10.” EX1054, 10:11-14; EX1053, 15:9-16:4, 20:5-22. *Clancy* also discloses a separator (9) (water separator) to drain water. EX1055, [0032], [0044]-[0048], Fig. 6A. *Clancy* discloses switches to monitor the separator’s level (status). *Id.*, [0046]. It would have been obvious to monitor the water separator

level (status) using *Coli*'s centralized monitoring to perform the *Coli-Clancy* control function and to ensure proper functioning. EX1052, ¶¶143-144; EX1053, 20:5-21:22, 22:20-23:2.

Particulate filter status. *Armstrong* discloses FCS particulate filters as discussed for [41g]. *Armstrong* discloses a pressure switch to monitor filter status, including the level of particles deposited on the filter surface (filter fouling levels). EX1054, 12:4-6; EX1053, 23:7-24:19; EX1052, ¶¶146-147. A POSITA would have been motivated to monitor particulate filter status to determine if the filter needs replacement or is working properly. EX1052, ¶148; EX1053, 25:11-18.

Gas pressures and gas temperatures. *Armstrong* discloses a pressure gauge to monitor the FCS's gas pressures. EX1054, 9:15-16. *Clancy* discloses pressures sensors to monitor gas pressures. EX1055, [0033], [0038], Fig. 2. *Armstrong* and *Clancy* both disclose temperature sensors to monitor gas temperatures. EX1054, 19:24-20:2, 13:7-14; EX1055, [0037], [0041]. A POSITA would have been motivated to monitor gas pressure and temperature to maintain proper pressure and temperature and adjust compressor speed. *Id.*; EX1052, ¶¶150-160; EX1054, 10:21-24, 19:10-25; EX1053, 34:2-10, 40:3-10.

Valve statuses. *Armstrong* discloses monitoring valve 11's status to determine when it closes so that valve 13 will open. EX1054, 10:2-6. *Armstrong* also teaches monitoring valve statuses so that solenoid valves 34 and 37 are opened while valves

36, 38, and 41 are closed. *Id.*, 12:15-21, Fig. 4. It would have been obvious to monitor valve 19's position to know the "throttling" amount, and control the fuel amount going to the gas compressor's inlet side. *Id.*, 12:18-22; EX1052, ¶¶161-165; EX1053 47:18-48:7. *Clancy* also renders obvious monitoring valve statuses. It would have been obvious to monitor *Clancy*'s valve (6)'s status to determine that it was open and safely complete "initial start up." EX1055, [0031]; EX1052, ¶¶166-168. A POSITA would have been motivated to monitor valve status to perform *Armstrong* and *Clancy*'s control functions, ensure proper functioning and prevent malfunctions. EX1052, ¶169; EX1053, 47:6-17, 49:4-12.

Filter bypass status. *Trobaugh* discloses a filter bypass assembly with bypass valve sensors. EX1056, [0031], Fig. 1. *Trobaugh*'s bypass valve sensor information "output[] [] to other components" would include the filter bypass status, *e.g.*, when there is fuel pressure at sensor 109 with valve 108 opened, and/or while the filter assembly is working improperly and/or is being repaired/serviced. *Id.*; EX1052, ¶¶171-173; EX1053, 49:14-52:8. It would have been further obvious to monitor filter bypass status based on *Coli*, as monitoring the entire fracturing operation would have included the filter bypass status (valve 109 opened, filter bypass activated). EX1052, ¶174. A POSITA would have been motivated to monitor filter bypass status to know whether the filter is operating properly, and whether the filter bypass is activated. EX1052, ¶¶120, 175-176; EX1053, 52:2-15, 53:7-18, 54:14-22.

[41j]-[41k]: Inlet valves. *Armstrong* discloses controlling inlet valve 19 (which controls the flow rate to the compressor) and inlet solenoid valve 8 (which throttles the inlet fuel to the compressor). EX1054, 9:16-19, 10:15-19, 12:18-22, Fig. 3. *Clancy* also discloses controlling multiple inlet valves, including at least ball valve (3) “to isolate the skid in the event of maintenance or if manual isolation is required,” and second 311 valve (6) controlled by an actuator to open the valve for initial start up or close the valve for emergency shut down. EX1055, [0031]; EX1053, 55:13-21, 56:10-57:1. A POSITA would have been motivated to control inlet valves to isolate the gas compression skid for maintenance or shut down, and adjust the flow rate. EX1052, ¶¶182-187; EX1053, 55:13-21, 56:10-57:20.

