

EXHIBIT A

**IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION**

**U.S. WELL SERVICES, LLC, U.S. WELL
SERVICES HOLDINGS, LLC, PROFRAC
MANUFACTURING, LLC, PROFRAC
SERVICES, LLC**

Plaintiffs,

vs.

**LIBERTY ENERGY, INC., LIBERTY
OILFIELD SERVICES LLC, LIBERTY
ADVANCED EQUIPMENT TECHNOLOGIES
LLC, ST9 GAS AND OIL LLC, ST9, INC.**

Defendants.

Civil Action No. 4:24-cv-00839-KPE

**CONFIDENTIAL – OUTSIDE
ATTORNEYS’ EYES ONLY**

**DECLARATION OF MICHAEL R. CHAMBERS, SR.
CONCERNING CLAIM CONSTRUCTION FOR THE ASSERTED PATENTS**

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I, Michael R. Chambers Sr., declare as follows:

1. I am over the age of 18 years and am fully competent to make this declaration. I make the following statements based on personal knowledge and, if called to testify to them, could and would do so.

I. INTRODUCTION

2. My name is Michael R. Chambers Sr., and I have agreed to serve as an expert witness in this matter for the Plaintiffs, U.S. Well Services, LLC, U.S. Well Services Holdings, LLC (together “USWS”), ProFrac Manufacturing, LLC, and ProFrac Services, LLC (together “ProFrac”) (collectively, “Plaintiffs”) in the above-captioned case as a technical expert on the technology of the patents described below. A copy of my curriculum vitae is attached to this Declaration as Appendix A.

3. I have been retained to provide certain opinions relating to claim construction, and this Declaration contains those opinions. Specifically, I have been asked to review U.S. Patent Nos. 10,598,258 (the “’258 Patent”), 10,655,435 (the “’435 Patent”), 11,091,992 (the “’992 Patent”), 11,208,878 (the “’878 Patent”), and 11,959,533 (the “’533 Patent”) (collectively, the “Asserted Patents”) and related documents to form an opinion regarding the meaning of certain terms used in the asserted claims. Specifically, I have been asked to form an opinion regarding the meaning of these terms as understood by persons of ordinary skill in the art reading the Asserted Patents.

4. I understand that Plaintiffs are asserting the following claims against Defendants Liberty Energy, Inc., Liberty Oilfield Services LLC, Liberty Advanced Equipment Technologies LLC, ST9 Gas and Oil LLC, and ST9, Inc. (collectively, “Liberty” or “Defendants”):

Asserted Patent	Asserted Claims
10,598,258	1-2, 4-11, 13-14, 16-24
10,655,435	1-20
11,091,992	1-20
11,208,878	1-19
11,959,533	1-10

5. I understand that the parties have identified the following terms for construction:

Term	Asserted Claim(s)	Plaintiffs' Proposed Construction	Defendants' Proposed Construction
"high pressure"	'258 patent (claims 1, 11, 15)	Plain and ordinary meaning. No construction needed. Alternatively, "high pressure" means the fluid has been pressurized and discharged out of the fracturing pump	Indefinite alternatively, "15,000 psi or more"
"a gear ratio of the planetary gear train . . . [is] selected" / "a selection of a gear ratio of the planetary gear train"	'258 patent (claims 1, 11) '533 patent (claim 19)	Plain and ordinary meaning. No construction needed.	"an operating gear from multiple operating gears of the planetary gear train . . . [is] selected" "a selection of an operating gear from multiple operating gears of the planetary gear train"

“critical plunger speed”	’258 patent (claims 4, 5, 14, 18) ’533 patent (claims 20, 21)	Plain and ordinary meaning. No construction needed.	“the speed above which fluid is accelerated too fast through a pump causing pump cavitation and damage from the formation of vacuum bubbles”
“input pinion gears”	’258 patent (claims 1, 2, 11, 12, 15, 16) ’533 patent (claims 1, 2, 8, 10, 11, 17, 22)	Plain and ordinary meaning. No construction needed.	“smaller drive gear that meshes with a larger gear”
“arms”	’533 patent (claims 1, 10, 22)	Plain and ordinary meaning. No construction needed.	Indefinite or “arms” do not include “gear teeth”
“centralized control unit”	’992 patent (claims 1-3, 6-8, 14-20)	Plain and ordinary meaning. No construction needed.	“unit that is connected to multiple pumps, electric motors, blenders, and other surface and/or downhole sensors and tools to allow the operator to control different parameters of the fracturing operation”
“emergency power off unit”	’992 patent (claims 6, 7, 15-18)	Plain and ordinary meaning. No construction needed.	“unit included in the centralized control unit that allows for the hydraulic fracturing operation to be shut off completely”

“one or more processing devices configured to receive a first parameter from a first device of the plurality of pumps, the distribution system, or the wellhead, and transmit the first parameter to a second device of the plurality of the plurality of pumps, the distribution system, or the wellhead, and detect that the first parameter is outside of an acceptable threshold; and generate automated control instructions at the second device based at least in part on the first parameter”	’435 patent (claim 1)	Plain and ordinary meaning. No construction needed.	indefinite
“generating the automated instructions at the second device based at least in part on the first parameter, and automatically adjusting one or more functions of the second device based on the automated instructions”	’435 patent (claim 7)	Plain and ordinary meaning. No construction needed.	indefinite
“generating automated instructions at the second device based at least in part on the first parameter, and automatically adjusting one or more functions of the second device based on the automated instructions”	’435 patent (claim 13)	Plain and ordinary meaning. No construction needed.	indefinite
“common support structure”	’878 patent (claim 1)	Plain and ordinary meaning. No construction needed.	“same skid, truck bed, or flatbed trailer”

6. If necessary, I am prepared to testify in Court about the statements contained in this Declaration.

7. My firm is being compensated for my work in the case at my normal hourly rate of \$295 per hour. My firm's compensation is in no way based on the outcome of this litigation or on the opinions that I provide. My firm and I have no interest, financial or otherwise, in the outcome of the current litigation between these companies.

II. EDUCATION, PROFESSIONAL EXPERIENCE, AND QUALIFICATIONS

8. My curriculum vitae is attached as Appendix A and a list of all other cases in which, during the previous years, I have testified as an expert at trial or by deposition is attached as Appendix B. Some of my relevant achievements and experience are discussed below.

9. I have over 45 years of experience in the drilling, completion, and production of all types of vertical, horizontal, conventional, and unconventional wells. I have worked worldwide on wells both onshore and offshore. I have been associated with many industry firsts on some of the deepest, hottest, and most prolific wells in the world.

10. In 1979, I obtained a Bachelor of Science degree in Petroleum Engineering from Texas A&M University. Prior to my degree I worked one summer as a roustabout for Chevron and worked as a roughneck on drilling and workover rigs during my summer and Christmas breaks while attending college.

11. My extensive career in the field of oil and gas well technologies since receiving my degree can be subdivided into the following stages:

12. First, I spent roughly 10 years working for a division of Mobil Oil Corporation ("Mobil") in West Texas and New Mexico in various engineering, supervision, and field assignments relating to drilling, completing, testing, and producing wells;

13. Second, I spent roughly 10 years working for Mobil in their technical service and research facility on industry firsts and challenging drilling, completing, testing, and producing

wells worldwide. Mobil's Dallas group was responsible for certifying downhole tools, tubulars, and connections used in company operated wells worldwide;

14. Third, I spent roughly 7 years working for Anadarko Petroleum Corporation where I was responsible for many of the company's completing and producing operations and personnel in Texas, Wyoming, Louisiana and Utah;

15. Fourth, I spent roughly 8 years working for EXCO Resources, Inc., as Vice President Operations responsible for drilling, completing, and producing wells for the company in the United States;

16. Fifth, I spent roughly 6+ years consulting on various oil and gas related projects; and,

17. Sixth, I spent approximately two years working for Geothermal Wells LLC to implement the use of hydraulic fracturing in geothermal systems.

18. I have extensive experience with field operations including the design and implementation of water floods, CO2 floods, gas and liquid gathering systems, disposal systems, electrical distribution systems, control room monitoring for 6 gas plants and field operations on over 600 high-rate oil and gas wells. Including the maintenance and repair of plunger, centrifugal, submersible and chemical pumps. I have implemented numerous VFD control systems on wells and in plants including my first application on a high volume deep submersible pump in the mid 1980's.

19. I have extensive experience working with plunger pumps including uses for:

- Mud pumps – for drilling
- Cement Pumps – for cementing casing and other uses
- Water Injection Pumps – for water flooding
- Disposal pumps – for disposing unwanted fluids in disposal wells
- Acidizing – for pumping acid into carbonate reservoirs to improve permeability
- Fracturing – to create fissures (conduits) in rocks through which sand is pumped to create permeable flow channels

20. I have extensive experience with all types of fracturing operations from my first multi-frac horizontal completion in 1988 up to simultaneous operations utilizing two separate frac fleets on one pad doing zipper fracing.

21. I have extensively involved automation in my designs though out my career whether in gas plants, artificial lift or field operations including a 24/7 control room in EXCO Resources Dallas office to monitor and control gas production of over 1 BCFD from over 500 wells.

22. I have implemented the use of fuel gas to replace diesel on generators used in about 1/3 of our 25 drilling rigs operating in the Haynesville field.

23. I have been heavily involved with the Society of Petroleum Engineers (SPE), where I have organized and run meetings on the latest developments and theories relating to Horizontal Completions, Horizontal Stimulations, and Multi-Lateral Well Construction and Completion methods. I was a distinguished lecturer for the SPE and a reprint chairman. I have presented papers, run forums and workshops, and conducted training sessions for SPE as well as the American Association of Petroleum Geologists (AAPG).

24. I am past president of the Completion Engineering Association (CEA) which was heavily involved with funding research and promoting new and innovative completion techniques and methods.

25. I was a founding member of TAML (Technology for the Advancement of Multi-Laterals), which is a group of industry experts classifying, promoting, and understanding multi-lateral (or horizontal) wells.

26. I was Mobil's Completion Representative in MoBPTeCh—a consortium of 4 major oil production companies (Mobil, BP, Texaco, and Chevron) in partnership with Texas A&M Petroleum Engineering Department to research and test new emerging technologies in drilling and completion (e.g., technologies like Multi-Lateral Junctions, expandables, and downhole laser welding). Working with this group I received Texaco's Chairman's award for assistance in their first difficult Level 4 Multi-lateral well.

27. I have extensive experience involving fracturing, having been involved with over 1,000 wells requiring fracturing since 1979. I have fractured some of the deepest horizontal wells in the world. Most of my fracturing experience has involved multi-frac stimulation of horizontal wells using a variety of methods. In the Haynesville Shale and Eagle Ford shales I have been involved with over 1,000 wells with lateral lengths of almost 2 miles and over 45 stages. I assisted Halliburton in their first time application of the Sand Box method to transport and distribute sand into the blender.

28. In the 1990's, Mobil was one of the leading companies in fracturing and particularly fracturing horizontal wells. We had our own design software and laboratories to run experiments with stressed cells and to test fluid properties. I worked alongside a group of Ph.D experts including Dr. Ibrahim Abou-Sayed and Wadood El-Rabaa to implement many new procedures. In 2011, I was asked to and gave a Keynote Speech at the Hydraulic Fracturing Technology Conference and Exhibition titled "Shale Fracturing".

29. Throughout my career I have worked with over 10 fracturing companies to implement improvements to operations and reduce equipment failures.

30. I also have extensive involvement with coil tubing run in over 1,000 wells in some of the deepest, hottest, and most challenging wells in the world. When I was President of the CEA, we funded some of the first computer modeling programs for coiled tubing. Mobil had in-house engineers to test these new programs and recommend improvements. I worked with other Mobil Engineers on a first-time application to develop and install an enormous coil reel on the Hibernia Platform in Canada enabling the ability to reach Total Depth (TD) on all directional wells. This required one of the first-time applications to weld multiple coil tubing strings together in an offshore environment.

31. Throughout my career I have been involved (working with service companies and service company engineers) with the development (testing, certification and first time use) of new types of isolation and stimulation tools for open hole and cased hole wells, including the development of the composite bridge plug, annular safety valve, hollow whipstock for multi-lateral wells, 9-5/8" coil tubing retrievable bridge plug for HPHT, composite tubing coupling, high load liner hangers, perforating cements, and a Level 6 Multi-lateral Junction. I have also participated in the performance certification of metal to metal and elastomeric tubular connections.

32. I am an author or co-author of numerous publications and presentations relating to oil and gas production and in particular well completions methods. A sample of my publications and presentations are listed in my curriculum vitae attached as Appendix A to this report.

33. I have been awarded 5 patents and currently have 4 patents relating to Geothermal Completions and Drilling in the process of approval.

III. MATERIALS REVIEWED

34. In forming my opinions, I have reviewed the Asserted Patents, including their specifications and prosecution histories. Additionally, I have relied on the materials cited throughout my declaration. I reserve the right to respond to any positions that an expert may submit on behalf of Liberty.

IV. LEGAL STANDARDS

A. Level of Ordinary Skill in the Art

35. I understand that terms in the patent claims must be read as they would have been understood by a person of ordinary skill in the art (“POSITA”) when the application that led to the Asserted Patent was first filed. My analysis does not and will not change should the priority date for the Asserted Patents be found to be later than the asserted priority dates because generally, the terms discussed below would not have changed in meaning to a POSITA from around 2012 to present.

36. I have also been advised that a POSITA is a hypothetical person to which the claimed subject matter pertains with the capability of understanding the scientific and engineering principles applicable to the pertinent art. I understand that the following factors may be considered in determining the level of ordinary skill: type of problems encountered in the art; prior art solutions to those problems; speed with which innovations are made; sophistication of the technology; and education level of active workers in the field. I also understand that not every factor may be present and that one or more factors may predominate.

37. I have been instructed by counsel that a POSITA is not a genius or expert in the art at hand, or one with a unique or special skill, and is not necessarily represented by the skill, education, or experience of the inventor. I have also been informed that this POSITA has common sense and ordinary creativity and is not an automaton.

38. I believe that a POSITA, as of the priority dates of the Asserted Patents, would have either (1) a Bachelor of Science in Mechanical Engineering, Electrical Engineering, Petroleum Engineering or an equivalent field and at least two years of academic or industry experience in the oil and gas industry, including well drilling, completion, or production; or (2) at least four years of industry experience in the oil and gas industry, including well drilling, completion, or production.

39. In light of my knowledge, education, training, academic background, and experience, together with my extensive industry experience spanning over five decades, I satisfy the requirements to be a POSITA for each of the Asserted Patents and I believe myself to be a POSITA for each of the Asserted Patents.

B. Legal Background

40. In performing my analysis and reaching my conclusions and opinions, I have applied various legal principles relating to claim construction. In setting forth these legal standards, I am only providing my understanding of the law as context, and I in no way intend to testify about the law.

41. I understand a patent may include two types of claims: independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend on an independent claim or another dependent claim. I understand a dependent claim includes all the limitations it recites in addition to all the limitations recited in the claim(s) on which it depends.

42. I understand claim terms are to be given their ordinary and customary meaning to a POSITA, absent lexicography or disavowal. In determining the meaning of a claim term, a court may look to the language of the claims, the specification, the prosecution history, and extrinsic evidence. I understand courts do not read limitations from the specification into claims and do not

redefine words. I also understand the law presumes the same term appearing in different portions of the claims should be given the same meaning. I understand the law also provides different claim terms are presumed to have different meanings.

43. I understand that patent claims must particularly point out and distinctly claim the subject matter regarded as the invention. I understand that, in order to be valid, the claims of a patent must be sufficiently definite that one skilled in the art can determine the metes and bounds of the claimed invention. I understand that a claim, when viewed in light of the intrinsic evidence, must inform those of skill in the art about the scope of the invention with reasonable certainty. I understand that if a claim fails to do so, it is deemed indefinite. I understand that a claim must be precise enough to afford clear notice of what is claimed, thereby apprising the public of what is still open to them.

V. HYDRAULIC FRACTURING AND EQUIPMENT OVERVIEW

A. Hydraulic Fracturing

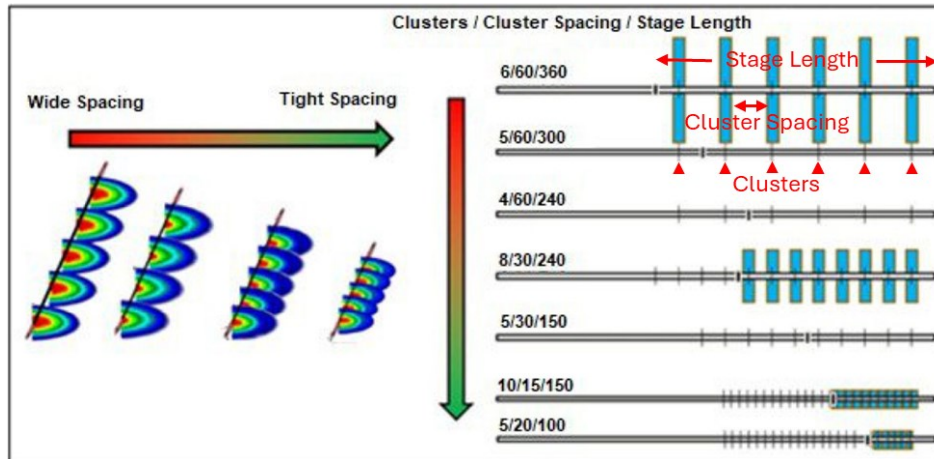
44. Oil and gas deposits are not in lakes or pools below ground. Instead, they are located in the porous space between individual grains in the clay or rock at depths from less than 1000 ft to greater than 20,000 ft below surface. These pores are often very small and not well interconnected, particularly in the fields that were developed with horizontal wells starting in the 2000's. The ability of the oil and gas to flow through the pores in the rock is measured by the permeability of the rock. The permeability of the rock on most conventional onshore formations is measured in millidarcies (md). These permeabilities allow a well to drain an area hundreds or thousands of feet from the well.

45. Before hydraulic fracturing was widely used, only reservoirs with relatively large, interconnected pores could be developed economically ($> \sim 1$ md). Hydraulic fracturing involves pumping fluid (usually water) at a pressure high enough to cause the rock to split open (fracture).

Once the fracture has been started, a mixture of fluid (usually water) and proppant (usually sand) are pumped into the open fracture. The fluid leaks off and the formation closes around the proppant after the treatment. The proppant creates a pathway with larger, better interconnected pores that is much easier for the oil and gas to flow through than the adjacent formation. This higher permeability pathway allows more oil and gas to be produced than without fracturing. As a result of the ability to flow at higher rates, fracturing improved the economics on wells that could be developed without fracturing. The ability to flow higher rates of oil and gas from fracturing also resulted in the development of reservoirs that could not be economically developed without fracturing. As hydraulic fracturing improved during the 1980's and 1990's, lower permeability reservoirs were developed economically with vertical wells.