Outlet valves. *Armstrong*’s PLC controls a fuel solenoid (FCS outlet valve) to ensure the receiver tank remains pressurized. EX1054, 16:10-15, 19:19-20:7; EX1052, ¶188. *Clancy* discloses controlling valves 49 and 50 (outlet valves) for starting/stopping gas flow. EX1055, [0042]. A POSITA would have been motivated to control outlet valves to control the gas flow/pressure. EX1052, ¶¶189-190.

Bypass valves. *Armstrong* discloses controlling solenoid valves 34 and 37 (bypass valves) of its bypass control system by opening the valves to reduce the flow rate. EX1054, 12:15-21, Fig. 3; EX1053, 60:11-16. A POSITA would have been motivated to control the bypass valves to be able to control flow rate and pressure, for example, by activating or de-activating the bypass line. EX1052, ¶¶192-194.

Pressure release. *Armstrong* discloses closing solenoid valve 8 and opening valves 66, 38, and 41 to purge the FCS (gas filtration skid) of high-pressure gas (controlling pressure release). EX1054, 17:17-23, Fig. 3; EX1052, ¶196. A POSITA would have been motivated to control the pressure release in order to maintain pressure and prevent over-pressurization, which can damage equipment and compromise safety. EX1052, ¶¶197-198; EX1053, 60:17-61:22.

[41l]: *Armstrong* and *Clancy* both disclose a gas compressor. EX1054, 10:15-22; EX1055, [0009]. A POSITA would have been motivated to combine such a gas compressor with *Coli*'s system to pressurize fuel for the engine. EX1052, ¶¶116-119; EX1054, 1:20-23. Doing so applies known techniques (gas compressors) to a known system (hydraulic fracturing system) ready for improvement. *Id.*

[41m]-[41n]: ***Compressor motor run status.*** *Armstrong* monitors compressor speed using pressure sensor 65 near the FCS outlet. EX1054, 19:19-25, 10:20-24. A POSITA would have understood that monitoring compressor speed monitors the compressor motor run status because if the motor speed is zero, the motor is not running, and if the speed is non-zero, then the motor is running. EX1053, 64:3-65:5; EX1052, ¶¶206-207. A POSITA would have been motivated to monitor compressor motor run status to determine if the compressor is activated and ensure proper function. EX1052, ¶¶208-209; EX1053, 65:6-22.

Oil pump run status and oil pump discharge pressure. *Teets* discloses

lubricating oil pump 50 (oil pump). EX1057, [0028], [0055], [0057], Fig. 1A. Teets discloses monitoring lubricating oil pump pressure (discharge pressure) with transducers. *Id.*, [0017], Fig. 1A. This also monitors oil pump run status because if the pressure is zero, the pump is not running, and if the pressure is above zero, the pump is running. EX1052, ¶¶211-212. Teets's engine controller monitors for oil pump failure, which monitors oil pump run status (failure or no failure). *Id.*, ¶213. EX1057, [0061]. A POSITA would have been motivated to monitor these characteristics to ensure proper function, so that the gas compressor receives appropriate lubricating oil to avoid unnecessary wear. EX1052, ¶¶214, 228-229.

Enclosure exhaust fan run status. *Clancy* discloses cooler fan (enclosure exhaust fan) directing air out of the skid's shelter structure's outlet louver. EX1055, [0071], [0039]-[0040], Claim 30. *Clancy*'s DCS controls the louvers to open and close to control temperature. *Id.*, [0039], [0003], [0028]. It would have been obvious and a POSITA would have been motivated to monitor the fan run status so that the DCS would know whether operating *Clancy*'s louvers would impact temperature, or whether the exhaust fan required service or maintenance. EX1052, ¶¶216-219; EX1053, 66:1-68:7.

Compressor inlet pressure. *Clancy* discloses first back-pressure valve (10) regulating inlet gas pressure to the compressor to maintain pressure within the compressor's max suction pressure, using pressure sensors (11) and (12). EX1055,

[0033]-[0034], Fig. 2; EX1052, ¶220. A POSITA would have been motivated to monitor compressor inlet pressure to maintain appropriate pressure and avoid damage and unsafe conditions. EX1052, ¶¶221-223; EX1053, 68:12-69:7.