46. Hydraulic fracturing was combined with horizontal wells to develop reservoirs with much lower permeability. Terms for fracturing a horizontal well are explained below. A perforation cluster is a group of perforations (typically 2 to 8 perforations per cluster) that are created from a single perforating gun over 1–2 feet. A fracture is designed to initiate from each cluster. The cluster spacing is the distance between individual clusters and is commonly 15 to 25 feet. 4 to 15 clusters are typically perforated on a single wireline run with multiple guns after setting a plug to isolate the previous frac stages. These clusters that were added in a single perforating run are treated in a single frac stage which is commonly between 100 and 250 feet long. The number of frac stages is dependent on the stage length and the length of the laterals and can exceed 100 stages per well. It is now common in horizontal wells to place hundreds of fractures per well. Each fracture is formed like the process above where each fracture is created and then propped open with sand or ceramic material.

47. The combination of horizontal wells and hydraulic fracturing has resulted in the ability to economically develop reservoirs that are much less than 1/1000 of the permeability that was required in the past to develop with unfractured vertical wells. The figure below shows an example of the progression of horizontal well fracturing conduits (blue bars) with tighter cluster perforation spacing and shorter stages.¹



48. It is now common in horizontal wells to place hundreds of fractures per well, with each fracture spaced 15 to 25 feet apart. Each fracture is formed similar to the process above where each fracture is created and propped open with sand or ceramic material. The combination of horizontal wells and hydraulic fracturing has resulted in being able to economically develop reservoirs that are much less than 1/1000 of the permeability that was required in the past to develop with unfractured vertical wells.

49. A POSITA that works with fracturing can estimate what the surface treating pressure will be when fracturing a well based on expected conditions. The surface treating pressure (STP) can be estimated by taking the pressure in the fracture outside of the perforations, subtracting

¹Figure from <https://jpt.spe.org/twa/key-design-considerations-maximizing-recovery-rate-unconventional-reservoirs> showing progression of tighter cluster spacing and shorter frac stages. Clusters, cluster spacing and stage length added to drawing in red.

the hydrostatic head of the fluid, and adding the pipe friction and the perforation friction using the below equation. Once the STP is estimated, and the desired pumping rate for a job is decided, then a POSITA can use that information to determine the minimum amount of hydraulic horsepower needed on site to perform the fracturing job.²

$$STP = [FG * TVD] - [.052 * \rho_{fluid} * TVD] + [\Delta_{friction} * \frac{MD}{1000}] + \Delta_{perf}$$

$$HHP = \frac{Rate * STP}{40.8}$$

STP = Surface Treating Pressure (psi)

FG = Frac Gradient (psi/ft)

MD = Measured Depth of Perforations (ft)

TVD = True Vertical Depth of Perforations (ft)

ρ_{fluid} = Density of the fluid (ppg)

$\Delta_{friction}$ = Pipe Friction pressure drop (psi/1000 ft)

Δ_{perf} = Perforation Friction pressure drop (psi)

HHP = Hydraulic Horsepower

Rate = Pump Rate (bpm)

50. Below are examples of Surface Treating Pressures for different *FGs*, depths and rates:

Parameter	Well 1	Well 1	Well 2	Well 2
Rate (BPM)	40	80	50	80
Frac Gradient (psi/ft)	0.75	0.75	1.00	1.00
MD (ft)	2500	2500	20000	20000
TVD (ft)	2500	2500	12000	12000
Density of Fluid (ppg)	8.4	8.4	8.4	8.4
Pipe Friction (psi/1000 ft)	75	180	100	180
Perf Friction (psi)	1000	1000	1200	1200
STP (psi)	1971	2233	9958	11558
HHP	1932	4378	12203	22663

² The HHP calculation shown is an estimate of the hydraulic horsepower required for the job design, but often extra horsepower is brought to site because of equipment efficiencies and to prepare for the event of one or more pieces of equipment needing maintenance during the job.

These parameters are known or can be estimated based on wellbore configuration, FG for wells in the area and friction charts

B. Equipment Used

51. While the equipment used to perform hydraulic fracturing has improved significantly in the last half century, the basic process has remained the same. Below is an excerpt from Chapter 12 of the book *Hydraulic Fracturing: Fundamentals and Advancements* (“Chapter 12”) published by the Society of Petroleum Engineers (SPE), which is the preeminent oil and gas professional organization in the world.³

12.3 Fracturing Equipment

The requirement for higher injection rates, increased treating pressure of fluids (both liquids and gases), and larger masses of propping agents and chemical volumes dictated the development of specialized mobile and reliable oilfield pumping equipment. Modern hydraulic-fracturing operations use several million dollars worth of fit-for-purpose equipment built to meet specific needs. Significant improvements in equipment, materials, treatment monitoring, communication, safety, and environmental protection have helped propel the industry in general and specifically drive reliability in field execution of hydraulic-fracturing treatments. [Fig. 12.2](#) shows an idealized schematic of the equipment layout for this process, with conventional, nitrogen (N₂), and CO₂ pumping units. When nonenergized treatments are being conducted, there will be no N₂ or CO₂ pumps. This basic configuration is similar to that for modern unconventional-resource stimulation treatments, except for significantly more equipment. In the fracture-treatment process, water, chemical additives from the liquid transports, and proppant from the feeders are slurried at the blender, discharged to a manifold, then transmitted to the high-pressure pumps. The high-pressure pumps intensify the fluid pressure of the slurry and discharge it back to the high-pressure manifold of the missile. The intensified slurry travels from the manifold through the treating iron to the wellhead.

³ USWS_Liberty_0010611 at 618–620.

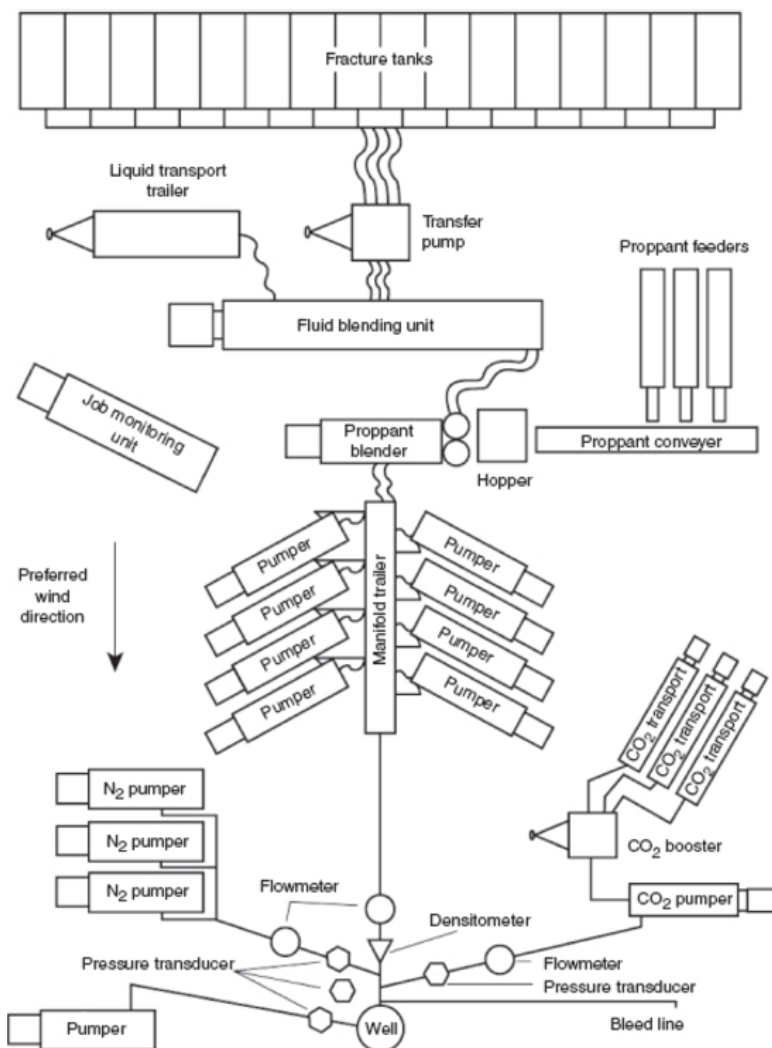


Fig. 12.2—Common equipment layout for a hydraulic-fracturing treatment. Only foam fracturing would include the nitrogen or carbon dioxide pumping units (Brown et al. 2000).

12.3.1 High-Pressure Pumping Units. Pumping units are skid-mounted, trailer-mounted, or body-loads configurations. In 1954, typical pumping equipment provided 300 hydraulic horsepower (hHP) per pump and by 1967 gas turbine engines could deliver 850 hHP/pump and 550 hHP/pump with the conventional diesel engine (Howard and Fast 1970). Today, the industry can use pumps that deliver in excess of 3,000 hHP/pump. The most prolific pumps used for hydraulic-fracturing operations are diesel-powered engines that deliver 2,000 to 2,500 hHP/pump with working pressures of 20,000 psi delivering 1,200 gal/min. Diesel engines have a high compression ratio and reliably operate near maximum brake horsepower (bHP) (i.e., have high mechanical efficiency), resulting in low fuel consumption, and they are cost-effective to construct and maintain. However, service life of the pump is greatly extended when it is routinely operated at a lower practicable horsepower. The iron on the pump must be sized to the capabilities for the pump rate and pressures, to ensure that performance efficiency of the pump is not reduced. Gas turbine engines were used in the past and had some advantage with the low weight-to-horsepower relationship, but they simply could not compete with the available horsepower output, fuel consumption, and construction cost of diesel engines. An inherent limitation with gas turbine engines is sensitivity to high temperatures and airborne particulates and the need for specialized maintenance technicians.

52. This book, published in 2019, is an update to SPE's 1989 book *Recent Advances in Hydraulic Fracturing, Monograph Series Vol. 12* ("Monograph 12"). As you can see from the below excerpt, the process has not changed much at a high level over time:⁴

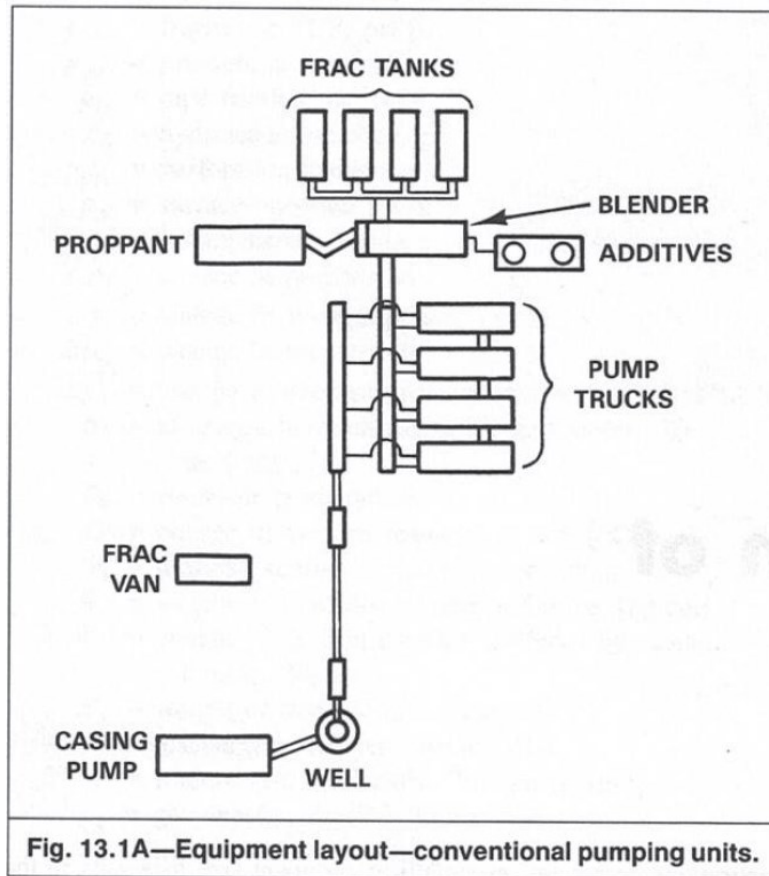
13.3 Fracturing Equipment

This section briefly describes the different equipment units used in storing, blending, and pumping fracturing fluids and slurries. Fig. 13.1A shows a schematic of equipment on a well site for conventional pumping units where pump pressures are normally less than 10,000 psi [69 MPa]. Pressure intensifiers are frequently used where surface pressures exceed 10,000 psi [69 MPa], or for long pumping times of 4 hours or more at pressures greater than 8,000 psi [55 MPa]. Such a typical hookup is shown in Fig. 13.1B. Fig. 13.2 is a photograph of fracturing equipment on location for a large treatment.

Before the fracturing treatment, the base gel of polymer and brine may have been mixed and stored in fracturing-fluid tanks. Water alone is stored in the tanks when a liquid gel concentrate is to be used. Mixing of the gel and quality-control testing are described later. During pumping, the fluid moves from the tanks to a common header and is then pulled to the blender by the centrifugal pump mounted on the blender. Fluid-loss additives may be added at the blender or may have been premixed in the initial gel preparation in the fluid tanks the day before. The proppant is added at the blender in a prescribed schedule, such as that illustrated in Table 13.1. The photograph in Fig. 13.3 shows bulk sand handlers feeding sand to a conveyor belt, which carries it to the blender and mixes it with fluid from the fracture tanks shown. The gelled fluid pads and the fluid/proppant mixtures (slurries) are pumped from the blender to the manifold for intake to high-pressure pumps or pressure intensifiers. Fig. 13.4 shows a manifold hookup to pump trucks. The crosslinking agents may be added at the blender or downstream of the blender at the intake manifold to the high-pressure pumps. If diesel oil is used as a fluid-loss additive, mixing it in the blender allows better dispersion of diesel-oil droplets in the viscous gel. The required number of pumps selected for the design rate are hooked up to the intake manifold along with the backup pumps in case any of the on-line pressure pumps shut down. Centrifugal pumps prime the intake manifold for good fluid supply to the high-pressure pumps. The high-pressure pumps are tied into a high-pressure manifold leading to the high-pressure line to the wellhead. Wellhead isolation tools are often used to isolate and protect the wellhead from the high pumping pressures involved in fracturing treatments. Such a tool is shown in Fig. 13.5.

⁴ USWS_Liberty_0010678-679.

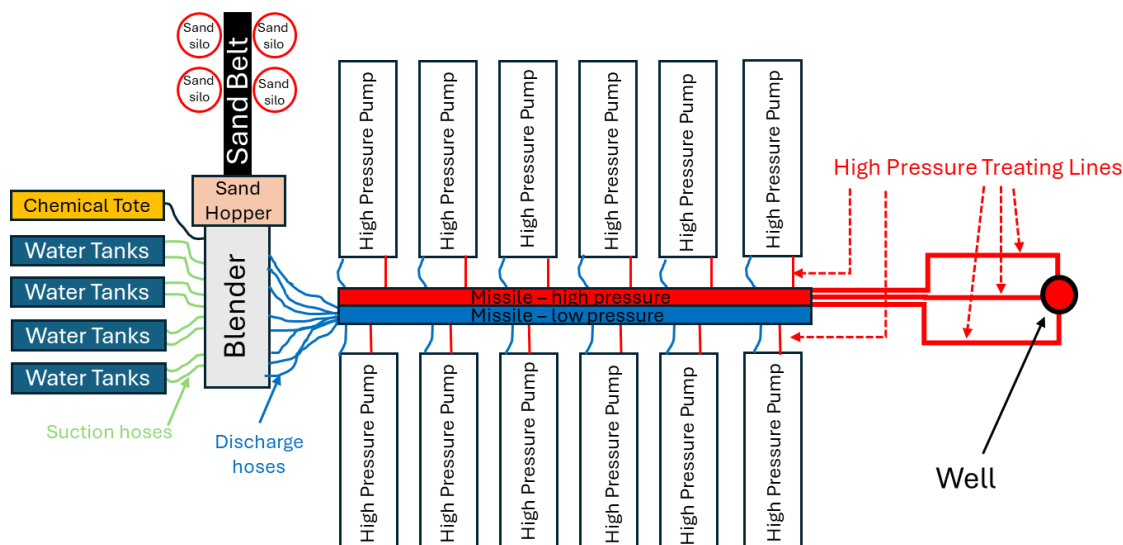
Densimeters are needed at the blender to enable the blender operator to control the proppant concentrations. A densimeter is also needed near the wellhead to monitor the final slurry concentration going down the treating string. This final densimeter is used to time the final overflush or displacement to prevent overflushing the proppant in the fracture and to ensure that the final design pumped concentration is placed in the fracture next to the wellbore.



53. As noted in *Chapter 12*, some equipment on site is referred to as high pressure equipment. This refers to the equipment from the frac pumps to the wellhead that handles the high pressure fluid which has been pressurized by the frac pumps as opposed to the low pressure equipment that handles the fluid upstream of the frac pumps. As shown in Figure 12.2 from *Chapter 12* and Figure 13.1A from *Monograph 12*, generally water is pulled from frac tanks, mixed with sand and chemicals in a blender, discharged to a low pressure manifold, pressurized by frac

pumps, discharged to a high pressure manifold, and directed through high pressure treating lines to the wellbore. This is illustrated below:

Frac Equipment Diagram



54. The frac pumps are sometimes referred to as high pressure pumps, because they pressurize the fluid to a high pressure:

12.3.1.1 Fluid Pumps. Fracture pumps comprise a power-end transmitting rotary motion from the crankshaft to the reciprocating plunger, promoting the fluid end to draw low-pressure liquid and then discharge high-pressure liquid (Fig. 12.3), providing high-flow-rate capabilities. Initially, conventional acid and cement pumping equipment was used to execute fracturing treatments (Smith and Montgomery 2015), where each pump had an individual operator. Today, pumps are monitored by a single person because multiple-pump readouts are centralized back into the data van. Commonly, the pump operator is situated next to the service supervisor for safety and communication.

55. A manifold, or missile, distributes low pressure liquid to the frac pumps then collect the high pressure liquid from the frac pumps:

12.3.8.4 Injection Manifolds. Injection manifolds, or missile trailers, are used to connect multiple high-pressure pumps to the blender and wellhead as shown in Fig. 12.20. Manifolds greatly reduce the quantity of treating iron on location and rig-up time and help organize both the low-pressure suction and high-pressure discharge. The manifold is positioned between banks of pumping units and accepts discharge from the blender and then transmits slurry to the suction of the pumps. The slurry is pressurized from the high-pressure side of the pumps, and discharges to the manifold, which delivers the high-pressure slurry down the treating iron to the wellhead. Connecting the pumps to both the suction and the discharge on the missile saves hours of rig-up time, reduces leaks, and allows for better housekeeping of the high-pressure working area.