Compressor discharge pressure. *Armstrong* discloses monitoring an FCS outlet pressure (EX1054, 19:10-25, 10:11-24), which discloses and renders obvious monitoring compressor discharge pressure, as the FCS outlet pressure is controlled by the compressor speed. EX1052, ¶¶224-225; EX1053, 70:13-21, 71:14-72:5. *Clancy* also discloses monitoring compressor discharge pressure with third pressure sensor (35). EX1055, [0028]; EX1052, ¶¶226-227; EX1053, 70:7-15. A POSITA would have been motivated to monitor compressor discharge pressure to maintain appropriate pressure, avoid damage and unsafe conditions, and adjust compressor speed. EX1052, ¶¶228-230; EX1053, 69:8-72:5.

SC 42: Pet., 35-39 (OC 2); Paper 16 (“Opp.”), 7 (SC 22); Paper 20 (“PG”), 14, 20. *Broussard079* discloses “liquefied natural gas” for turbine generators. (EX1024, [0009], [0024]), which would have been obvious to combine with *Coli*’s liquid fuels (EX1004, [0010], [0038], [0040]). Doing so applies a known technique (liquefied natural gas) to a known system (turbine generators) ready for improvement. EX1052, ¶¶123, 235; Pet., 7; EX1023, 31:7-9. [42b] is obvious for the same reasons as [41n], and because *Coli*’s “control center 40” “controls [] the entire fracturing operation,” including *Armstrong-Clancy*’s natural gas compression.

EX1052, ¶¶236-239; EX1004, [0072]; EX1054, 19:10-25; EX1055, [0003].

2. Ground 13A: Substitute Claim 43 is Obvious.

Supra, §I.C.1 (SC 41); Pet., 39 (OC 4), 58-65 (switchgear); Opp., 14-15 (SC 24); PG, 14, 20. *Gensel* discloses a switchgear and monitoring fire alarms. EX1033, Abstract, [0001]-[0002], [0004], [0031], [0063]-[0066]. It would have been obvious to incorporate this functionality into *Coli*'s system because *Coli* monitors all hydraulic fracturing equipment, switchgears were prone to fires, and doing so applies known techniques (switchgear fire alarm monitoring) to a known system (switchgears in hydraulic fracturing), ready for improvement (improving safety). EX1052, ¶¶306-307, 311-312; EX1034, 342; EX1023, 52:2-53:5; EX1004, [0072].

3. Ground 14A: Substitute Claims 45-46 are Obvious.

SC 45: *Supra*, §I.C.I (SC 42); Pet., 58-60 (OC 6); Opp., 18-20 (SC 26); PG 14, 20. It would have been obvious to effectuate the “emergency power-off” functionality via *Smith*'s “switch.” EX1052, ¶¶340-341; EX1035, 1:1-3, 1:24-29. It would have been obvious to sound an alarm when triggering such a switch, as it was well-known to “sound an alarm” to notify a drill site about “off-normal operation,” as taught by *Bromell*, which a POSITA would have understood to include an “emergency power off” scenario. EX1052, ¶¶27-33, 340-341; EX1036, 1:19-21, 1:33-36. Doing so applies known techniques (switch-controlled technique for turbine generator shut down and audible alarm) to a known system (hydraulic

fracturing system) ready for improvement (improving safety). EX1052, ¶¶330-333; EX1023, 63:9-19, 72:19-73:4; EX1053, 72:6-73:14.

SC 46: Pet., 33-34 (Ethernet cables), 60-65 (OC 7); Opp., 20-21 (SC 27); PG, 14, 20. *Thompson* discloses armored shielded CAT5E cabling. EX1037, Abstract, [0008], [0015], [0049]. A POSITA would have been motivated to look to *Thompson* for details of Ethernet cables, such as shielded CAT5E cabling, to protect the cable from damage and prevent interference. EX1052, ¶¶346-347. Doing so applies known techniques (armored shielded CAT5E) to a known system (hydraulic fracturing system using Ethernet cables) ready for improvement (resilient cables). *Id.*, ¶¶335-336; EX1023, 78:7-80:4; EX1053, 95:16-96:8.

4. Ground 15A: SC 47-49, 52, 54, 56-57, & 59 are Obvious.

SC 47 and 56: Pet., 26-35, 40-42, 66-69 (OC 1, 8, 17); Opp., 20-21. [47f] and [56f] are obvious. Pet., 35-39, 42 (OC [2a], [9a]). [47g] and [56g] are obvious. *Id.*, 39 (OC [3a]). [47h] and [56h] are obvious. *Id.*, 35-39, 43 ([2b], [3b], [12b]); EX1052, ¶¶384-418. ***“Turbine air inlet filter transmitter failure”***: *Ekanayake*’s “filter assembly” filters “air entering a gas turbine,” and “includes a fouling detection instrument” for detecting the extent to which the filter assembly has been “fouled” (is dirty) and “a wireless communication module” for “wirelessly communicating the degree of fouling.” EX1027, 1:24-27, 2:19-35; EX1053, 24:5-19; EX1052, ¶419. *Ekanayake* discloses that load cells determine whether the filter weight exceeds a

“threshold” and is thus dirty, and “convert the load acting on them into electrical signals.” EX1027, 1:55-2:3, 3:21-26, 4:34-35, 11:56-57; EX1052, ¶420; EX1053, 73:15-74:14, 75:11-22, 80:6-15, 80:21-81:1. *Bliss* discloses monitoring for load cell failure using a weighing apparatus. EX1058, Abstract, 1:19-25, 2:14-18, 2:41-46, 4:66-5:2, 5:9-12, 10:15-19; EX1053, 78:11-79:11; EX1052, ¶421. It would have been obvious for *Coli*’s control system to monitor the status of *Ekanayake*’s filter assembly and associated wireless communication module (“*turbine air inlet filter transmitter*”) using *Bliss*’s technique to ensure that these components are operating properly. EX1052, ¶¶375-383, 422; EX1023, 38:8-39:17.

SC 48: *Supra*, §I.C.1 (SC 42); *see* SC 47 above; Pet., 42 (OC 9); Opp., 5-7 (SC 22, 29); EX1052, ¶¶423-425.

SC 49: *Supra*, §I.C.2 ([43c], [43d]); *see* SC 48 above; EX1052, ¶426.

SC 52: Pet., 39, 43 (OC 3, 12); Opp., 21-23 (SC 33). *Coli*’s “control center 40” “monitor[s]” “the entire fracturing operation,” including turbine generators. EX1004, [0010], [0072]. It would have been obvious to monitor [52c]’s “*operating characteristics*” in view of *Coli* and because it was known and/or obvious to do so. EX1023, 80:5-82:20; EX1052, ¶429. ***Gas fuel main valve discharge pressure transmitter failure.*** *Birch*’s “under and over pressure electronic sensors 6a and 6b,” disclose this characteristic because the sensors monitor pressure of a gas fuel mains supply 1, which supplies gas to the turbine generator and includes a valve just before

the sensors. EX1005, 2:30-39, Fig. 1; EX1052, ¶430. It would have been obvious to monitor whether such a transmitter failed, consistent with well-known pressure transmitter functionality, and to improve safety. EX1052, ¶430; EX1023, 81:4-15. ***Backup system relay failure.*** *Hunt* discloses switchgear control relay 229 (backup system relay) that controls utility power bus 260 (the backup system). Pet., 54-55; EX1008, [0033]-[0035], [0046], [0075]-[0076]; EX1052, ¶431. It would have been obvious to monitor this relay's status, including for failure, to determine whether backup power was available. EX1052, ¶431; EX1023, 81:16-82:20.

SC 54: *Supra*, §I.C.3 ([45c]); *see* SC 48 above; Pet., 65 (OC 15); Opp., 18-20 (SC 35); EX1052, ¶¶432-435.

SC 57: *Supra*, §I.C.3 (SC [43c], [43d]); *see* SC 56 above; Pet., 66-69 (OC 17); EX1052, ¶¶447-449; EX1004, [0038] (“[o]ne or more [] turbine generators”).

SC 59: *See* [56h] above; *supra*, §I.C.1 ([42a]); EX1052, ¶¶450-452.

5. Ground 16A: Substitute Claim 50 is Obvious.

[50a]-[50b] are obvious. *Supra*, §I.C.1 ([42a], [48a]). Moreover, *Allam* discloses compressing liquefied natural gas (LNG) and controlling such compression. EX1054, 8:30-33, 15:39-46; EX1052, ¶¶488. A POSITA would have been motivated to combine *Allam* with the combination to ensure LNG supply to gas turbine generators, and doing so applies known techniques (controlling LNG compression) to a known system (turbine generator fueled by LNG in hydraulic

fracturing system), ready for improvement (ensuring LNG supply). EX1052, ¶¶479-489; EX1004, [0036]. [50c]-[50d] are obvious. *Infra*, §I.C.9 ([44b]-[44d]); *supra*, §I.C.4 (SC 48); Pet., 42-43 (OC 11); Opp., 16-18 (SC 31).