56. While the pressures used on a given job are a function of the job design based on certain parameters as laid out in Section V, on any given frac site there will be low pressure (upstream of frac pumps) equipment and high pressure (frac pumps and downstream of frac

pumps) equipment. The area in which the high pressure equipment sits is referred to as the high pressure zone or the red zone, and certain precautions must be taken by personnel who enter the high pressure zone due to the dangers posed by the high pressure equipment, as discussed in *Chapter 12*:

12.2.7 Fuel. Hydraulic-fracturing operations require a steady supply of fuel and safe and efficient on-site fueling operations. For unconventional treatments, diesel fuel can be the third-greatest expense for the stimulation treatment because of long pump times. Long-pump-time refueling methods need to be considered. Diesel needs to be available, and fuel levels adequate to execute the treatment are needed. Equipment should not unexpectedly run out of fuel.

Inventory control of diesel is necessary. Diesel fuel used for fracturing equipment is off-road grade (red) and is not intended for on-road use. Pumps, blenders, power plants, and other equipment require refueling, and many vendors use scanners, bar codes, and other management software to improve efficiency, control cost, and ensure accurate records.

Hot fueling is the process of fueling equipment actively engaged in pumping the hydraulic-fracturing treatment. This is not a preferred method for refueling equipment, but is necessary when treatment length is greater than the fuel capacity of the equipment. Operators might have specific procedures and protocols because personnel are required inside the high-pressure zone. Several vendors have developed automated fuel management systems to improve efficiency, maintain environmental integrity, and minimize or eliminate personal exposure to the high-pressure zone.

12.4.1 Pre-Job Safety Meeting. Working with high pressure is a reality of fracturing operations and a very real danger exists. Field implementation of hydraulic fracturing is not so urgent or important that it cannot be performed safely. The mandatory pre-job safety meeting is the most significant step toward a safe execution before exposure to the high-pressure environment and consumables of the stimulation treatment. Typically, the pumping-service-provider supervisor calls and leads the meeting and key operating company representatives and leaders from the multiple service providers actively participate in conducting the meeting. At a minimum, topics covered should include

- Personnel safety
- Treatment procedures and high pressure
- Emergency procedures
- Location safety

Attendance from everyone on location is mandatory, and it is important to ensure that everyone present can hear the meeting. In addition to the critical safety considerations of the personnel on location and environmental stewardship of the wellsite, this is the opportunity to

- Communicate the goals and objective of the treatment
- Confirm pressure limits
- Ensure personnel responsibilities and set expectations
- Discuss contingency plans
- Provide an opportunity to ask questions
- Obtain a head count of personnel on location and understand who has accountability for the critical valves, especially the wellhead

Review contingency plans for lost communications, equipment malfunction, unplanned shutdowns, personnel access to location, and the high-pressure zone. Pumping N₂ or CO₂ comes with additional risk. Personnel not familiar with the hazards specific to these engineered fluids should not be allowed access to the high-pressure pumping area, control valves, or specialized pumps. Only authorized vehicles should be permitted access to the location. Communicate designated medical treatment locations, escape routes, and muster locations in the event of an emergency and, if permitted, the designated smoking area. Post directions to the well and the location defined by longitude and latitude. All personnel should be aware of the posting. Ensure that road access to and from the location is always possible, and waiting sand and water trucks need to be arranged such that road access is never impeded. Everyone should understand his or her responsibility in an emergency situation and their expected behavior on location. It should be understood before ending the safety meeting who is the single point of contact for the pumping-service provider and the operating company and who is responsible for the wellhead. [Table 12.7](#) provides a checklist on minimum topics to be discussed in the pre-job safety meeting.

Location Safety

- ☐ Identify, secure, and rope off high-pressure pumping lines
- ☐ Ensure RED zone is marked off, and caution bystanders to stay clear or in designated areas while pumping
- ☐ Confirm radio silence and prohibit cell-phone use when perforating
- ☐ Identify designated smoking area
- ☐ Follow location specific lock-out/tag-out procedures
- ☐ Communicate and inform all personnel about tasks being performed on location: pressure testing, pumping, crane movement, etc.
- ☐ Outline all visible/audible signs used on location for elevated-risk tasks (flags, strobe lights, horn blasts, and sirens)

Table 12.7—Hydraulic-fracturing pre-job safety-meeting checklist.

VI. OPINIONS

A. “high pressure”

1) Claim Language

57. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the <i>multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;</i> a plurality of motors positioned to simultaneously power the multi-plunger pump; and a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors, wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.
11	A hydraulic fracturing system for fracturing a subterranean formation comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the <i>multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;</i> a plurality of motors positioned to simultaneously power the multi-plunger pump; a variable frequency drive connected to the plurality of motors to control the speeds of the plurality of motors; and

	a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors, wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.
15	A method for pumping fluid into a wellbore associated with a subterranean formation, the method comprising: fluidly connecting a multi-plunger hydraulic fracturing pump to a well associated with the subterranean formation such that the <i>multi-plunger pump pumps fluid into the wellbore at a high pressure so that fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation;</i> simultaneously powering the multi-plunger pump with a plurality of motors; providing a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors so as to translate power from the plurality of motors into a desired pump rate of the multi-plunger pump.

58. In Claims 1 and 11 shown above, the relevant claims are directed to a system for hydraulic fracturing and the relevant limitation requires a “multi-plunger hydraulic fracturing pump” with the “multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation.” Without any further context, the claim language informs a POSITA as to the meaning of the term, which is simply a hydraulic fracturing pump such as those present on almost if not every hydraulic fracturing site in the United States today and without which you could not perform a hydraulic fracturing operation.

59. Claim 15 is a method claim which requires a multi-plunger pump that “pumps fluid into the wellbore at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation.” Again, without any further context, the claim language informs a POSITA as to the meaning of the term, which is the use of a hydraulic

fracturing pump such as those used on almost if not every hydraulic fracturing site in the United States today and without which you could not perform a hydraulic fracturing operation.

60. As discussed in Section V above, the equipment on a hydraulic fracturing site is selected for the particular job at hand. In order to select the equipment, a POSITA would understand that the amount of hydraulic horsepower on site would be a function of the surface treating pressure and the pump rate required to accomplish the job.⁵ Once the amount of HHP is estimated, the type of pumps on site would be selected in part based on pressure rating and the number of pumps on site would be determined based on equipment specifications HHP requirements. Collectively, the frac pumps on site pump the fluid into the wellbore with enough rate and pressure to fracture the formation, performing the hydraulic fracturing operation. A POSITA would readily understand whether a system is configured to generate high enough pressure to fracture a formation because the system would be designed and the equipment chosen such that the fracturing operation could be performed. A POSITA would also readily understand whether an act of pumping fluid would be at enough pressure to fracture a formation because the job would be designed such that the fracturing operation could be performed.

61. As discussed in Section V above, on a hydraulic fracturing site there are generally two types of equipment that touch the frac slurry—low pressure equipment and high pressure equipment. The term high pressure simply means that the fluid has been discharged from the fracturing pumps.

62. It is my opinion that the term “high pressure” in the context of the claim language is readily understandable to a POSITA from its plain and ordinary meaning. It is further my

⁵ Sample calculations for treating pressure and hydraulic horsepower requirements are shown in the table in Section V.

opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would readily understand that high pressure simply means that fluid has been pressurized by and discharged from the fracturing pumps (also called high pressure pumps).

2) Specification

63. The specification does not further define “high pressure.” That is because no further definition is needed. Any POSITA would understand what the patent is referring to when using the term high pressure in the context of the claims.

3) Extrinsic Evidence

64. As I have noted, the frac pumps (or high pressure pumps) are the equipment that transforms the fluid from low pressure to high pressure. This is described in *Chapter 12* and can be seen throughout industry literature.⁶

12.3.1.1 Fluid Pumps. Fracture pumps comprise a power-end transmitting rotary motion from the crankshaft to the reciprocating plunger, promoting the fluid end to draw low-pressure liquid and then discharge high-pressure liquid (Fig. 12.3), providing high-flow-rate capabilities.

65. As also noted above in Section V, the equipment downstream of the frac pumps is considered high pressure equipment. This terminology is ubiquitous in the hydraulic fracturing industry. Liberty and ST9 frequently use high pressure to describe their equipment, including their

⁶ USWS_Liberty_0010611 at 620.

high pressure pumps,⁷ high pressure iron,⁸ high pressure lines/hoses,⁹ and the fluid entering the wellbore.¹⁰ This is consistent with standard industry usage of the term high pressure.¹¹

B. “a gear ratio of the planetary gear train . . . [is] selected” / “a selection of a gear ratio of the planetary gear train”

1) Claim Language

66. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	'258 Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation; a plurality of motors positioned to simultaneously power the multi-plunger pump; and a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors, <i>wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.</i>
11	A hydraulic fracturing system for fracturing a subterranean formation comprising:

⁷ USWS_Liberty_0010685 at 819; USWS_Liberty_0010976 at 1033; USWS_Liberty_0010865 at 868, 892; USWS_Liberty_0011130 at 133; USWS_Liberty_0011327 at 330; Liberty_00000091 at 147; Liberty_00001127 at 131, 140, 141; Liberty_00001322 at 392.

⁸ USWS_Liberty_0010976 at 1033; USWS_Liberty_0010868 at 892; USWS_Liberty_0011130 at 133; USWS_Liberty_0011327 at 330; USWS_Liberty_0011384.

⁹ Liberty_00001127 at 136; USWS_Liberty_0011384.

¹⁰ Liberty_00001322 at 398.

¹¹ Liberty_00001440; Liberty_00004739 at 805; Liberty_00009589; Liberty_00010616 at 710, 711; Liberty_00011011 at 024, 038; Liberty_00011122 at 129, 136; Liberty_00011360 at 360, 361; USWS_Liberty_0010674; USWS_Liberty_0010675; USWS_Liberty_0010677; USWS_Liberty_0011292 at 293; USWS_Liberty_0011298 at 299; USWS_Liberty_0011300 at 301; USWS_Liberty_0011302 at 303, 304; USWS_Liberty_0011307 at 309; USWS_Liberty_0011316 at 317; USWS_Liberty_0011320 at 325.

	a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation; a plurality of motors positioned to simultaneously power the multi-plunger pump; a variable frequency drive connected to the plurality of motors to control the speeds of the plurality of motors; and a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors, <i>wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.</i>
Claim	'533 Claim Language
19	The hydraulic fracturing method of claim 10, <i>comprising limiting a maximum pump speed of the multi-plunger hydraulic fracturing pump, wherein the maximum pump speed is limited by a selection of a gear ratio of the planetary gear train and a speed at which the plurality of motors operate.</i>

67. A POSITA would understand that the gear ratio in a planetary gear train is designed to reduce or increase the RPM and either increase or decrease the torque depending on the ratio of the multiple gears that interface with one another. Selecting the correct gear ratio will allow proper speeds of motors and pumps to be selected.

2) Specification

68. The '258 and '533 patents' specifications provide context and guidance that would inform a POSITA what is meant by this claim term. These specifications provide guidance as to the interaction of the gear ratios of the planetary drive and electric motor speeds as follows:¹²

¹² '258 Patent at 5:64–6:18.

In the multiple electric motor-driven embodiment of the present disclosure, the electric motors may directly drive the pump, and the gear ratios of the planetary drive along with the electric motor-rated speeds may be chosen to limit the maximum pump speed, so as to not exceed the plunger critical speed. However, the gear ratios and electric motor-rated speeds may also be chosen to allow only a slight percentage of overspeed (higher than critical plunger speed) as a safe margin to enable a fleet of operating pumps to achieve a desired pump rate, for example when one pump is taken off line, as is often the case in hydraulic fracturing. For example, the gear ratios and electric motor-rated speeds may be chosen to operate 5% or less above the critical plunger speed according to some examples; 10% or less above the critical plunger speed according to some examples; or any other acceptable range as will be readily understood by one having ordinary skill in the art. Repairs or maintenance are generally performed as quickly as possible so that the offline pump is available by the next sequential fracturing stage. This same logic could be applied to the hydraulic motor driven system or the system that utilizes speed reduction gearboxes driving a single ring gear.

69. Based on the specifications and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

3) Extrinsic Evidence

70. *Chapter 12* shows that a POSITA would be familiar with the concepts of gear ratios and gear reduction. Figure 12.3 shows the relationship between pressure, rate, and engine speed for given gears in an example transmission:¹³

¹³ USWS_Liberty_0010611 at 629–630.

Fluid-End Specifications				
Number of Plungers 3	Stroke Length 11 in.	Plunger Diameter 4.5 in.	Pressure Rating 15 ksi	Gear Ratio 7.842
Efficiencies: Transmission 98%, Mechanical 90%, Volumetric 100%				
Hydraulic horsepower: 1,883 bHP at 1,400 rev/min				
2,392 bHP at 1,940 rev/min				
Transmission Reduction (TR)				
Engine rev/min (erev/min)	TR	Gear	Volumetric Rate (gal/min)	Pressure (psi)
1,400	4.67	1st	87	15,000
1,940			120	15,000
1,400	3.43	2nd	118	15,000
1,940			164	15,000
1,400	3.03	3rd	134	15,000
1,940			185	15,000
1,400	2.53	4th	160	15,000
1,940			222	15,000
1,400	2.22	5th	183	15,000
1,940			253	14,290
1,400	1.85	6th	219	12,992
1,940			304	11,908
1,400	1.64	7th	247	11,517
1,940			343	10,556
1,400	1.36	8th	298	9,551
1,940			413	8,754
1,400	1.00	9th	405	7,022
1,940			562	6,437

Table 12.3—Pressure/volume/engine-speed relationship. Courtesy Liberty Oilfield Services.

While Figure 12.3 shows data for different gears in a transmission, the disputed terms pertain to a planetary gear train wherein there is a fixed ratio from input revolutions to output revolutions as shown below which would be selected in designing and building the system of multiple gears to achieve the desired output RPM from a given input RPM:



71. A POSITA would be familiar with the terminology and would understand this term to be sufficiently definite without further construction.

C. “critical plunger speed”

1) Claim Language

72. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	‘258 Claim Language
4	The system of claim 1, <i>wherein the maximum pump speed correlates to a critical</i>

	plunger speed <i>associated with the multi-plunger hydraulic fracturing pump.</i>
5	The system of claim 1, <i>wherein the maximum pump speed is 5% or less over a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.</i>
14	The system of claim 11, <i>wherein the maximum pump speed correlates to a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.</i>
18	The method of claim 15, <i>wherein the maximum pump speed correlates to a critical plunger speed associated with the multi-plunger hydraulic fracturing pump.</i>
Claim	'533 Claim Language
20	The hydraulic fracturing method of claim 19, <i>wherein the maximum pump speed correlates with a critical plunger speed of the multi-plunger hydraulic fracturing pump.</i>
21	The hydraulic fracturing method of claim 19, <i>wherein the maximum pump speed is 5% over a critical plunger speed of the multi-plunger hydraulic fracturing pump.</i>

73. It is my opinion that the term “critical plunger speed” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would fully understand the effects of elevated plunger speeds on frac pumps, with speeds too high leading to an elevated risk of damage due to vibration, cavitation, harmonics considerations, pitting, valve wear, seat wear, and other issues.

2) Specification

74. The '258 and '533 patents' specifications provide context and guidance that would inform a POSITA what is meant by this claim term. These specifications describe problems posed by transmissions whose use can lead to the critical plunger speed being exceeded which may result in damage:¹⁴

¹⁴ '258 Patent at 5:23–33.

Similarly, the common hydraulic fracturing application transmissions known in the art may exhibit the same issues in higher gears, as shown below in FIGS. 6-10. For example, as shown in FIG. 6 and FIG. 7, the critical plunger speed is reached in the 3rd gear, such that use of gears 4-7 may cause cavitation and damage accumulation. Similarly, as shown in FIG. 8 and FIG. 9, the critical plunger speed is reached in the 4th gear, such that use of gears 5-7 may cause cavitation and damage accumulation. In FIG. 10, the critical plunger speed is reached in the 4th gear, such that use of gears 5-9 may result in cavitation and damage accumulation.

75. The '258 and '533 Patents go on to note that eliminating transmissions may eliminate the problems associated with operating pumps above critical plunger speeds:¹⁵

Use of the multi-plunger hydraulic fracturing pumps according to the present disclosure may eliminate the need for a diesel engine and transmission. As shown above, diesel engines and transmissions often include multiple gears that accelerate the plunger speed above critical operating speeds. This elimination of the typical engine and transmission from hydraulic fracturing pump units may enable the pumps to be driven by multiple electric motors, according to some embodiments, or multiple hydraulic motors according to other embodiments. These electric or hydraulic motors may have fewer gears such that operation in gears that increase the plunger speeds above their critical speeds can be avoided. By using multiple motors, whether hydraulic or electric, to drive a single pump, pump rates can be increased without exceeding critical plunger speeds.

¹⁵ '258 Patent at 5:34-48.

76. Based on the specifications and the plain and ordinary meaning of the term, particularly when viewed in the context of the claims, a POSITA would understand this term to be sufficiently definite without further construction.