6. Ground 17A: Substitute Claim 51 is Obvious.

Supra, §I.C.4 (SC 48); Pet., 39, 43 (OC 3, 12); Opp. 8-14 (SC 32); PG, 11-12, 14 (SC 32). *Coli*'s "control center 40" "controls" and "monitor[s]" "the entire fracturing operation," including turbine generators. EX1004, [0010], [0072]. It would have been obvious to monitor [51c]'s "operating characteristics" in view of *Coli* and because it was known and/or obvious to do so. EX1023, 33:18-48:8; EX1052, ¶¶497-523. It would have been obvious to monitor for the various thermocouple and transmitter failures consistent with well-known functionality of pressure transmitters to transmit failure codes. EX1052, ¶¶511, 513, 519-520; EX1030, C-4-5; EX1031, D-5.

Fuel system air supply pressure transmitter failure: *Kohlenberger* discloses sensors (transmitters) for monitoring pressure at the gas turbine's air inlet (fuel system air supply pressure). EX1026, 6:2-6. ***Thermocouple input module thermistor failure:*** *Birch* discloses a "thermocouple 18 for monitoring the discharge (gas) temperature." EX1005, 3:4-13. ***Start VFD configuration failure:*** *Coli* discloses "variable frequency drives" (VFDs). EX1004, [0065]; Pet., 25. *Rusnak* discloses an external controller 30 (centralized control unit) that controls a VFD and

“automatically reset[s] [a] faulted condition” in the VFD. EX1007, [0087], [0020]-[0021]; Pet., 34. It would have been obvious for “faulted condition” to include failure to start. EX1052, ¶515. ***Generator circuit breaker failure to open:*** *Weiher* discloses a circuit breaker electronic trip unit that provides an alarm if the circuit breaker fails to open (stuck breaker) EX1028, 3:1-3, 3:58-66, 5:34-36, 9:3-8. ***Gas fuel supply pressure transmitter failure:*** *Birch* discloses monitoring pressure of a mains supply that provides natural gas to a turbine generator’s compressor. EX1005, 2:30-39, Fig. 1; *supra* §I.C.4 (SC 52). ***Gas fuel control pressure transmitter failure:*** *Birch* discloses “pressure sensor 17” for monitoring the discharge pressure of a compressor. EX1005, 3:4-8, 3:37-4:12, Abstract. ***Utility circuit breaker closed:*** The switchgear discloses a utility circuit breaker. Pet., 60-65; EX1052, ¶521. *Coli*’s control system “monitor[ing]” “the entire fracturing operation” would have monitored the utility circuit breaker’s status, including whether it is open or closed. *Id.* ***Generator frequency:*** *Hunt* discloses monitoring generator frequency. EX1008, [0040], [0054]. ***Engine serial number:*** *Newman* discloses a “life tracking system (LTS) for automatically identifying and recording” gas turbine engine configurations by “serial number.” EX1029, 1:50-58. It would have been obvious to monitor the turbine generator’s “*engine serial number*” to associate the monitored characteristics with the relevant engine. EX1052, ¶523; EX1023, 46:4-48:8.

A POSITA would have been motivated to combine *Coli*’s control system with

*Kohlenberger, Birch, Ekanayake, Hunt, Weiher, Bliss, Broussard*⁰⁷⁹, and *Newman*'s monitoring techniques to further *Coli*'s "control" and "monitoring for the entire fracturing operation" and for details regarding monitoring turbine generators. EX1052, ¶¶504-506; EX1004, [0072]. A POSITA would have been motivated to monitor [51c]'s characteristics to take appropriate action, *e.g.*, to replace/repair a failed component, restart a component, improve safety, and to ensure characteristics fall within the appropriate ranges for proper/efficient function. EX1052, ¶¶510-523; EX1023, 35:4-38:7, 40:8-14, 41:2-46:3. Doing so applies known techniques (monitoring turbine generators and associated equipment) to a known system (hydraulic system with turbine generators) ready for improvement (improving functionality and safety). EX1052, ¶506.

7. Ground 18A: Substitute Claim 53 is Obvious.

Supra, §I.C.4 (SC 47); Pet., 43-44 (OC 14); Opp., 23-25 (SC 34); PG, 13-14, 20. *Coli*'s "control center 40" "monitor[s]" "the entire fracturing operation," which includes VFDs. EX1004, [0065]-[0066], [0072]. It would have been obvious to monitor [53c]'s "operating characteristics," in view of *Coli* and because it was known and/or obvious to do so. *See* EX1023, 82:21-87:2; EX1052, ¶¶547-562.

Motor winding temperatures: *Discenzo* discloses monitoring an electric motor's "winding temperature." EX1038, 3:1-12, 6:39-43, 8:65-9:13; EX1052, ¶¶557-558; EX1023, 83:6-84:6. ***The motor RPM:*** *Rusnak*'s VFD measures motor

speed (motor RPM). EX1007, [0002]-[0003]; EX1052, ¶559; EX1023, 84:7-20. ***The voltage:*** *Rusnak* discloses monitoring a VFD's voltage. EX1007, [0005]. *Discenzo* discloses VFDs monitoring motor voltage. EX1038, 6:35-39; EX1023, 85:12-86:3; EX1052, ¶560. ***The torque and the current (amperage):*** *Rusnak*'s VFD measures motor torque and monitors "output current." EX1007, [0003], [0005]; EX1052, ¶¶561-562; EX1023, 85:12-86:19. *Discenzo*'s VFDs also monitor current. EX1038, 6:35-39.

A POSITA would have been motivated to combine *Coli*'s system with *Discenzo* and *Rusnak*'s monitoring techniques to further *Coli*'s "monitoring for the entire fracturing operation [] at a single central location." EX1052, ¶¶550-551, 556; EX1004, [0072]. Doing so applies known techniques (monitoring electric motors and VFDs) to a known system (hydraulic fracturing system, which includes electric motors and VFDs that control the electric motors) ready for improvement (improving *Coli*'s system monitoring functionality). EX1052, ¶551.

8. Ground 19A: Substitute Claim 55 is Obvious.

Supra, §§I.C.3-4 (SC 46, 54); Pet., 66 (OC 16); Opp., 20-21 (SC 27, 36).

9. Ground 20A: Substitute Claim 44 is Obvious.

Supra, §I.C.2 (SC 43); Pet., 39 (OC 5); Opp., 16-18 (SC 25); EX1052, ¶¶592-621. **[44b]:** *Clancy* discloses "an engine generates power and transfers the power generated using a hydraulic system. The hydraulic system is used to drive two

natural gas compressors, a natural gas after-cooler and a water pump.” EX1055, [0027], [0004]-[0005], [0007]; EX1052, ¶611 (citing EX1065, 527). A POSITA would have been motivated to incorporate *Clancy*’s hydraulic system to obtain power to drive the compressors and pumps, and because doing so involves applying known techniques (hydraulic systems) to known systems (hydraulic fracturing systems) ready for improvement (powering components). EX1052, ¶600.

[44c]-[44d]: *Delaney* discloses monitoring hydraulic system operating characteristics. *Delaney* discloses hydraulic valve “system controller 40,” which monitors hydraulic system characteristics discussed below. EX1059, 3:21-28, 2:64-66, 4:51-62, 5:26-38, Fig. 6. *Weir* also disclosed monitoring hydraulic system operating characteristics by disclosing a “pump monitoring device,” which monitors multiple functions of the hydraulic system discussed below. It would have been obvious to monitor [44d]’s operating characteristics in view of *Coli*’s “control center 40” that “monitor[s]” “the entire fracturing operation” (EX1004, [0010], [0072]) and *Delaney-Weir*’s monitoring hydraulic system operating characteristics, and because it was known and/or obvious to do so. EX1052, ¶¶601-603; EX1023, 80:5-82:20. Doing so applies known techniques (monitoring hydraulic pumps) to a known system (hydraulic fracturing system) ready for improvement. EX1052, ¶604.

System pressure, Temperature: *Coli* teaches monitoring pump pressure. Pet., 30-32. *Delaney* discloses monitoring hydraulic “system oil pressure and

temperature.” EX1059, 3:21-28, 2:64-66, 4:51-62, 5:26-38, Fig. 6; EX1023, 58:7-13, 59:21-60:15. **Charge pressure:** *Weir*’s “pump monitoring device (PMD)” monitors for a hydraulic system pump’s “insufficient charge pressure.” EX1060, 34; *id.*, 21, 23-28; EX1052, ¶618; EX1023, 59:5-11. **Hydraulic oil level:** *Delaney* discloses monitoring “hydraulic fluid [oil] level in reservoirs.” EX1059, 3:21-28, 2:64-66, 4:51-62, 5:26-38, Fig. 6; EX1023, 61:6-11. **Filter status:** *Delaney* discloses monitoring filter status: “[r]eturn filter 35 condition is indicated by the pressure drop across the filter, which is reported by a sensor to valve system controller 40, which reports the need for maintenance.” EX1059, 3:21-28; EX1023, 61:22-62:13.