D. “input pinion gears”

1) Claim Language

77. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	‘258 Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation; a plurality of motors positioned to simultaneously power the multi-plunger pump; and a planetary gear train having a plurality of input pinion gears <i>in rotational contact with each of the plurality of motors</i> wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.
2	The system of claim 1, the system further <i>comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors</i> so as to achieve a desired pump rate.
11	A hydraulic fracturing system for fracturing a subterranean formation comprising: a multi-plunger hydraulic fracturing pump fluidly connected to a well associated with the subterranean formation, the multi-plunger pump configured to pump fluid into a wellbore associated with the well at a high pressure so that the fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation; a plurality of motors positioned to simultaneously power the multi-plunger pump; a variable frequency drive connected to the plurality of motors to control the speeds of the plurality of motors; and

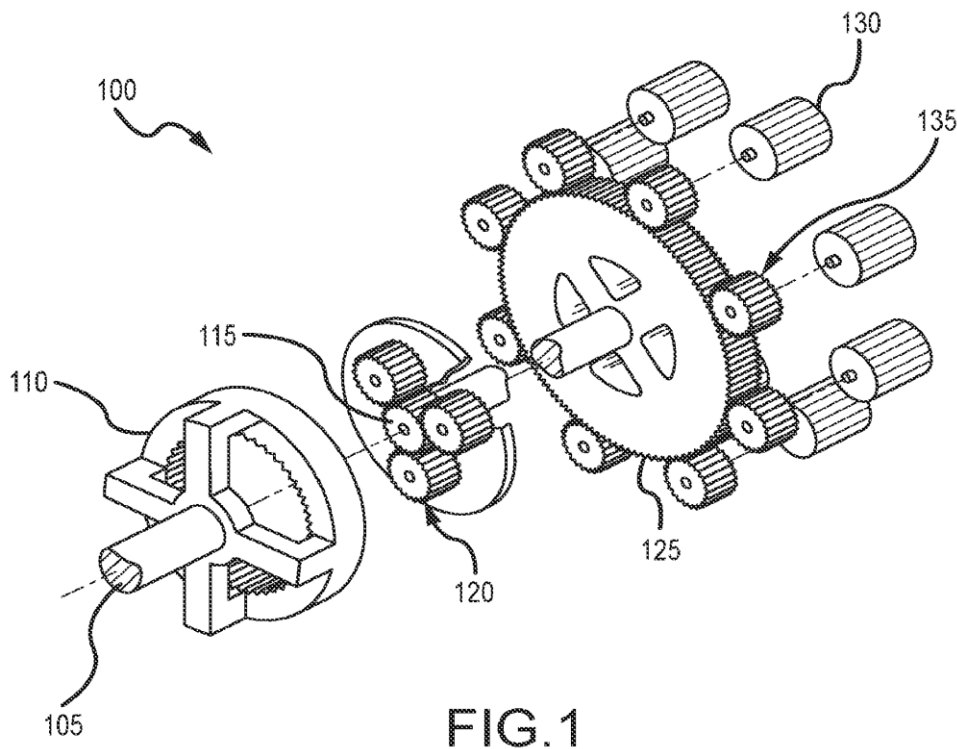
	<i>a planetary gear train having a plurality of input pinion gears in rotational contact with each of the plurality of motors,</i> wherein a gear ratio of the planetary gear train and a speed at which the plurality of motors operates are selected so as to limit a maximum pump speed associated with the multi-plunger pump.
12	The system of claim 11, the system further <i>comprising a plurality of speed reduction gearboxes positioned between the plurality of input pinion gears and the plurality of motors so as to achieve a desired pump rate.</i>
15	A method for pumping fluid into a wellbore associated with a subterranean formation, the method comprising: fluidly connecting a multi-plunger hydraulic fracturing pump to a well associated with the subterranean formation such that the multi-plunger pump pumps fluid into the wellbore at a high pressure so that fluid passes from the wellbore into the subterranean formation and fractures the subterranean formation; simultaneously powering the multi-plunger pump with a plurality of motors; providing a planetary gear train <i>having a plurality of input pinion gears in rotational contact with each of the plurality of motors so as to translate power from the plurality of motors into a desired pump rate of the multi-plunger pump.</i>
16	The method of claim 15, further comprising: <i>positioning a plurality of speed reduction gearboxes between the plurality of input pinion gears and the plurality of motors so as to achieve the desired pump rate</i>
Claim	‘533 Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation, the hydraulic fracturing system comprising: a multi-plunger hydraulic fracturing pump configured to pump fluid to a wellbore associated with the subterranean formation, the multi-plunger hydraulic fracturing pump comprising a pump crankshaft; a plurality of motors positioned to power the multi-plunger hydraulic fracturing pump; and a planetary gear train positioned to translate power from the plurality of motors to the pump crankshaft of the multi-plunger hydraulic fracturing pump, the planetary gear train comprising: <i>a plurality of input pinion gears connected to the plurality of motors; and</i>

	a final drive gear connected to the pump crankshaft of the multi-plunger hydraulic fracturing pump by a plurality of arms extending from the final drive gear.
2	The hydraulic fracturing system of claim 1, <i>wherein the plurality of motors comprises a plurality of electric motors, and each of the plurality of input pinion gears is connected to a respective one of the plurality of electric motors.</i>
8	The hydraulic fracturing system of claim 1, <i>wherein the planetary gear train comprises a main gear that contacts each of the plurality of input pinion gears, wherein the main gear comprises external gear teeth that mate with external gear teeth of the plurality of input pinion gears.</i>
10	A hydraulic fracturing method comprising: by operation of a multi-plunger hydraulic fracturing pump of a hydraulic fracturing system, pumping fluid to a wellbore associated with a subterranean formation, the multi-plunger hydraulic fracturing pump comprising a pump crankshaft; powering the multi-plunger hydraulic fracturing pump with a plurality of motors; and translating power from the plurality of motors to the multi-plunger hydraulic fracturing pump through a planetary gear train, wherein translating power through the planetary gear train comprises translating power through: <i>a plurality of input pinion gears that are driven by the plurality of motors; and</i> a final drive gear that drives the pump crankshaft, wherein the final drive gear is connected to the pump crankshaft by a plurality of arms extending from the final drive gear.
11	The hydraulic fracturing method of claim 10, wherein the plurality of motors comprises a plurality of electric motors, and <i>each of the plurality of input pinion gears is driven by a respective one of the plurality of electric motors.</i>
17	The hydraulic fracturing method of claim 10, wherein translating power through the planetary gear train <i>comprises translating power through a main gear that contacts each of the plurality of input pinion gears, wherein the main gear comprises external gear teeth that mate with external gear teeth of the plurality of input pinion gears.</i>
22	a plurality of input pinion gears , <i>each driven by a respective one of the plurality of electric motors;</i> <i>a main gear driven by the plurality of input pinion gears, the main gear comprising external gear teeth that mate with external gear teeth of the plurality of input pinion gears;</i>

78. It is my opinion that the term “input pinion gears” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would understand the input pinion gears are necessary to connect the motors to the main planetary gear and through their size either increase or decrease the system speed.

2) Specification

79. The '258 and '533 patents' specifications provide context and guidance that would inform a POSITA what is meant by this claim term. The specifications both include Figure 1, a schematic diagram of a planetary gear train having multiple input pinions for direct connection to an electric motor:¹⁶



¹⁶ '258 Patent at Fig. 1.

80. Regarding Figure 1, the specification offers the following description of the planetary gear train:¹⁷

In the example illustrated in FIG. 1, an exploded schematic view shows an embodiment of a planetary gear train **100** in which the multiple input pinion gears **135** are directly connected to the electric motors **130**. According to the illustrated embodiment, both ends of the pump crankshaft **105** may be powered with an identical planetary gear train **120** and electric motors **130** to enable the motors **130** to be sized small enough to simplify motor removal and installation as compared to a larger single electric motor, or a double electric motor drive system.

In the illustrated embodiment of FIG. 1, eight electric motors **130** may correspond to and drive eight input pinion gears **135** associated with a single main planetary gear **125**. The main planetary gear **125** may in turn drive the sun gear **115** positioned central to three planetary gears **120**. The final drive gear **110** may have internal gear teeth positioned to catch the external gear teeth of the three planetary gears **120**, which may cause rotation of the pump crankshaft **105**. In this way, a plurality of electric motors **130** may provide power to a pump crankshaft **105**, which may in turn drive a multi-plunger pump, for example as illustrated in FIG. 3 and discussed in greater detail below.

81. Based on the specification and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

E. “arms”

1) Claim Language

82. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

¹⁷ '258 Patent at 7:4–25; '533 Patent at 7:12–33.

Claim	Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation, the hydraulic fracturing system comprising: a multi-plunger hydraulic fracturing pump configured to pump fluid to a wellbore associated with the subterranean formation, the multi-plunger hydraulic fracturing pump comprising a pump crankshaft; a plurality of motors positioned to power the multi-plunger hydraulic fracturing pump; and a planetary gear train positioned to translate power from the plurality of motors to the pump crankshaft of the multi-plunger hydraulic fracturing pump, the planetary gear train comprising: a plurality of input pinion gears connected to the plurality of motors; and <i>a final drive gear connected to the pump crankshaft of the multi-plunger hydraulic fracturing pump by a plurality of arms extending from the final drive gear.</i>
10	A hydraulic fracturing method comprising: by operation of a multi-plunger hydraulic fracturing pump of a hydraulic fracturing system, pumping fluid to a wellbore associated with a subterranean formation, the multi-plunger hydraulic fracturing pump comprising a pump crankshaft; powering the multi-plunger hydraulic fracturing pump with a plurality of motors; and translating power from the plurality of motors to the multi-plunger hydraulic fracturing pump through a planetary gear train, wherein translating power through the planetary gear train comprises translating power through: a plurality of input pinion gears that are driven by the plurality of motors; and a final drive gear that drives the pump crankshaft, wherein <i>the final drive gear is connected to the pump crankshaft by a plurality of arms extending from the final drive gear.</i>
22	A hydraulic fracturing system for fracturing a subterranean formation, the hydraulic fracturing system comprising: a plurality of electric motors; a planetary gear train connected to the plurality of electric motors, the planetary gear train comprising: a plurality of input pinion gears, each driven by a respective one of the plurality of

	electric motors; a main gear driven by the plurality of input pinion gears, the main gear comprising external gear teeth that mate with external gear teeth of the plurality of input pinion gears; a sun gear driven by the main gear and connected to the main gear by a shaft; planetary gears driven by the sun gear, the planetary gears each comprising external gear teeth that mate with external gear teeth of the sun gear; and a final drive gear driven by the planetary gears, the final drive gear comprising internal gear teeth that mate with the external gear teeth of the planetary gears; and a multi-plunger hydraulic fracturing pump that pumps fluid to a wellbore and comprises a pump crankshaft that is driven by the final drive gear of the planetary gear train, <i>the final drive gear connected to the pump crankshaft by a plurality of arms extending from the final drive gear.</i>
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83. It is my opinion that the term “arms” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would readily understand some device would be required to connect the final gear to the pump and arms would be the logical choice.

2) Specification

84. The specification does not further define “arms.” That is because no further definition is needed. Any POSITA would understand what the patent is referring to when using the term arms in the context of the claims.

3) Extrinsic Evidence

85. In considering the definition of “arm(s),” the Merriam Webster’s dictionary provides the following: “a slender part of a structure, machine, or an instrument projecting from a main part, axis, or fulcrum.”¹⁸

arm 1 of 5 **noun (1)**

ˈɑːrm

plural **arms**

Synonyms of *arm* >

- 1** : a human upper limb
especially : the part between the shoulder and the wrist
- 2** : something like or corresponding to an arm: such as
 - a** : the forelimb of a vertebrate
 - b** : a limb of an invertebrate animal
 - c** : a branch or lateral shoot of a plant
 - d** : a slender part of a structure, machine, or an instrument projecting from a main part, axis, or fulcrum

86. Oxford’s English dictionary also provides a number of definitions for common uses of the word “arm(s)” including, in mechanics, “A projecting or terminal part of a structure, object, or machine; (in later use chiefly) *spec.* a mechanical part which resembles an arm in shape or size; a part which projects from a machine or piece of technical apparatus.”¹⁹

II.10.a. A projecting or terminal part of a structure, object, or machine; (in later use chiefly) *spec.* a mechanical part which resembles an arm in shape or size; a part which projects from a machine or piece of technical apparatus.

mechanics

¹⁸ “arm.” 2024. In Merriam-Webster.com. Retrieved November 18, 2024, from <https://www.merriam-webster.com/dictionary/arm>.

¹⁹ “arm” 2024. From the Oxford English Dictionary. Retrieved November 20, 2024 from https://www.oed.com/dictionary/arm_n1?tab=meaning_and_use.

87. These definitions further support that a POSITA would understand this term to be sufficiently definite without further construction.

F. “centralized control unit”

1) Claim Language

88. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
1	A system for hydraulically fracturing an underground formation in an oil or gas well to extract oil or gas from the formation, the oil or gas well having a wellbore that permits passage of fluid from the wellbore into the formation, the system comprising: an electric pump fluidly connected to the well, and configured to pump fluid into the wellbore; and a centralized control unit <i>coupled to the electric pump, wherein the centralized control unit is configured to:</i> <i>monitor the electric pump; and</i> a variable frequency drive that controls a speed of the electric pump; wherein the centralized control unit <i>is coupled to the electric pump via one or more of cabling, Ethernet, or wirelessly; and</i> wherein the centralized control unit <i>is further configured to reset a fault occurring in the variable frequency drive.</i>
2	The system of claim 1, further comprising: a generator electrically connected to the electric pump to provide power to the electric pump, wherein the generator is powered by natural gas, and wherein the centralized control unit <i>is further configured to monitor and control compression of the natural gas.</i>
3	The system of claim 2, wherein the generator is a turbine generator, and wherein the centralized control unit <i>is further configured to monitor and control the turbine generator.</i>
6	The system of claim 2, further comprising an emergency power off unit coupled to the centralized control unit, the electric pump, and the generator, wherein the emergency power off unit is configured to substantially immediately cut power from the generator

	when activated.
7	The system of claim 6, the emergency power off unit comprising an auxiliary power and a switchgear, each coupled to the generator and the centralized control unit , wherein the switchgear is responsive to a signal from the centralized control unit to open a breaker to substantially immediately cut power to the generator.
8	A method, comprising: pumping fracturing fluid into a well in a formation with an electrically powered pump, the fracturing fluid having at least a liquid component and a solid proppant, and inserting the solid proppant into the cracks to maintain the cracks open, thereby allowing passage of oil and gas through the cracks; <i>monitoring at a centralized control unit the electrically powered pump; wherein the centralized control unit is coupled to the electrically powered pump via one or more of cabling, Ethernet, or wirelessly; and</i> controlling the speed of the pump with a variable frequency drive, wherein the centralized control unit is configured to reset a fault occurring in the variable frequency drive.
14	The method of claim 8, further comprising <i>resetting a fault occurring in the variable frequency drive from the centralized control unit.</i>
15	The method of claim 9, further comprising: providing an emergency power off unit coupled to the centralized control unit, the electrically powered pump and the generator; and substantially immediately cutting power to the generator by activating the emergency power off unit.
16	The method of claim 15, the emergency power off unit comprising an auxiliary power and switchgear, each coupled to the generator and the centralized control unit , <i>the method further comprising signaling the switchgear from the centralized control unit to open a breaker to substantially immediately cut power to the generator.</i>
17	A system for centralized monitoring and control of a hydraulic fracturing operation, comprising: an electric powered fracturing fleet, the electric powered fracturing fleet comprising: a combination of one or more of: electric powered pumps, turbine generators, blenders, sand silos, chemical storage units, conveyor belts, manifold trailers, hydration units, variable frequency drives, switchgear, transformers, compressors;

	a centralized control unit coupled to electric powered fracturing fleet; and an emergency power off unit coupled to the centralized control unit, the electric powered pumps and the turbine generators, the emergency power off unit configured to substantially immediately cut power to the turbine generators when activated, wherein the centralized control unit is configured to: <i>monitor one or more operating characteristics of the electric powered fracturing fleet; and control one or more operating characteristics of the electric powered fracturing fleet;</i> wherein the centralized control unit is coupled to the electric powered fracturing fleet via one or more of cabling, Ethernet, or wirelessly.
18	The system of claim 17, the emergency power off unit comprising an auxiliary power and switchgear, each coupled to the generators and the centralized control unit , <i>the switchgear responsive to a signal from the centralized control unit</i> to open a breaker to substantially immediately cut power to the turbine generators.
19	The system of claim 17, wherein the centralized control unit is <i>further configured to monitor and control compression of natural gas.</i>
20	The system of claim 17, wherein the centralized control unit is <i>further configured to monitor and control the turbine generators.</i>

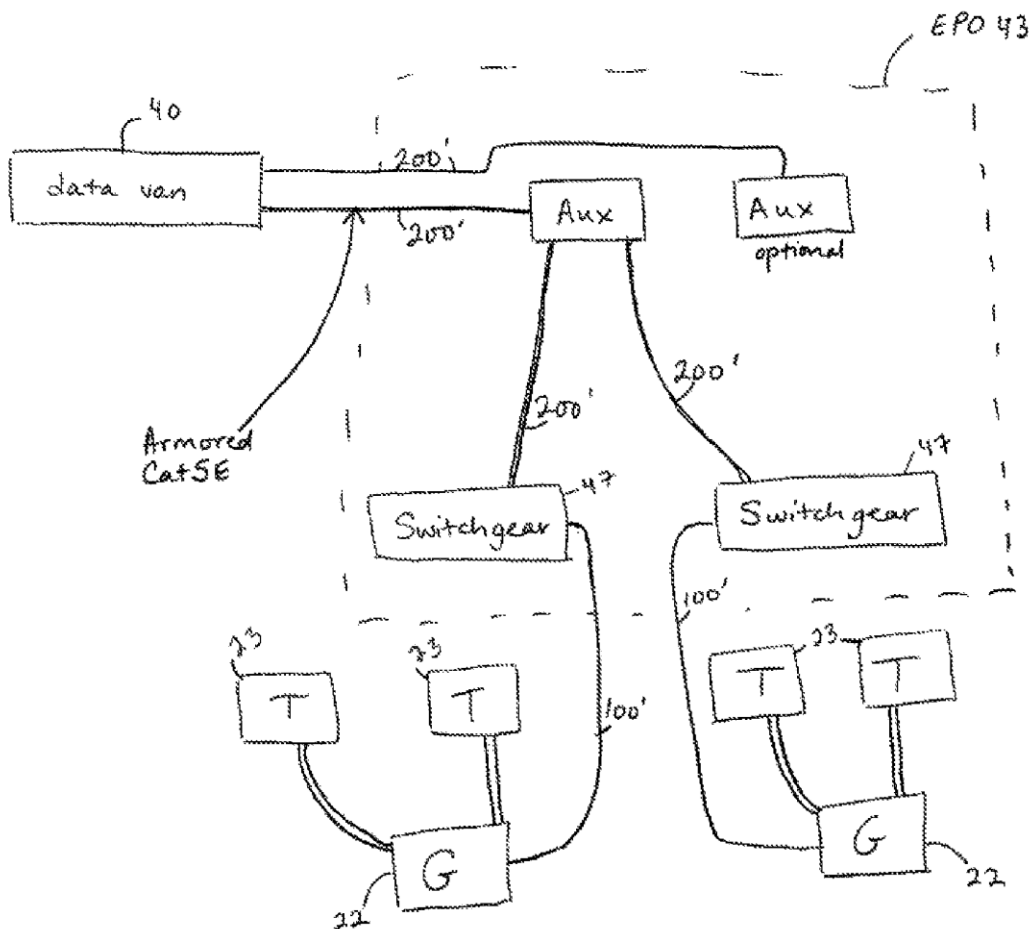
89. The relevant claims are directed to a system for hydraulic fracturing that can include a “centralized control unit” with the limitation that the centralized control unit is “coupled to the plurality of electric pumps” and “the plurality of generators” to monitor at least one of pressure, temperature, fluid rate, fluid density, concentration, volt, amps, etc.” and then enter inputs to control for these variables.

2) Specification

90. The ’992 patent’s specification provides context and guidance that would inform a POSITA what is meant by this claim term. The patent includes Figure 3, plan view of equipment used in a hydraulic fracturing operation, according to an embodiment of the present technology, including an emergency power off circuit:²⁰

²⁰ ’992 Patent at Fig. 3.

FIG. 3



91. Regarding Figure 3, the specification explains at length how the control unit “can be mounted on a control vehicle, and connected to the pumps, electric motors, blenders, and other surface and/or downhole sensors and tools,” as well as other pump control and data monitoring equipment that can be included.²¹

92. Further, the specification offers the following description of the various components that may be incorporated in a control unit:²²

²¹ *Id.* at 5:14–27.

²² *Id.* at 5:28–49.