A POSITA would have been motivated to combine *Coli*’s system with *Delaney* and *Weir*’s monitoring techniques to further *Coli*’s “control and [] monitoring for the entire fracturing operation.” EX1052, ¶¶598-608; EX1004, [0072]. Further, a POSITA would have been motivated, in light of *Clancy*, to look to *Delaney* and *Weir*, which disclose complimentary hydraulic systems, for details of which characteristics to monitor. EX1052, ¶¶601-602, 606; EX1055, [0003]-[0004], [0009], [0027]-[0028], [0061], [0067], [0073], [0077]; EX1059, 1:19-24, 3:21-28, 3:49-51. A POSITA would have been motivated to combine such systems to minimize costly damage and increase pump longevity. EX1052, ¶607; EX1060, 34. Doing so applies known techniques (monitoring characteristics) to a known system (hydraulic fracturing system) ready for improvement (improving *Coli*’s

system monitoring functionality). EX1052, ¶¶604, 608.

10. Ground 21A: Substitute Claim 58 is Obvious.

Supra, §1.C.4 (SC 56); Pet., 70 (OC 19); Opp., 25-30 (SC 39); PG 14, 18-19. *Coli*'s "control center 40" "controls" and "monitor[s]" "the entire fracturing operation," which includes SC 58's equipment/characteristics. EX1004, [0010], [0072]. It would have been obvious to monitor SC 58's equipment in view of *Coli* and because it was known and/or obvious to do so. EX1052, ¶¶639-651.

Compression of natural gas: See Pet., 36-39 (OC [2b]). ***Electric motors:*** *Coli* discloses controlling electric motors via a VFD. Pet., 32-33; EX1004, [0011], [0065], [0072]. ***Switchgear:*** A switchgear is part of the combined system. Pet., 58-65. ***Transformers:*** *Coli* discloses an electrical transformer. EX1004, [0047], Fig. 3. ***Mobile turbines:*** *Coli* in view of *Birch* discloses monitoring/controlling gaseous fuel compression for a gas turbine generator. Pet., 36-39. *Broussard*079 discloses mobile turbines. EX1024, [0008]; EX1052, ¶647. ***Rate and pressure of the overall system:*** *Coli* discloses controlling the rate of the overall system. EX1052, ¶¶648-649; EX1004, [0071]. The combined system discloses monitoring/controlling various system pressures. Pet., 30-32 (pump pressure); see *supra* §§1.C.4, 1.C.6 (SC 51-52, turbine generator pressure), §I.C.9 (SC [44d], hydraulic system pressure); EX1052, ¶¶648-649. ***Vertical sand silos:*** *McIver* discloses vertical silos, monitoring "the level of sand in each silo" and controlling "the rate at which the sand or other proppant is

[] removed from the silo.” EX1039, [0017], [0056]. *Electrical conveyer belt: McIver* discloses a VFD that controls the speed of its electrical dual conveyer belt system. EX1039, [0044]-[0045], [0054], [0056]; EX1052, ¶651.

A POSITA would have been motivated to combine *McIver*’s proppant storage and transport equipment with *Coli* to ensure sufficient proppant for *Coli*’s proppant blending functions. EX1052, ¶640; EX1004, [0053]-[0055]. A POSITA further would have been motivated to incorporate *McIver*’s monitoring functionality to further *Coli*’s “monitoring” “the entire fracturing operation.” EX1052, ¶640; EX1004, [0072]. Doing so applies known techniques (proppant storage and transport equipment and the monitoring thereof) to a known system (hydraulic fracturing system with a blender) ready for improvement. EX1052, ¶640.

11. Grounds 12-21B: Substitute Claims 41-59 are Obvious.

SC 41-59 are obvious based on the references discussed in Grounds 12-26A, respectively, in combination with the public availability of each limitation based on Dr. Durham’s testimony and as admitted by Dr. Nikolaou:

Ground	SC	Evidence of What Was Otherwise Available to the Public and a POSITA’s Motivations
12B	41[p]-[g]	<i>Supra</i> , §1.C.1; EX1052, ¶¶241-247; EX1053, 10:20-11:2, 11:11-17, 12:13-13:12 ([41[g]]).
	41[h]-[n]	<i>Supra</i> , §1.C.1; EX1052, ¶¶248-296; EX1053, 21:1-13, 22:20-23:2 (water separator status); <i>id.</i> , 24:20-25:2, 25:11-18, 27:7-9, 27:22-28:3, 29:7-10, 30:11-31:1, 32:21-33:1 (particulate filter status); <i>id.</i> , 34:2-10, 34:21-35:5, 35:17-36:7, 37:6-17,

		38:20-39:6, 39:16-40:1, 40:11-17, 43:5-6 (gas pressures); <i>id.</i> , 40:3-17 (gas temperatures); <i>id.</i> , 48:21-49:12 (valve statuses); <i>id.</i> , 52:2-15, 53:7-18, 54:14-22 (filter bypass status).
	42	<i>Supra</i> , §1.C.1; EX1052, ¶¶297-302; EX1023, 31:7-9 ([42[a]).
13B	43	<i>Supra</i> , §1.C.2; EX1052, ¶¶316-321; EX1023, 52:16-53:5 (43[d]).
14B	45	<i>Supra</i> , §1.C.3; EX1052, ¶¶349-359; EX1053, 72:6-73:8 (45[c]).
	46	<i>Supra</i> , §1.C.3; EX1052, ¶¶360-369; EX1053, 96:4-8 (46[c]).
15B	47, 56	<i>Supra</i> , §1.C.4; EX1052, ¶¶454-461 (SC 47-48), 473-465 (SC 56); EX1053, 79:12-16 (47[i], 56[i]); EX1023, 39:13-17 (same).
	48, 59	<i>Supra</i> , §1.C.4; Ground 12B (42[a]).
	49, 57	<i>Supra</i> , §1.C.4; Ground 13B (43[c], 43[d]).
	52	<i>Supra</i> , §1.C.4; EX1052, ¶¶463-471; EX1023, 81:9-15 (gas fuel main discharge pressure transmitter failure); <i>id.</i> , 82:11-16 (backup system relay failure).
	54	<i>Supra</i> , §1.C.4; Ground 14B (45[c]).
16B	50	<i>Supra</i> , §1.C.5; EX1052, ¶¶494-496; Ground 20B (50[d]).
17B	51	<i>Supra</i> , §1.C.6; EX1052, ¶¶524-546; EX1023, 35:14-21 (fuel system air supply pressure transmitter failure); <i>id.</i> , 36:20-37:3 (thermocouple input module thermistor failure); <i>id.</i> , 37:22-38:7 (start VFD configuration failure); <i>id.</i> , 40:15-41:1 (generator circuit breaker failure to open); <i>id.</i> , 42:4-9 (gas fuel supply pressure transmitter failure); <i>id.</i> , 43:10-15 (gas fuel control pressure transmitter failure); <i>id.</i> , 44:13-19 (utility circuit breaker closed); <i>id.</i> , 45:17-46:3 (generator frequency); <i>id.</i> , 48:3-8 (engine serial number).
18B	53	<i>Supra</i> , §1.C.7; EX1052, ¶¶563-577; EX1023, 83:19-84:6 (motor winding temperatures); <i>id.</i> , 84:17-20 (motor RPM); <i>id.</i> , 85:7-11 (voltage); <i>id.</i> , 85:21-86:3 (torque); <i>id.</i> , 86:12-87:2 (current (amperage)).
19B	55	<i>Supra</i> , §1.C.8; EX1052, ¶¶587-591; Ground 14B (55[b]).
20B	44	<i>Supra</i> , §1.C.9; EX1052, ¶¶622-636; EX1023, 58:7-13 (system pressure); <i>id.</i> , 59:5-11 (charge pressure); <i>id.</i> , 59:21-60:15 (temperature); <i>id.</i> , 61:6-11 (hydraulic oil level); <i>id.</i> , 61:22-62:13 (filter status).
21B	58	<i>Supra</i> , §1.C.10; EX1052, ¶¶652-653; <i>see</i> Ground 15B.

Date: December 1, 2025

Respectfully submitted,
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A handwritten signature in black ink, appearing to read "Chad C. Walters", is positioned above a horizontal line.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies on this 1st day of December, 2025, that true and correct copies of the foregoing PETITIONERS' OPPOSITION TO PATENT OWNER'S REVISED NON-CONTINGENT MOTION TO AMEND, Exhibits 1052-1072, and related documents were served in their entirety on Patent Owner via electronic mail at the following addresses:

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