The monitor/control data van 40 incorporate various functions in a centralized location such that compressors and turbines spread across a plurality of trucks can be monitored 3 by a single operator. The functions can include: monitoring and control of the gas compression for the turbines (and in particular, of pressure and temperature, or load percentage), monitoring and control of the mobile turbines (and in particular, of pressure and temperature), monitoring and 3 control of the electric distribution equipment, switchgear and transformers, monitoring and control of the variable frequency drives, monitoring and resetting faults on the variable frequency drives remotely without having to enter danger areas such as high pressure zone and high voltage 4 zones, monitoring and control of the electric motors, monitoring and control of rate and pressure of the overall system, control for an emergency shut off that turns off the gas compressors, turbines, and opens all of the breakers in the switchgear, and monitoring and control of vertical sand silos 4 and electrical conveyor belt. Sensors for monitoring pressure, temperature, fluid rate, fluid density, etc. may be selected as design considerations well within the understanding of one of ordinary skill in the art.

93. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

G. “emergency power off unit”

1) Claim Language

94. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
6	The system of claim 2, <i>further comprising an emergency power off unit coupled to the centralized control unit, the electric pump, and the generator, wherein the emergency power off unit is configured to substantially immediately cut power from the generator when activated.</i>

7	The system of claim 6, the emergency power off unit <i>comprising an auxiliary power and a switchgear</i> , each coupled to the generator and the centralized control unit, wherein the switchgear is <i>responsive to a signal from the centralized control unit to open a breaker to substantially immediately cut power to the generator</i> .
15	The method of claim 9, further comprising: providing an emergency power off unit <i>coupled to the centralized control unit, the electrically powered pump and the generator</i> ; and <i>substantially immediately cutting power to the generator by activating the emergency power off unit</i> .
16	The method of claim 15, the emergency power off unit <i>comprising an auxiliary power and switchgear</i> , each coupled to the generator and the centralized control unit, the method further comprising <i>signaling the switchgear from the centralized control unit to open a breaker to substantially immediately cut power to the generator</i> .
17	A system for centralized monitoring and control of a hydraulic fracturing operation, comprising: an electric powered fracturing fleet, the electric powered fracturing fleet comprising: a combination of one or more of: electric powered pumps, turbine generators, blenders, sand silos, chemical storage units, conveyor belts, manifold trailers, hydration units, variable frequency drives, switchgear, transformers, compressors; a centralized control unit coupled to electric powered fracturing fleet; and an emergency power off unit <i>coupled to the centralized control unit, the electric powered pumps and the turbine generators</i> , the emergency power off unit <i>configured to substantially immediately cut power to the turbine generators when activated, wherein the centralized control unit is configured to:</i> monitor one or more operating characteristics of the electric powered fracturing fleet; and control one or more operating characteristics of the electric powered fracturing fleet; wherein the centralized control unit is coupled to the electric powered fracturing fleet via one or more of cabling, Ethernet, or wirelessly.
18	The system of claim 17, the emergency power off unit <i>comprising an auxiliary power and switchgear</i> , each coupled to the generators and the centralized control unit, the switchgear responsive to a signal from the centralized control unit to open a breaker <i>to substantially immediately cut power to the turbine generators</i> .

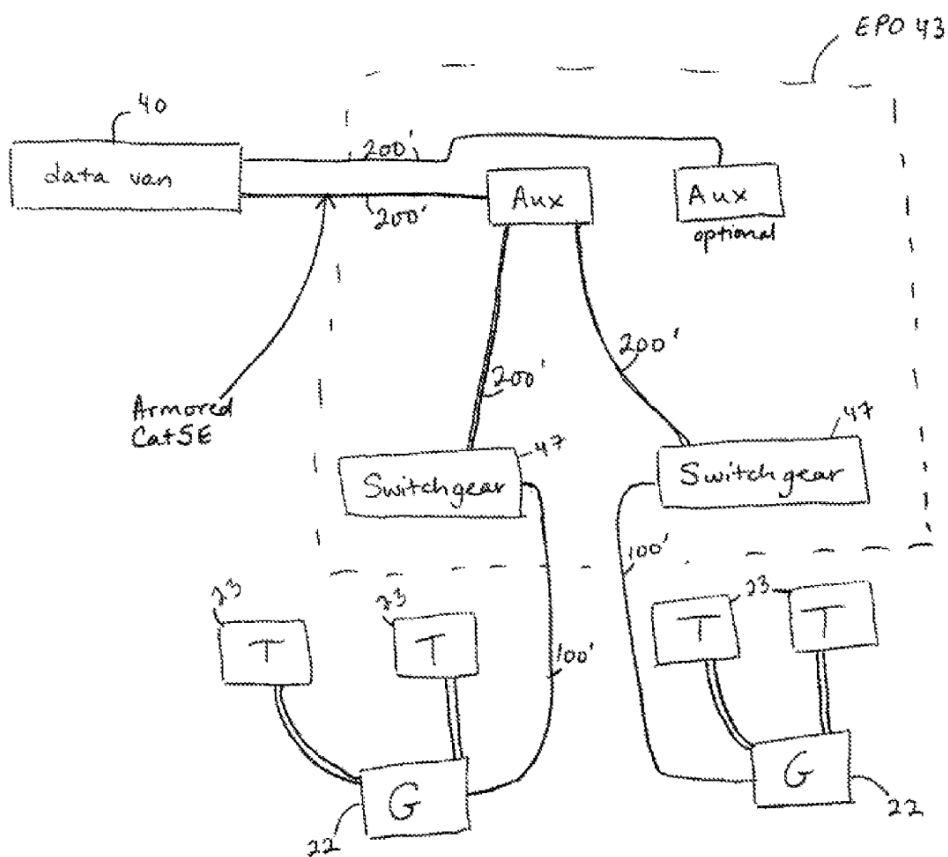
95. It is my opinion that the term “emergency power off unit” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would fully recognize with the given title that this device would be used when an immediate cessation of the operation was required due to an unplanned event.

2) Specification

96. The '992 patent's specification provides context and guidance that would inform a POSITA what is meant by this claim term. The specification explains that the “monitor/control data van further includes an Emergency Power Off (EPO) outlined in Figure 3:²³

²³ '992 Patent at Fig. 3.

FIG. 3



97. The specification provides that the “monitor/control data van further includes an Emergency Power Off (EPO) functionality”, which allows for the entire site to be shut off completely and explains, as follows, the following example: “over CAT5E cabling, breakers will open in both switchgear to cut power to the site, and gas compression will turn off, cutting the connection for fuel to the turbine.”²⁴

²⁴ *Id.* at 5:56–61.

98. Furthermore, the specification explains at length how electric hydraulic fracturing, in comparison to diesel hydraulic fracturing, is amenable to an emergency power off configuration through the power source:²⁵

Additionally, diesel fleets do not have gas compression, and are thus not amenable for an emergency power off configuration. Electric fleets, however, are amenable to an emergency power off configuration. Referring now to FIG. 3, the EPO 43 can include power (or optionally, plural auxiliary power sources) coupled to the monitor/control data van 40 via, for example, armored shielded CAT5E cabling to a switchgear 47. The switchgear 47 couples the data van 40 to turbine(s) 23 (or the EER(s) coupled to the turbines). In certain embodiments, the shielded CAT5E cabling may run from the data van 40, to an auxiliary trailer that includes switchgear 47, to a gas compressor (not shown), and to the EER/Turbine 23. Upon activation of the EPO 43, breakers open in the switchgear 47, cutting power to the generator 22. The gas compression will turn off, cutting fuel to the turbine(s) 23. Optionally, the EPO 43 is operated by a switch in the control vehicle 42 that sounds an audible alarm that the EPO 43 is imminently deployable. Alternatively, serial data and cables may be used instead of Ethernet.

99. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

H. “one or more processing devices configured to receive a first parameter from a first device of the plurality of pumps, the distribution system, or the wellhead, and transmit the first parameter to a second device of the plurality of the plurality of pumps, the distribution system, or the wellhead, and detect that the first parameter

²⁵ *Id.* at 7:26–44.

is outside of an acceptable threshold; and generate automated control instructions at the second device based at least in part on the first parameter”

1) Claim Language

100. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
1	A control system comprising: a plurality of pumps positioned at a wellsite and configured to pressurize a fracturing fluid; a distribution system fluidly coupled to receive and consolidate fracturing fluid from the plurality of pumps for injection into a wellhead; and a control system comprising: a plurality of sensing devices configured to measure one or more parameters of the plurality of pumps and the distribution system; one or more processing devices configured to receive a first parameter from a first device of the plurality of pumps, the distribution system, or the wellhead, and transmit the first parameter to a second device of the plurality of the plurality of pumps, the distribution system, or the wellhead, and detect that the first parameter is outside of an acceptable threshold; and generate automated control instructions at the second device based at least in part on the first parameter; and one or more control devices configured to receive the automated control instructions and automatically adjust one or more aspects of the second device based on the control instructions.

101. It is my opinion that the term “one or more processing devices configured to receive a first parameter from a first device of the plurality of pumps, the distribution system, or the wellhead, and transmit the first parameter to a second device of the plurality of the plurality of pumps, the distribution system, or the wellhead, and detect that the first parameter is outside of an acceptable threshold; and generate automated control instructions at the second device based at least in part on the first parameter” is readily understandable to a POSITA from its plain and

ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed.

2) Specification

102. The '435 patent's specification provides context and guidance that would inform a POSITA what is meant by this claim term. The patent includes Figure 2, a schematic diagram of an embodiment of an automated hydraulic fracturing system:²⁶

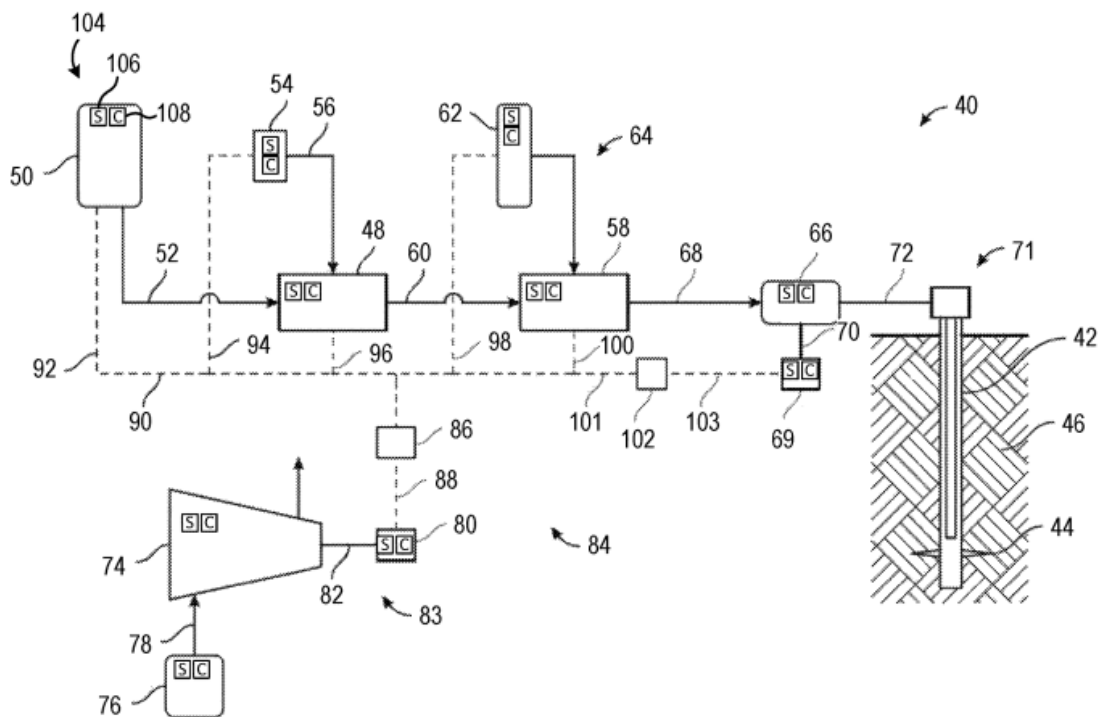


FIG.2

Regarding Figure 2, the specification offers the following description of the various “devices” illustrated:²⁷

²⁶ '435 Patent at Fig. 2, 2:379–39.

²⁷ '435 Patent at 5:25–50.

In the illustrated embodiment, one or more instrumentation devices **104** such as various types of sensors **106** and controllers **108** are arranged throughout the hydraulic fracturing system **40** and coupled to one or more of the aforementioned components, including any of the wellhead assembly **71**, pump **66**, blender unit **58**, proppant source **62**, hydration unit **48**, additive source **54**, fluid source **50**, generator **80**, turbine **74**, fuel source **76**, any deliveries lines, and various other equipment used in the hydraulic fracturing system **40**, not all of which are explicitly described herein for sake of brevity. The instrumentation **104** may include various sensors, actuators, and/or controllers, which may be different for different components. For example, the instrumentation devices **104** may include hardware features such as, low pressure transducer (low and high frequency), high pressure transducers (low and high frequency), low frequency accelerometers, high frequency accelerometers, temperature sensors, external mounted flow meters such as doppler and sonar sensors, magnetic flow meters, turbine flow meters, proximity probes and sensors, speed sensors, tachometers, capacitive, doppler, inductive, optical, radar, ultrasonic, fiber optic, and hall effect sensors, transmitters and receivers, stroke counters, GPS location monitoring, fuel consumption, load cells, PLCs, and timers. In some embodiments, the instrumentation devices may be installed on the components and dispersed in various locations.

The specification goes on to describe components used in transmitting information, and describe how equipment can react to certain communications:²⁸

²⁸ '435 Patent at 5:50–6:9.

The components may also include communication means that enable all the sensor packages, actuation devices, and equipment components to communicate with each other allowing for real time conditional monitoring. This would allow equipment to adjust rates, pressure, operating conditions such as engine, transmission, power ends RPMs, sand storage compartment gates, valves, and actuators, sand delivery belts and shoots, water storage compartments gates, valves, and actuators, water delivery lines and hoses, individual fracture pump's rates as well as collective system rates, blender hydraulics such as chemical pumps, liquid and dry, fan motors for cooling packages, blender discharge pumps, electric and variable frequency powered chemical pumps and auger screws, suction and discharge manifold meters, valves, and actuators. Equipment can prevent failures, reduce continual damage, and control when it is allowed and not allowed to continue to operate based on live and continuous data readings. Each component may be able to provide troubleshooting codes and alerts that more specifically narrow down the potential causes of issues. This allows technicians to more effectively service equipment, or for troubleshooting or other processes to be initialized automatically. Conditional monitoring will identify changes in system components and will be able to direct, divert, and manage all components so that each is performing its job the most efficiently

103. Later on, the specification teaches what can be accomplished through the use of such devices:²⁹

²⁹ '435 Patent at 6:20–61.

The features of the present disclosure may allow for remote monitoring and control from diverse location, not solely the data van 68. Fracturing control may be integrated in with the sensor and monitoring packages 104 to allow for automated action to be taken when/if needed. Equipment may be able to determine issues or failures on its own, then relay that message with a specified code and alarm. Equipment may also be in control to shut itself down to prevent failures from occurring. Equipment may monitor itself as well as communicate with the system as a whole. This may allow whole system to control equipment and processes so that each and every component is running at its highest efficiency, sand, water, chemical, blenders, pumps, and low and high pressure flow lines. Features of the present disclosure may capture, display, and store data, which may be visible locally and remotely. The data may be accessible live during the data collection and historical data may also be available. Each component to this system can be tested individually with simulation as well as physical function testing.

Operating efficiencies for each individual component and the system 40 may be greatly improved. For example, sand storage and delivery to the blender can be monitored with load cells, sonar sensors and tachometers to determine storage amounts, hopper levels, auger delivery to the tub. Pump efficiencies may be monitored with flow sensors, accelerometers, pressure transducer and tachometers to optimize boost and rate while minimizing harmful conditions such as cavitation or over rating. Failure modes such as wash outs, cutting, valve and/or seat failures, packing issues and supply blockage can be captured and then prevented. Flow lines, both suction supply and discharge can be monitored with flow meters to distribute and optimize flow rates and velocities while preventing over pumping scenarios. Feedback loops of readings from blender to supply manifolds and to pumps can work with each other to optimize pressure and flow. Dropping out of an individual pump may occur preventing further failures, when this occurs the system as a whole may automatically select the best pumps to make up that needed rate. These changes and abilities solve equipment issues and prevent down time as well as provide a means to deliver a consistent job.

104. In addition to the above descriptions of Figure 2, the specification goes on to describe Figures 3, 4, 5, 6, and 7 in great detail which would inform a POSITA ways to implement

the identified language of Claim 1.³⁰ For example, one specific description of a way to implement claim 1 that a POSITA would readily understand is described in reference to Figure 7:³¹

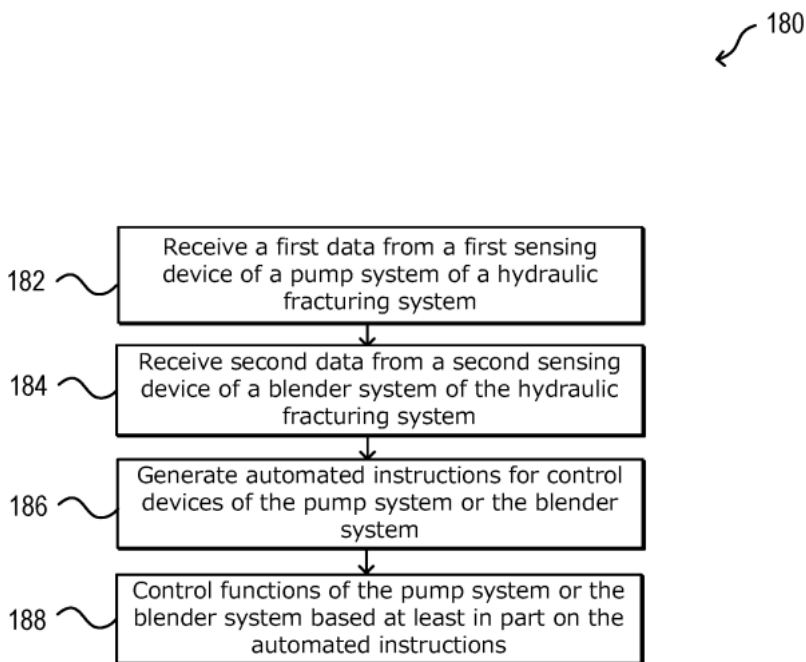


FIG.7

³⁰ '435 Patent at 7:6–11:18.

³¹ '435 Patent at Fig. 7; 11:1–18.

In some embodiments, the pump system includes one or more pumps and a distribution system that receives and consolidates the fracturing fluid from the one or more pumps for injection into a wellhead. In some embodiments, the method **180** also includes controlling one or more functions of the distribution system based on the automated instructions. In some embodiments, the pump system includes a plurality of pumps, and the first data includes measurements of each of the plurality of pumps. The method **180** may also include controlling one or more of the plurality of pumps individually based on the automated instructions. The method **180** may further include detecting that a measurement associated with a first pump of the plurality of pumps is outside of an acceptable threshold, and automatically taking the first pump offline in response to the detection. The method may further include adjusting one or more of the other pumps in the plurality of pumps to compensate for taking the first pump offline.

105. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

- I. “generating the automated instructions at the second device based at least in part on the first parameter, and automatically adjusting one or more functions of the second device based on the automated instructions”**

1) Claim Language

106. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
7	A hydraulic fracturing method, comprising: providing a fracturing fluid to a plurality of pumps; pumping the fracturing fluid into a distribution system; injecting the fracturing fluid into a wellhead; <i>measuring one or more parameters</i> of the plurality of pumps, the distribution system,

	or the wellhead via a plurality of sensing devices instrumented thereon; <i>detecting that a first parameter of the one or more parameters is outside of an acceptable threshold;</i> generating automated instructions for one or more control devices based at least in part on the one or more parameters; automatically adjusting one or more functions of the plurality of the pumps, the distribution system or the wellhead based at least in part on the automated instructions; transmitting the first parameter from a first device of the plurality of pumps, the distribution system, or the wellhead to a second device of the plurality of pumps, the distribution system, or the wellhead; generating the automated instructions at the second device based at least in part on the first parameter; and automatically adjusting one or more functions of the second device based on the automated instructions.
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107. It is my opinion that the term “generating the automated instructions at the second device based at least in part on the first parameter;” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed. A POSITA would readily understand the system had previously identified issues which might occur and had a planned method to react to them.

2) Specification

108. The ’435 patent’s specification provides context and guidance that would inform a POSITA what is meant by this claim term. The patent includes Figure 2, a schematic diagram of an embodiment of an automated hydraulic fracturing system:³²

³² ’435 Patent at Fig. 2, 2:379–39.

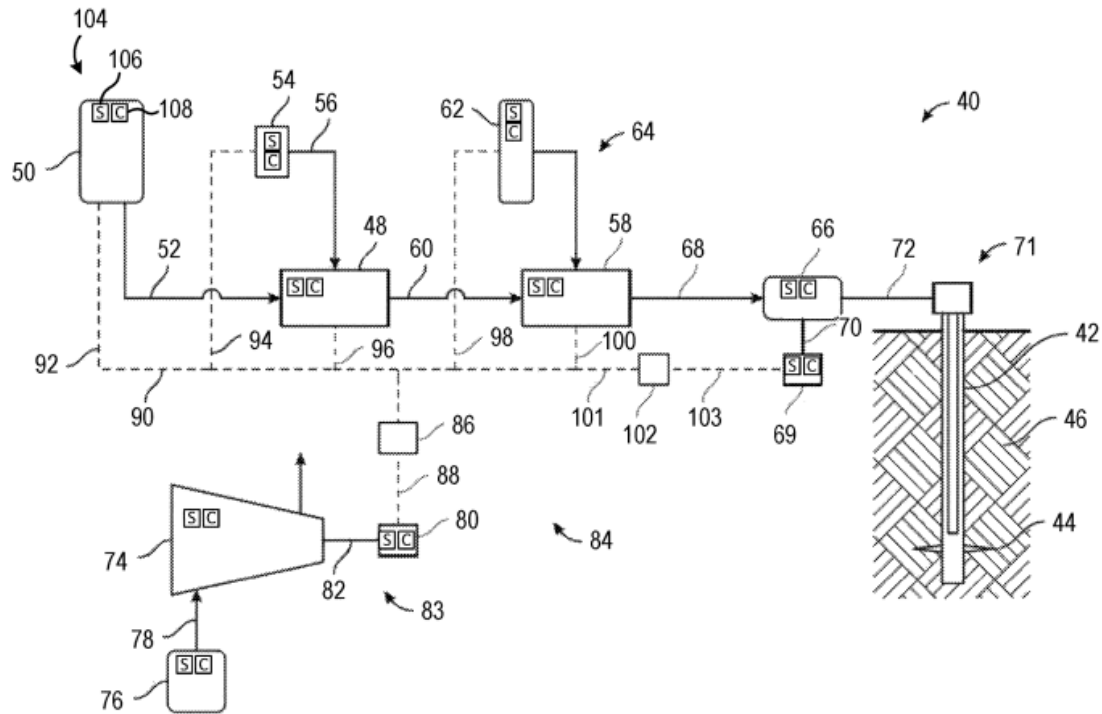


FIG.2

Regarding Figure 2, the specification offers the following description of the various “devices” illustrated:³³

³³ '435 Patent at 5:25–50.

In the illustrated embodiment, one or more instrumentation devices **104** such as various types of sensors **106** and controllers **108** are arranged throughout the hydraulic fracturing system **40** and coupled to one or more of the aforementioned components, including any of the wellhead assembly **71**, pump **66**, blender unit **58**, proppant source **62**, hydration unit **48**, additive source **54**, fluid source **50**, generator **80**, turbine **74**, fuel source **76**, any deliveries lines, and various other equipment used in the hydraulic fracturing system **40**, not all of which are explicitly described herein for sake of brevity. The instrumentation **104** may include various sensors, actuators, and/or controllers, which may be different for different components. For example, the instrumentation devices **104** may include hardware features such as, low pressure transducer (low and high frequency), high pressure transducers (low and high frequency), low frequency accelerometers, high frequency accelerometers, temperature sensors, external mounted flow meters such as doppler and sonar sensors, magnetic flow meters, turbine flow meters, proximity probes and sensors, speed sensors, tachometers, capacitive, doppler, inductive, optical, radar, ultrasonic, fiber optic, and hall effect sensors, transmitters and receivers, stroke counters, GPS location monitoring, fuel consumption, load cells, PLCs, and timers. In some embodiments, the instrumentation devices may be installed on the components and dispersed in various locations.

The specification goes on to describe components used in transmitting information, and describe how equipment can react to certain communications:³⁴

³⁴ '435 Patent at 5:50–6:9.

The components may also include communication means that enable all the sensor packages, actuation devices, and equipment components to communicate with each other allowing for real time conditional monitoring. This would allow equipment to adjust rates, pressure, operating conditions such as engine, transmission, power ends RPMs, sand storage compartment gates, valves, and actuators, sand delivery belts and shoots, water storage compartments gates, valves, and actuators, water delivery lines and hoses, individual fracture pump's rates as well as collective system rates, blender hydraulics such as chemical pumps, liquid and dry, fan motors for cooling packages, blender discharge pumps, electric and variable frequency powered chemical pumps and auger screws, suction and discharge manifold meters, valves, and actuators. Equipment can prevent failures, reduce continual damage, and control when it is allowed and not allowed to continue to operate based on live and continuous data readings. Each component may be able to provide troubleshooting codes and alerts that more specifically narrow down the potential causes of issues. This allows technicians to more effectively service equipment, or for troubleshooting or other processes to be initialized automatically. Conditional monitoring will identify changes in system components and will be able to direct, divert, and manage all components so that each is performing its job the most efficiently

109. Later on, the specification teaches what can be accomplished through the use of such devices:³⁵

³⁵ '435 Patent at 6:20–61.

The features of the present disclosure may allow for remote monitoring and control from diverse location, not solely the data van 68. Fracturing control may be integrated in with the sensor and monitoring packages 104 to allow for automated action to be taken when/if needed. Equipment may be able to determine issues or failures on its own, then relay that message with a specified code and alarm. Equipment may also be in control to shut itself down to prevent failures from occurring. Equipment may monitor itself as well as communicate with the system as a whole. This may allow whole system to control equipment and processes so that each and every component is running at its highest efficiency, sand, water, chemical, blenders, pumps, and low and high pressure flow lines. Features of the present disclosure may capture, display, and store data, which may be visible locally and remotely. The data may be accessible live during the data collection and historical data may also be available. Each component to this system can be tested individually with simulation as well as physical function testing.

Operating efficiencies for each individual component and the system 40 may be greatly improved. For example, sand storage and delivery to the blender can be monitored with load cells, sonar sensors and tachometers to determine storage amounts, hopper levels, auger delivery to the tub. Pump efficiencies may be monitored with flow sensors, accelerometers, pressure transducer and tachometers to optimize boost and rate while minimizing harmful conditions such as cavitation or over rating. Failure modes such as wash outs, cutting, valve and/or seat failures, packing issues and supply blockage can be captured and then prevented. Flow lines, both suction supply and discharge can be monitored with flow meters to distribute and optimize flow rates and velocities while preventing over pumping scenarios. Feedback loops of readings from blender to supply manifolds and to pumps can work with each other to optimize pressure and flow. Dropping out of an individual pump may occur preventing further failures, when this occurs the system as a whole may automatically select the best pumps to make up that needed rate. These changes and abilities solve equipment issues and prevent down time as well as provide a means to deliver a consistent job.

110. In addition to the above descriptions of Figure 2, the specification goes on to describe Figures 3, 4, 5, 6, and 7 in great detail which would inform a POSITA ways to implement the identified language of Claim 7. For example, one specific description of a way to implement claim 7 that a POSITA would readily understand is described in reference to Figure 6:

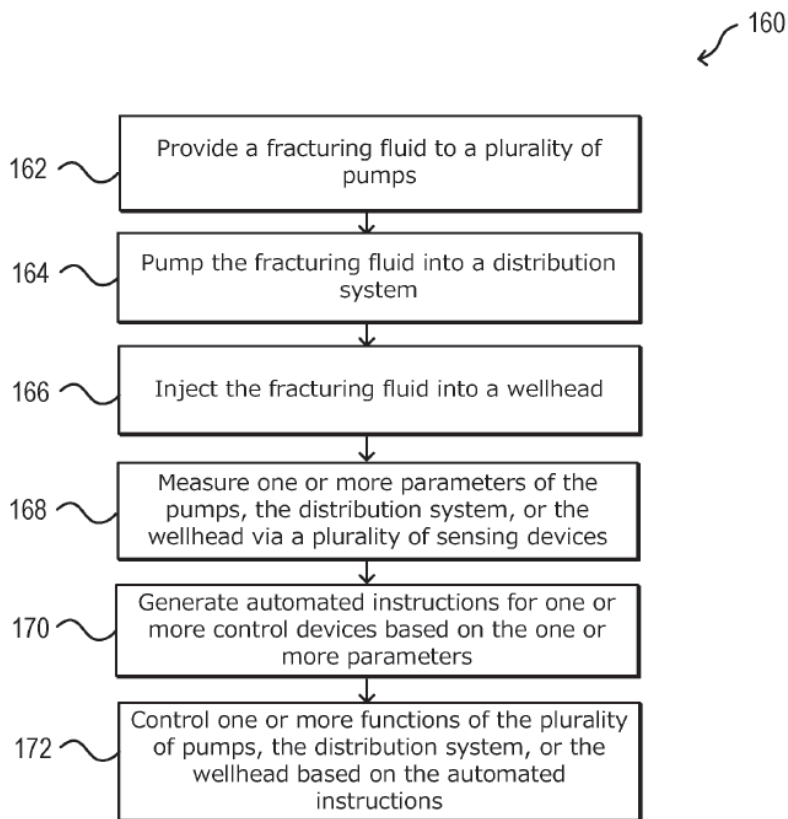


FIG.6

In some embodiments, the method 160 also includes detecting that a first parameter of the one or more parameters is outside of an acceptable threshold, in which the first parameter is associated with a first pump of the plurality of pumps, and automatically adjusting or turning off the first pump. In some embodiments, the method 160 also includes adjusting one or more of the other pumps in the plurality of pumps to compensate for the first pump. In some embodiments, the method 160 also includes selecting the one or more of the other pumps to adjust based at least in part on the conditions of the other pumps as indicated by one or more of the one or more parameters. In one or more embodiments, the method 160 also includes determining that the one or more parameters are indicative of a potential failure condition; and determining a source of the potential failure condition. In some embodiments, the method 160 also includes generating an alert or notification indicative of the potential failure condition and the source. In some embodiments, the method 160 also includes logging operation data including a number of strokes and pumping hours performed by a pump of the plurality of pumps, and determining a maintenance schedule based at least in part on the operation data.

111. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

J. “generating automated instructions at the second device based at least in part on the first parameter, and automatically adjusting one or more functions of the second device based on the automated instructions”

1) Claim Language

112. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
13	A hydraulic fracturing method, comprising: Performing one or more hydraulic fracturing operations at a hydraulic fracturing system, the hydraulic fracturing system comprising a plurality of pumps, a

	distribution system, and a wellhead; measuring one or more operational parameters of the plurality of pumps, the distribution system, or the wellhead; transmitting a first parameter of one or more operational parameters from a first device of the plurality of pumps, the distribution system, or the wellhead to a second device of the plurality of the plurality of pumps, the distribution system, or the wellhead; detecting that the first parameter is outside of an acceptable threshold; generating the automated instructions at the second device based at least in part on the first parameter; and automatically adjusting one or more functions of the second device based on the automated instructions.
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113. It is my opinion that the term “generating the automated instructions at the second device based at least in part on the first parameter;” is readily understandable to a POSITA from its plain and ordinary meaning. It is further my opinion that a POSITA would understand this term to be sufficiently definite and no construction is needed.

2) Specification

114. The ’435 patent’s specification provides context and guidance that would inform a POSITA what is meant by this claim term. The patent includes Figure 2, a schematic diagram of an embodiment of an automated hydraulic fracturing system:³⁶

³⁶ ’435 Patent at Fig. 2, 2:379–39.

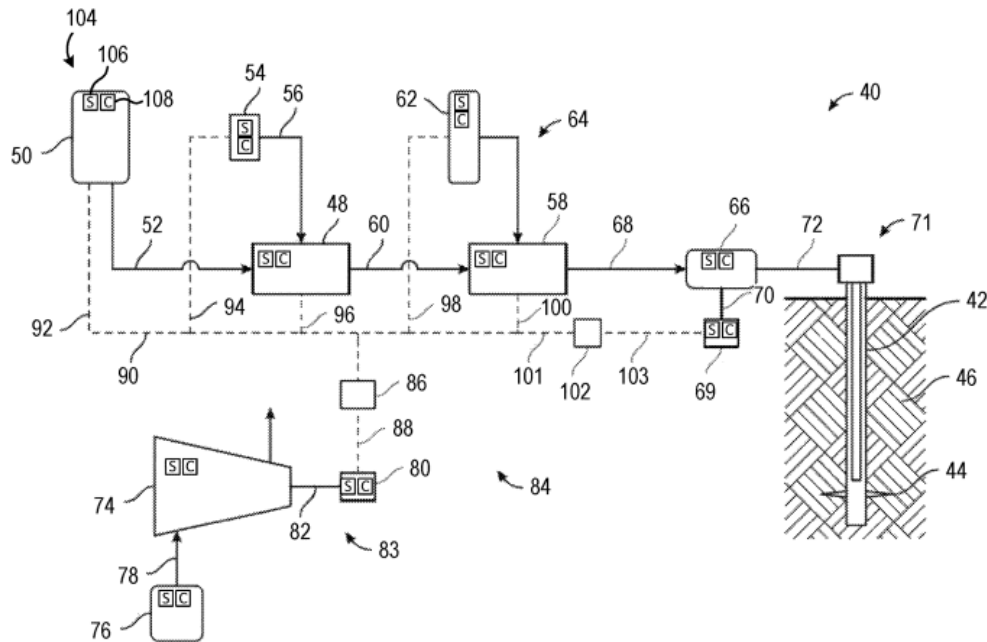


FIG.2

Regarding Figure 2, the specification offers the following description of the various “devices” illustrated:³⁷

³⁷ '435 Patent at 5:25–50.

In the illustrated embodiment, one or more instrumentation devices **104** such as various types of sensors **106** and controllers **108** are arranged throughout the hydraulic fracturing system **40** and coupled to one or more of the aforementioned components, including any of the wellhead assembly **71**, pump **66**, blender unit **58**, proppant source **62**, hydration unit **48**, additive source **54**, fluid source **50**, generator **80**, turbine **74**, fuel source **76**, any deliveries lines, and various other equipment used in the hydraulic fracturing system **40**, not all of which are explicitly described herein for sake of brevity. The instrumentation **104** may include various sensors, actuators, and/or controllers, which may be different for different components. For example, the instrumentation devices **104** may include hardware features such as, low pressure transducer (low and high frequency), high pressure transducers (low and high frequency), low frequency accelerometers, high frequency accelerometers, temperature sensors, external mounted flow meters such as doppler and sonar sensors, magnetic flow meters, turbine flow meters, proximity probes and sensors, speed sensors, tachometers, capacitive, doppler, inductive, optical, radar, ultrasonic, fiber optic, and hall effect sensors, transmitters and receivers, stroke counters, GPS location monitoring, fuel consumption, load cells, PLCs, and timers. In some embodiments, the instrumentation devices may be installed on the components and dispersed in various locations.

The specification goes on to describe components used in transmitting information, and describe how equipment can react to certain communications:³⁸

³⁸ '435 Patent at 5:50–6:9.

The components may also include communication means that enable all the sensor packages, actuation devices, and equipment components to communicate with each other allowing for real time conditional monitoring. This would allow equipment to adjust rates, pressure, operating conditions such as engine, transmission, power ends RPMs, sand storage compartment gates, valves, and actuators, sand delivery belts and shoots, water storage compartments gates, valves, and actuators, water delivery lines and hoses, individual fracture pump's rates as well as collective system rates, blender hydraulics such as chemical pumps, liquid and dry, fan motors for cooling packages, blender discharge pumps, electric and variable frequency powered chemical pumps and auger screws, suction and discharge manifold meters, valves, and actuators. Equipment can prevent failures, reduce continual damage, and control when it is allowed and not allowed to continue to operate based on live and continuous data readings. Each component may be able to provide troubleshooting codes and alerts that more specifically narrow down the potential causes of issues. This allows technicians to more effectively service equipment, or for troubleshooting or other processes to be initialized automatically. Conditional monitoring will identify changes in system components and will be able to direct, divert, and manage all components so that each is performing its job the most efficiently

115. Later on, the specification teaches what can be accomplished through the use of such devices:³⁹

³⁹ '435 Patent at 6:20–61.

The features of the present disclosure may allow for remote monitoring and control from diverse location, not solely the data van 68. Fracturing control may be integrated in with the sensor and monitoring packages 104 to allow for automated action to be taken when/if needed. Equipment may be able to determine issues or failures on its own, then relay that message with a specified code and alarm. Equipment may also be in control to shut itself down to prevent failures from occurring. Equipment may monitor itself as well as communicate with the system as a whole. This may allow whole system to control equipment and processes so that each and every component is running at its highest efficiency, sand, water, chemical, blenders, pumps, and low and high pressure flow lines. Features of the present disclosure may capture, display, and store data, which may be visible locally and remotely. The data may be accessible live during the data collection and historical data may also be available. Each component to this system can be tested individually with simulation as well as physical function testing.

Operating efficiencies for each individual component and the system 40 may be greatly improved. For example, sand storage and delivery to the blender can be monitored with load cells, sonar sensors and tachometers to determine storage amounts, hopper levels, auger delivery to the tub. Pump efficiencies may be monitored with flow sensors, accelerometers, pressure transducer and tachometers to optimize boost and rate while minimizing harmful conditions such as cavitation or over rating. Failure modes such as wash outs, cutting, valve and/or seat failures, packing issues and supply blockage can be captured and then prevented. Flow lines, both suction supply and discharge can be monitored with flow meters to distribute and optimize flow rates and velocities while preventing over pumping scenarios. Feedback loops of readings from blender to supply manifolds and to pumps can work with each other to optimize pressure and flow. Dropping out of an individual pump may occur preventing further failures, when this occurs the system as a whole may automatically select the best pumps to make up that needed rate. These changes and abilities solve equipment issues and prevent down time as well as provide a means to deliver a consistent job.

116. In addition to the above descriptions of Figure 2, the specification goes on to describe Figures 3, 4, 5, 6, and 7 in great detail which would inform a POSITA ways to implement the identified language of Claim 7. For example, one specific description of a way to implement claim 13 that a POSITA would readily understand is described in reference to Figure 6:

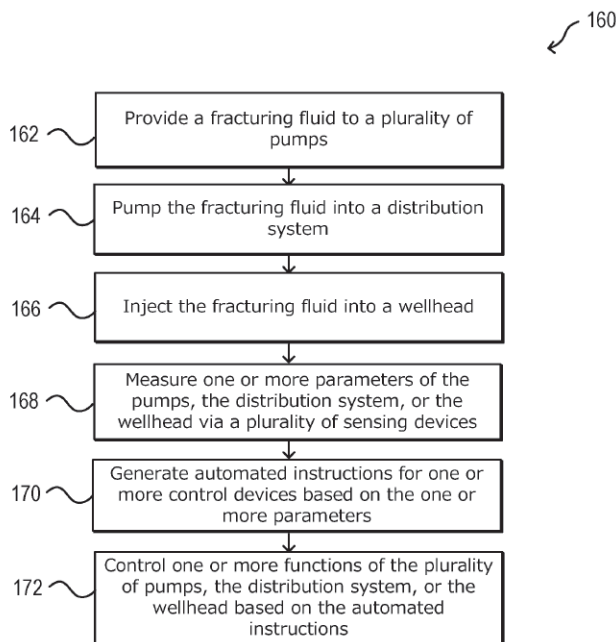


FIG.6

In some embodiments, the method 160 also includes detecting that a first parameter of the one or more parameters is outside of an acceptable threshold, in which the first parameter is associated with a first pump of the plurality of pumps, and automatically adjusting or turning off the first pump. In some embodiments, the method 160 also includes adjusting one or more of the other pumps in the plurality of pumps to compensate for the first pump. In some embodiments, the method 160 also includes selecting the one or more of the other pumps to adjust based at least in part on the conditions of the other pumps as indicated by one or more of the one or more parameters. In one or more embodiments, the method 160 also includes determining that the one or more parameters are indicative of a potential failure condition; and determining a source of the potential failure condition. In some embodiments, the method 160 also includes generating an alert or notification indicative of the potential failure condition and the source. In some embodiments, the method 160 also includes logging operation data including a number of strokes and pumping hours performed by a pump of the plurality of pumps, and determining a maintenance schedule based at least in part on the operation data.

117. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand this term to be sufficiently definite without further construction.

K. “common support structure”

1) Claim Language

118. I understand that claim terms are to be evaluated within the context with which they appear, and the claims in which the term appears are below:

Claim	Claim Language
1	A hydraulic fracturing system for fracturing a subterranean formation, comprising: an electric powered pump coupled to a well associated with the subterranean formation and powered by at least one electric motor, the electric powered pump configured to pump fluid into a wellbore associated with the well; a variable frequency drive (VFD) connected to the at least one electric motor to control the speed of the at least one electric motor; a transformer for conditioning power to the electric powered pump, the power being received from at least one generator at a voltage higher than an operating voltage of the electric pump; and a switchgear, receiving power from at least one generator, configured to distribute power to a plurality of pieces of wellsite equipment, the switchgear having a common load sharing bus and front aligned, shielded cable connections, the switchgear being positioned within an enclosure; wherein <i>the electric powered pump, the VFD, the switchgear, and the transformer are mounted on a common support structure</i> and a single cable couples the switchgear to the transformer.

119. It is my opinion that the term “common support structure” is readily understandable to a POSITA from its plain and ordinary meaning.

120. In Claim 1 shown above, the relevant claim is directed to a system for hydraulic fracturing and the relevant limitation requires a “electric powered pump” “configured to pump fluid into a wellbore associated with the well,” a VFD connected to “at least one electric motor,”

a transformer for conditioning power to the electric powered pump,” and “a switchgear, receiving power from at least one generator, configured to distribute power to a plurality of pieces of wellsite equipment.” Without any further context, the claim language informs a POSITA as to the meaning of the term “common support structure,” which is simply any common structure on which the electric powered pump, the VFD, the switchgear, and the transformer could be mounted.

2) Specification

121. It is my opinion that a POSITA would not understand this term to be limited to the “same skid, truck bed, or flatbed trailer.” The specification teaches that:⁴⁰

As illustrated, in various embodiments, the trailer **402** is sized to accommodate a variety of different pieces of equipment. Advantageously, mounting the equipment to a single trailer **402** facilitates mobilization and demobilization between well sites. Moreover, the configuration may enable hard-piping or coupling various pieces of equipment before arriving at the well site, thereby reducing time. Additionally, the configuration illustrated in FIG. 4 may reduce congestion at the well site. It should be appreciated that inclusion of a trailer is for illustrative purposes only and that the components may also be mounted on a skid, truck bed, flatbed trailer, or the like.

122. The specification also lists the following examples of common support structures:⁴¹

In various embodiments, the switchgear unit **200** can be trailer mounted, skid mounted, bodyload mounted, or mounted on another type of platform. Furthermore, the switchgear unit **200** can be separate or combined with other equipment described herein, such as the pump units.

⁴⁰ ‘878 patent at 10:1-12.

⁴¹ ‘878 patent at 8:6-10.

123. Based on the claim language, the specification, and the plain and ordinary meaning of the term, a POSITA would understand the term “common support structure” without further construction.

VII. CONCLUSION

124. Based on my education, knowledge, experience, and training in the industry, and in light of my review of the materials cited within this declaration, it is my opinion that each of the terms that parties have identified for construction are readily understandable to a POSITA from their plain and ordinary meaning and no construction is needed.

125. If the Court finds that the term “high pressure” is not readily understandable to a POSITA from its plain and ordinary meaning and a construction is necessary, it is my opinion that “high pressure” should be defined as “the fluid has been pressurized and discharged out of the fracturing pump.”

I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 21, 2024

A handwritten signature in blue ink, appearing to read "Michael R. Chambers, Sr.", written over a horizontal line.

Michael R. Chambers, Sr.

APPENDIX A

CURRICULUM VITAE

CONTACT INFORMATION

Michael (Mike) Roy Chambers Sr.

11328 CR 4102 Lindale, Texas 75771

(O) 903-881-8788 (C) 713-898-2454

Email: MChambers@MRCPet.com

PERSONAL INFORMATION

Citizenship – USA

Active Passport

PROFILE OF RELEVANT E&P EXPERIENCE

- Third generation oil and gas with over 40 years of drilling, completion, and production experience working with all types of conventional and unconventional wells and facilities worldwide.
- Proven track record of managing staff, capital, and gross operating budgets in excess of 2 billion dollars / year and production volumes of over 1.5 BCFD.
- Over 10 years working in Mobil's technology center on industry first projects worldwide and have been in over 50 countries working oil and gas issues.
- Extensive experience in managing foreign Joint Ventures.
- Leader in Environmental Health and Safety.
- SPE Distinguished Lecturer and Patent holder.
- 15 years managing US land based operations and development in East Texas / North Louisiana, Oklahoma, Appalachia, South Texas, Rockies, and West Texas. Wide variety of operations from Coal Bed Methane, CO2 Floods, Sour Gas Plants, Water Floods, Conventional Tight Gas, and Horizontal Shale Wells. Extensive experience operating wells from less than 1 mcfpd to over 100 million cfpd/well.
- Highly supportive of automation technologies to lower down time, improve well performance, minimize environmental impact, reduce work force, and produce reliable production data.
- Expert Witness reports, depositions, and testimony in US, Scotland, and Canada on oil industry related projects.
- In charge of all operations and engineering for a major independent oil and gas company while satisfying requirements from JV partner British Gas. All done safely and environmentally sound.
- On the Board of Azure Midstream. (East Texas Gas Gathering Company)
- Took a company that had never drilled a horizontal well to one running over 20 rigs drilling over 500 wells in the deepest, highest pressure, hottest, shale formation in the United States.
- Developing Completion equipment and techniques for Enhanced Geothermal Completions.

EMPLOYMENT HISTORY

President
MRCPET LLC

November 2015 – Present

Provide Expert Witness testimony and project consulting in the US, Canada, and Scotland on patents and disputes.

**President
Geothermal Wells LLC**

October 2022 - Present

Developing projects to use oil and gas technology to develop Enhanced Geothermal Resources for Electricity or Heat. Currently focusing on developments in Nevada, the United Kingdom, Taiwan and Japan.

**Vice President, Operations and Asset Management
EXCO Resources, Inc., Dallas, Texas**

January 2013 – November 2015

Responsible for EXCO's Drilling, Completion, Development, and Production Operations. Operations and Development at the peak included over 350 staff (100 office, and 250 field). Operated ~ 6,500 wells producing over 1.5 BCFD and 30,000 BOPD in 4 states. Manage two JV operations with BG Group as well as EXCO non JV properties. Managed 3 Development Teams for the Haynesville, Marcellus, and Eagle Ford. At the peak managed 26 drilling rigs ramping down to 3 rigs in late 2015 due to low commodity prices.

Operations varied from 6,000 conventional shallow gas wells in Pennsylvania, and West Virginia (producing ~5 mcf/d /well), 120 Marcellus Horizontal Wells (rates to 12 Mmscf/d @ 6,000 psi), 500 Haynesville Shale Wells (rates to 30 Mmscf/d @ 10,500 psi), and 220 Eagle Ford Shale Wells (rates over 1,000 BOPD), Austin Chalk and Buda horizontal Wells. Lowest cost operator and driller in the Haynesville shale.

**Vice President Operations – East Texas / North Louisiana
EXCO Resources, Inc., Dallas, Texas**

February 2007 – December 2012

Responsible for Geology, Reservoir Engineering, Drilling, Completion, and Producing operations in East Texas and North Louisiana Including: 260 Company personnel (3 major areas) and over 1,500 wells with gross production of over 1.5 Bscfd. Well mix included conventional Cotton Valley wells in the Vernon, Waskom, Holly and Danville Fields to Horizontal Haynesville Shell wells in Louisiana and East Texas. Managed Haynesville Joint Venture with BG Group including operation of twenty-two 1,500 HP drilling rigs and 4 frac fleets. Board member for EXCO Appalachia and TGGT Joint (Gas Gathering) ventures with the BG Group. These operations accounted for ~85% of the company's production and capital spend. Set up new production, well work, and maintenance data bases. Guided EXCO's Haynesville field development from inception to over 400 wells producing ~ 1 BCFD in 3 years.

**General Manager – Operations – Eastern Region
Anadarko Petroleum Corporation, The Woodlands, Texas**

August 2006 – February 2007

Responsible for Anadarko's field operations in Central Texas, East Texas, Louisiana, Mississippi and Pennsylvania. Including: 240 Company Personnel (5 major areas), 200 + Contract Personnel and Over 4,000 wells. Responsible for a net 166,000 BOED, 3 Gas (sweetening) Plants, central gathering / compression systems. Capital budget (\$500 million) Expense budget of (\$200 million)

Major Properties include

- Vernon – Louisiana (250 MMscfd) (Caney Lake Plant – 100MMscfd)
- Bossier - Central Texas (250 MMscfd) (Pinnacle Plant – 350 MMscfd)
- Carthage – East Texas (90 MMscfd)
- Chalk – Central Texas (120 MMscfd & 10,000 BOPD) (Tyler County Plant – 60 MMscfd)

**Production Manager – Rockies
Anadarko Petroleum Corporation, The Woodlands, Texas**

June 2000 – August 2006

Producing and Production Engineering Manager for Anadarko's assets in Wyoming, Colorado, and Utah.

Grew area from 50 to 250 company employees, 3 Engineers to 20 Engineer, 310 wells to over 5,000 wells, 20,000 to 120,000 Company owned Compression HP, production of 10 MM BOE/YR to 28 MM BOE/YR

Included in the area were 4 major PSM sweetening gas plants, 2 major CO₂ floods, Conventional Tight Gas Production, Sour Gas Production, and Coal Bed Methane Production. Operated 1,200 miles of company owned power transmission lines and sub stations. Numerous DOT pipelines.

Extensive experience on private and BLM lands with production, injection, disposal, surface discharge.

Major Properties Include

Elk Basin – Water Flood – 5,000 BOPD- Elk Basin Plant - 30 MMscfd, butane, gasoline
 Salt Creek – EOR – Salt Creek Plant – 120 MMscfd (CO₂)
 Monell – EOR – 30 MMscfd (CO₂)
 County Line – Powder River CBM – 150 MMscfd
 Atlantic Rim – CBM – 10 MMscfd
 Helper – Utah CBM – 60 MMscfd – 2 Plants (60 MMscfd)
 Brady – Sour Gas – 60 MMscfd - (Brady Plant – 60 MMscfd)
 Table Rock – Sour Gas – 60 MMscfd (Table Rock Plant – 60 MMscfd)
 Moxa – Conventional – 30 MMscfd
 Wamsutter – Conventional – 100 MMscfd

Sr. Production Engineer – Rockies Union Pacific Resources, Ft Worth, Texas

January 2000 – June 2000

Provide engineering support and supervision for completions and workover operations in Wamsutter, Moxa, and Brady fields of South Western Wyoming.

IDS Completions / Well Testing Supervisor MEPTEC Completions Engineering Advisor, Dallas, Texas

April 1998 – Jan 2000

Dual role responsibilities reporting to both Research and Operations to help maintain communication and technology transfer

IDS (International Drilling Services) Completions / Well Testing Supervisor

Provide engineering supervision and coordination to 7 completion and well test engineers. 3 Engineers support subsea completions and installation of a new 40 slot platform in Equatorial Guinea, 1 engineer supports completions in Indonesia, 1 engineer supports heavy oil artificial lift activities in Venezuela, and 2 engineers support well tests worldwide. Developed new completion scheme on subsea wells to allow the pay interval to be drilled horizontally with oil base mud prior setting the production casing and gravel packing the open hole pay interval. This scheme reduced completion costs by over \$1.5 million per well while simultaneously increasing well productivity. Subsea wells produce in excess of 15,000 BOPD. On-site supervised this new completion technique. This new scheme was made possible by working with research group. Developed new P&A scheme to allow bottom hole pressure to be continuously monitored in subsea well after abandonment. This new scheme also cut the normal P&A cost in half.

Supervisory Duties include:

- Review and approve completion and well test procedures.
- Coordinate tender activities for 40 slot platform (\$80 million completion program), including bid preparation, bid analysis, contract approval, equipment manufacturing QA/QC for completion equipment and services.
- Evaluate alternatives and prepare cost estimates for new well tests and new field developments.

Completions Engineering Advisor

Internal consultant for MEPTEC (Mobil E & P Technical Center) on operated and non-operated properties including evaluating new development schemes before they go to the board of directors of the corporation for approval. Assist Mobil management in assessing risk and determining solutions for daily operating problems. Ensure Mobil Drilling is using latest technology available from either MEPTEC or outside.

**MEPTEC Completions Advisor
(Mobil E&P Technical Center) Dallas, Texas**

November 1990 - April 1998

Internal consultant and technical service engineer. Responsible for designing and implementing new and complex technologies worldwide, and providing day to day support for areas where the company did not have a existing completions, test, or operations engineer. A sampling of these activities include:

- Offshore wells tests from semis, drill ships and jackups in Australia, Vietnam, Canada, Red Sea, North Sea & West Africa. Onshore tests in Austria, Germany, Bolivia, Peru, Indonesia, & Algeria,
- Designed and provided on-site completion supervision for the first two successful horizontal wells in West Africa (1993). This entirely new development scheme has resulted in the drilling of over 100 offshore horizontal wells to date. Second well proved sand control was not required and significantly reduced costs on the next wells.
- Designed and provided on-site completion supervision for the first two horizontal gas storage wells in upper Austria (1993). Well design consisted of 7" monobore to minimize friction. To date 5 more wells using same design have been implemented in the field and design has been copied by numerous other operators.
- Designed and provided on-site supervision to complete the world's deepest multi-frac horizontal well (Germany 1994). This well has made previously uneconomic reserves commercial. Designed and on-site assisted affiliate in implementing a more cost effective well design (35% less cost using 4-1/2" casing) on a new well with 7 more approved to develop field (1999).
- Designed test program and provided onsite supervision for HPHT drill stem tests from a semi. One well was 200 miles offshore Australia in 600' of water. On this well seawater was used for the first time as a annular fluid in Australia and in a Mobil HPHT well. Two other wells were in 500' of water offshore Vietnam. Both tests used seawater as a annular fluid and one had a SITP above 12,000 psi. (1995)
- Designed and provided on-site supervision in completing a extended reach multi-frac horizontal well from a jackup. (Southern North Sea 1995).
- Worked with vendor to develop and supervised first installation of a new expandable metal open hole external casing packer. (West Texas 1996)
- Worked with vendor and affiliate to develop and to install two level Six S (pressure containing) Multi-lateral junctions in a single well. (California 1995)
- Assisted in the designs of almost all new horizontal and multi-lateral wells in Mobil. Also assisted in the designs for new developments in: Hibernia, Terra Nova, Sable (East coast of Canada), SCO, LaCeiba (Venezuela heavy oil), Sierra Chata (Argentina), Buckland, (North Sea), Soehlingen (Germany), Puchkirchen (Austria), Griffin (Australia), Ubit, OSO (Nigeria), Jade, Zafiro, Turmalina, Opallo (Equatorial Guinea), Arun, West Seno (Indonesia), Camesia, Candamo (Peru), Tempa Rosa (Italy), North Field (Qatar), Burun (Turkmenistan).
- Worked with Affiliate to install first level Two (cased mainbore) Multi-lateral in Southern North Sea. (1994)
- Worked with vendors and affiliate to install first Mobil level Four (cemented lateral tied back to cemented mainbore) Multi-lateral system. (Canada 1996)
- Worked with vendor to develop high temperature wire line set coil tubing retrievable bridge plug for first 9-5/8" monobore completion in Indonesia. (1991)
- Worked with vendors to develop concept and tools for a downhole shut off valve to allow perforating long intervals without killing the well. (1993)
- Developed concept, built, tested, and patented new corrosion resistant composite tubing coupling. (1991)
- Developed concept, patented and implemented new horizontal treatment method using simultaneous treatment down coil tubing and coil tubing/tubing annulus. (1993)
- Worked with vendor to develop and test a new open hole formation cracker tool. (1997)
- Worked with vendor to develop and test a downhole fiber optic laser for cutting and welding. (1998)
- Worked with vendor to develop and test a new level five (cemented lateral tied back to cemented mainbore with isolation) Multi-lateral hollow whipstock system. (North Sea 1997)
- Worked with vendors to develop and calibrate a new computer program to predict the strength of predrilled liners and measured failures on slotted casings. (1993)
- Designed testing scheme and conducted perforating, pressure, and drilling tests of a 4-1/2" composite bridge plug to optimize bit and motor selection. (1994)
- Provided company expertise in completions and producing to internal Technical Health Study on Drilling and Well Operations (1996)

- Conducted on-site review of drilling and completion operations in Uzbekistan. (1997)
- Completions Engineering & Well Testing Supervisor for Mobil International Drilling Services. (1999)
- Designed completion for open hole horizontal gravel pack where the drill in fluid was oil based instead of the water-based calcium carbonate polymer and utilized the Mobil shunt tube system to gravel pack. (1999)
- Numerous in-house presentations to foreign oil ministers and staffs including the President of Equatorial Guinea, Italian Oil Minister, and delegates from Uzbekistan, Turkmenistan, Russia, China, Bolivia, Kazakhstan, India, Qatar, Kuwait, Abu Dabi, Venezuela, Argentina, Nigeria, and Angola.

**MEPUS Completion Engineering Supervisor
(Mobil E & P U.S.) Midland, Texas**

1987 - 1989

Supervised 8 Engineers and 1 technician to complete on average +/- 200 wells per year and Drill Stem Test 20 exploration wells per year. Wells ranged from less than 2,500' to more than 19,000' TVD in West Texas, and New Mexico. All types of Artificial Lift including, Rod Pump, Gas Lift, Hydraulic Lift and Submersible pumps were designed and installed. Implemented new program of QA/QC on acid stimulation and propped fracturing stimulation that was adopted by the corporation. Supervised completion of first Horizontal cased hole multi-frac well. Supervised completion of first sequential frac stimulation in Texas to alter fracture direction. Assisted in development on new downhole shutoff valve for CO2 injectors.

**MEPUS Operations Engineering Supervisor
(Mobil E & P U.S.) Midland, Texas**

1986 - 1987

Supervised group of 12 engineers to support operations in the Pegasus District (composed southern half of West Texas) by performing, workovers, recompletions, drill deepers, artificial lift upgrades, and modification and new installations on producing facilities. District covered the southern half of West Texas, contained 5 field offices and over 1,000 wells. Production varied from deep gas wells, to shallow oil wells under primary production, water flood, and gas recycling of a retrograde gas condensate reservoir. Assisted Area Operations Manager prepare budgets and ensure production and safety goals were met.

**MEPUS Completions Engineer
(Mobil E & P U.S.) Midland, Texas**

1984 - 1986

Designed and supervised field implementation of well completion programs for more than 100 new oil, gas, and water injection wells in West Texas and New Mexico. Designed and supervised open hole Drill Stem tests on 13 exploration wells. Completions varied from simple acid stimulations, to multi-zone propped fracture stimulations. Implemented industry's first radioactive tagging of propped fractures and assisted vendor in new use of cement evaluation tool (CET) for foam cements. Worked with research lab to monitor frac direction and height growth during stimulation using sonic tools in observation wells.

**MPTM Drilling Engineer & Drilling Supervisor
(Mobil Producing Texas & New Mexico) Midland, and Sundown, Texas**

1983 - 1984

For 6 months supervised the drilling of new San Andres producers and water injectors in the Sundown District of West Texas. Supervised the completion of the new wells and performed casing repairs, fishing jobs and stimulations on existing wells. Rig activity ranged from 2 - 4 drilling rigs and 6 - 14 pulling units.

For 6 months worked in Midland Office preparing drilling and completion programs for 4 rig program.

**MPTM Production Supervisor
(Mobil Producing Texas & New Mexico) Sundown, Texas**

1981 - 1983

Supervised activities of two company gangs, welders, pumpers, technicians, and contractors to maintain over 500 producing and water injection wells. During tenure rebuilt two tank batteries, a water injection station and installed two new tank batteries. Oversaw site preparation, and installed new flowlines, pumping units and roads for over 50 new wells.

**MPTM Operations Engineer
(Mobil Producing Texas & New Mexico) Hobbs, New Mexico**

1979 - 1981

Provided Engineering support to field operations for properties in Denver City, Texas, Lovington, New Mexico, and the Four Corners Area of New Mexico. Duties included identifying workover candidates, designing new production facilities, upgrading artificial lift equipment, preparing procedures to repair casing strings, stimulations, recompletions, drill deepers, and plug and abandonments.

**Colorado Well Service - Roughneck, Derrickman, Operator
Rangely, Colorado**

1975 - 1979

Beginning in the winter of 1975 and for every winter and summer break until graduation from college in 1979 worked on Drilling Rigs and Pulling Units in Colorado, Utah, and Wyoming. Started as a floor hand and soon worked up to derrick man for both pulling units and drilling rigs and to operator on pulling units. Assignments varied with each school break from drilling wells in the mountains to performing artificial lift changes on submersibles and rod pumps to performing acid and fracture stimulations.

**Chevron U.S.A. Inc. Roustabout / Pumper
Redwash, Utah**

summer of 1975

During the summer of 1975 worked as a roustabout in company gangs doing maintenance during the first half of the summer and relief for the pumpers during the second half.

EDUCATION

Texas A & M University
Bachelor of Science - Petroleum Engineering
May - 1979

AWARDS

Texaco Star Ambassador, Texaco Oil Corporation, October 1997, For assistance in Multi-lateral development at Texaco.

Shreveport, Dallas and Ft. Worth Wildcatters 2009 – 2012, For Haynesville Development

PUBLICATIONS / PRESENTATIONS

Publications

Chambers, M.R., McCready K.E., Rankin, M.D., “Productivity-Based Service Contracts”, SPE 20103, Presented at the 1990 SPE Annual Technical Conference and Exhibition, New Orleans, Louisiana, Oct 1990, and the Permian Basin Oil and Gas Recovery Conference, Midland, Texas, March 1990

Nwankwo, A.S., Chambers, M.R., et. al., “Ubit Horizontal Well Performance Evaluation - Completion Operations”, Horizontal Well Conference, Dallas, March 1994

Pebdani, F.N., Chambers, M.R., et. al., “Ubit Horizontal Well Performance Evaluation and Future Potential”, Horizontal Well Conference, Dallas, March 1994

Abou-Sayed, I.S., Chambers, M.R., et. al. "Mobil Completes Deep, Tight, Horizontal Gas Well in Germany", Petroleum Engineer International, August 1996

Chambers, M.R., Meehan, D.N., "Practical Issues in Multi-lateral Horizontal Well Completions", SPE 36455, Presented at the 1996 SPE Annual Technical Conference & Exhibition, Denver, Colorado, October 1996

Chambers, M.R., "Making Multi-lateral Wells Cost Effective", SPE 51244, Presented at the 1998 22nd Annual International Conference and Exhibition, Lagos, Nigeria, August 1998

Chambers, M.R., "Multilateral Technology Opens New Horizons On and Offshore for Mobil", American Oil and Gas Reporter, December 1998

Sugden, C. Dr., Chambers, M.R., Johnson, J.A., "Special Considerations in the Design Optimization of High Rate, Multistage Fractured Shale Wells. SPE Paper 2012

Chambers, M.R., Hebert, D.A. "Successful Application of Oil-based Drilling Fluids in Subsea Horizontal, Gravel Packed Wells in West Africa" Paper # 088, SPE 58743 - SPE 2000 Formation Damage Control Symposium, Lafayette, Louisiana, Feb 2000

Numerous Internal Publications, a sampling of the latest non confidential listed below

Chambers, M.R. "Using Oil Based Mud to Drill Long Horizontal sections in Deep Subsea wells prior to Gravel Packing", Mobil Drilling & Well Operations Newsletter, July 1999

Chambers, M.R., "Topacio #1 Observation Well or How to inexpensively make a subsea observation well" Mobil Drilling & Well Operations Newsletter, July 1999

Chambers, M.R., "Recent Drilling and Completion Changes in E.G." Mobil Drilling & Well Operations Newsletter, June 1999

Chambers, M.R., "On the DL Tour", Mobil Drilling & Well Operations Newsletter, May 1998

Chambers, M.R., "First Application of New Generation External Casing Packer", Mobil Drilling & Well Operations Newsletter, January 1998

Industry Presentations

Chambers, M.R. "EXCO's Operations in the Haynesville" AADE, Dallas, Texas, January 16, 2013

Chambers, M.R. "Issues with producing over 1 BCFD from a single field." Ziff Operations Excellence Conference, Houston, Texas, March 1, 2012

Chambers, M.R. "Overview of US Gas and Exco's Operations" AADE Meeting, Dallas, Texas, September 21, 2011

Chambers M.R. "Shale Fracturing" – SPE Shreveport Chapter Luncheon, June 23, 2011

Chambers, M.R. "Shale Fracturing" – SPE Hydraulic Fracturing Conference Keynote Speaker, January 1, 2011

Chambers, M.R. "Haynesville Development", Kilgore College Board of Directors, June 14, 2010, Kilgore, Texas

Chambers, M.R. "Haynesville Operations", EXCO Analyst Day, September 23, 2009, Dallas, Texas

Chambers, M.R., "Using Oil Base Mud to Drill Long Horizontal Sections in Deep Subsea Wells Prior to Gravel Packing", 11th International Conference on Horizontal Well and Emerging Technologies, Houston, Texas, November 16, 1999

Chambers, M.R. “Making Multi-lateral Completions Cost Effective” - Distinguished Lecturer for SPE October 1997 - May 1998, 31 talks, 19 countries, (South America, West Africa, Middle East, Europe, 5 States in U.S.)

Chambers, M.R., “Low Cost Multi-lateral, Hollow Whipstock”, TAML Forum, San Francisco, California, September 1998

Chambers, M.R., “Multi-lateral Completions at Mobil, Past, Present & Future”, Strategic Research Institute Drilling Technologies, San Antonio, Texas June 1998

Chambers, M.R., “How to Determine the Shallowest Depth for a Multi-Lateral Junction”, TAML Forum, London, England, March 1998

Chambers, M.R., “Level 4 Multi-lateral, Canada”, TAML Forum, Stavanger, Norway, November 1997

Chambers, M.R., “New Oil Patch Technologies”, Energy Rubber Group, Houston, Texas, October 1997

Chambers, M.R. “Proposal for 6 Multi-lateral Levels”, TAML Forum, Breckenridge, Colorado, July 1997

Chambers, M.R. “How drilling technology has changed over the last 10 years”, Hi-Tech Happenings in the Patch, Basin Research Institute Center for Coastal, Energy, and Environmental Resources, Louisiana State University, New Orleans, Louisiana, May 1997

Chambers, M.R., “Level 2 Multi-lateral Development at Aneth, Utah”, TAML Forum, Aberdeen, Scotland, March 1997

Chambers, M.R., “Overview of Multi-lateral Completions”, SPE Applied Multi-lateral Technology, ATW, Houston, Texas, August 1996

Chambers, M.R., “New Low Cost Multi-lateral Concepts”, HWTU Multi-lateral Workshop, Aberdeen, Scotland, January 1996

Chambers, M.R., Mueller, M. “Completion of a Deep Multi-frac Horizontal Well”, North Sea Offshore Technology Conference, Aberdeen, Scotland, April 1995

Chambers, M.R., “Damage Minimization in Ubit I4, Horizontal Well, Offshore Nigeria”, HWTU Horizontal Forum, Aberdeen, Scotland, January 1994

Chambers, M.R., “History of Horizontal Well Technology at Mobil”, 4th International Conference on Horizontal Wells, Houston, Texas, October 1992

PROFESSIONAL MEMBERSHIPS

SPE Forum Series - The Future of Horizontal Wells in Unconventional Reservoirs Committee – Park City, Utah – August 2012

SPE Reprint Chairman – 2001 - 2003

SPE Reprint Chairman on Multi-lateral Completions - 2000

1997 SPE Forum Chairman for “Multi-lateral Completion Technology”, Breckenridge, Colorado, July 1997

Attended SPE July 1992 Forum on Horizontal Well Completions - Snowmass Colorado

Attended SPE November 1997 Carbonate Reservoir Stimulation - Kuwait City, Kuwait

Founding Member of SPE ATW's Committee member - Applied Multi-lateral Technology, Dallas, Texas, April 1996 and Houston, Texas, August, 1996

CEA (Completion Engineering Association) President - 1999- 2000

CEA Treasurer 1998 - 1999

CEA Advisory Board 1996 - 1998

CEA Downhole Tools Subcommittee - 1992

Heriot-Watt Horizontal Well Technology Unit - Technical Advisory Board (Edinburgh, Scotland)
February 1995 - 1998

SPE Dallas Chapter Completions Subcommittee Member - 1994 - 1996

API Subcommittee on Perforating Member 1997 – 2000

SPE Production Engineering Award Committee 1999 -

Courses Taught

AAPG Short Course, "New Advancements in Drilling and Completions", San Diego (1996), Dallas (1997), Salt Lake City (1998), San Antonio (1999 canceled)

Petro-Vietnam and VietSovPetro workshop, "Hydraulic Fracturing", Vung Tau, Vietnam - 1994

Chambers, M.R., "Horizontal Completions", Enron In-house Training, Houston, Texas, January 1998

Regularly taught sections at Mobil Completions Equipment Course and Mobil Completions Methods Course on Horizontal and Multi-lateral Completion Equipment and Methods (1991 - 1999)

Updated and Distributed Mobil's Completion Handbook, and Mobil Drill Stem Testing Guidelines

Patents

Chambers, M.R. And Sprunt, E.S., "Method for Controlling Sand Production from a Hydrocarbon Producing Reservoir", United States Patent No. 5,443,119, August 22, 1995

Chambers, M.R., and Sukup, R.S., "Corrosion-Resistant Composite Couplings and Tubular Connections", United States Patent No. 5,406,983, April 18, 1995

Jennings, A.R. and Chambers, M.R., "Method for Enhanced Cleanup of Horizontal Wells", United States Patent No. 5,462,118, October 31, 1995

Chambers, M.R., Alexander, S.A., and Pickett, S. "Multi-lateral Junction", United States Patent No. 5,960,873, October 5, 1999

Chambers, M.R., Lines, T.D., Pate, C.B. El Rabaa, R.M. Pearson, "Method of Controlling Tensile-Splitting and Hydro-Shearing Parameters during Completion of Enhanced Geothermal System Wells, United States Patent No. 12,140,344, November 12, 2024

4 additional patents Provisional filed 8/2023, Additional patents under same title Method of Controlling Tensile-splitting and Hydro-Shearing Parameters During Completion of Enhanced Geothermal System Wells" submitted 6/4/2024, 6/27/2024, 8/14/2024, 8/29/2024.

MRCPET Consulting Projects

Work with GLG Group and Third Bridge to conference call with Private Equity Groups on investments and trends in the Oil and Gas Industry.

March 2016 working with Heim, Payne & Chorush, L.L.P., Blakes (Blake, Cassels, & Graydon, LLP), Torys LLP, & BLG (Bordon, Ladner, & Gervais, LLP) to represent their clients as an Expert Witness in Patent Litigation in the United States and Canada.

January 2019 working with Heim, Payne & Chorush, L.L.P. and Armond Wilson LLP to represent their client as an Expert Witness in Patent Litigation in the United States.

2019 – CEO and President of a group in discussions and analysis of Ohio Clinton Horizontal Well Development Properties on lands operated by Reserve Energy Exploration Company.

November 2019 working with Heim, Payne & Chorush, L.L.P. and Armond Wilson to represent their client as an Expert Witness in Patent Litigation in the United States.

February 2021 working with Stronachs LLP to represent their client as an Expert Witness in Patent Litigation in Scotland.

February 2021 working with Piasetzki, Nenniger, Kvas LLP to represent their client as an Expert Witness in Patent Litigation in Canada.

September 2023 working with Cabello Hall Zinda, PLLC to represent their client as an Expert Witness in Patent Litigation in the U.S.

January 2024 working with Parlee McLaws LLP to represent their client as an Expert Witness in Canadian litigation.

March 2024 working with Heim, Payne & Chorush L.L.P. and Armond Wilson to represent their client as an Expert Witness in Patent Litigation in the United States.

June 2024 working with Locke Lord LLP to represent their client as an Expert Witness on patent infringement in the United States.

October 2024 working with Winston & Strawn LLP to represent their client as an Expert Witness in the United States.

APPENDIX B

Michael Roy Chambers Sr.

November/1/2024

Cases testified in:

Canadian Court File T-1741-13

Packers Plus Energy Services Inc. (Plaintiff) and Essential Energy Services Ltd. And Tryton Tool Services Limited Partnership (Defendants)

Canadian Court File T-1569-15

Rapid Completions LLC. And Packers Plus Energy Services Inc. (Plaintiffs) and Baker Hughes Canada Company (Defendant)

Canadian Court File T-1728-15

Packers Plus Energy Services and Rapid Completions LLC (Plaintiffs) and Weatherford International PLC., Weatherford Canada LTD., Weatherford Canada Partnership, and Harvest Operations Corp. (Defendants)

Canadian Court File T-2088-15

Packers Plus Energy Services INC. and Rapid Completions LLC (Plaintiffs) and Resource Well Completion Technologies INC. and Resource Completion Systems Inc. (Defendants)

Canadian Court File T-1420-18

NCS Multistage Inc. (Plaintiffs) and Kobold Corporation, Kobold Completions Inc., and 2039974 Alberta Ltd. (Defendants)

Canadian Court File T-567-20

NCS Multistage Inc. (Plaintiffs) and Promac Industries Ltd. (Defendants)

Aberdeen Sheriff Court Reference: ABE-CA40-18

Development GmbH –v- iiiTEC Limited (Plaintiffs) and Weatherford Switzerland Trading and Development GmbH (Defendants) – Aberdeen Sheriff Court, Aberdeen Scotland – October 2024

Cases Deposed in:

United States Case No. 4:18-cv-4797

United States Patent and Trademark Office – Weatherford International, LLC (Petitioner) vs Baker Hughes Oilfield Operations, LLC (Patent Owner) Case IPR2019-0708 & IPR2019-0768 Patent RE46,137 11/21/2019 & 4/7/2020

United States District Court Southern District of Texas Houston Division Civil Action 4:19-cv-02397

Weatherford U.S. L.P. (Petitioner) v. Enventure Global Tech., Inc. (Patent Owner)

IPR2020-01648 – 6/25/2021

Weatherford U.S. L.P. (Petitioner) v. Enventure Global Tech., Inc. (Patent Owner)

IPR2021-00107; IPR2020-1580 – 6/23/2021

Weatherford U.S. L.P. (Petitioner) v. Enventure Global Tech., Inc. (Patent Owner)

IPR2020-01684; IPR2020-01700 6/21/2021