UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TANKLOGIX, LLC,
Petitioner,

v.

SITEPRO, INC.
Patent Owner.

Case IPR2025-00651

Patent No. 11,175,680

DECLARATION OF DR. ROBERT A. DURHAM

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I, Dr. Robert Durham, Ph.D., hereby declare as follows:

I. INTRODUCTION & QUALIFICATIONS

1. I have been retained on behalf of SitePro, Inc. ("SitePro") to provide my opinions regarding Tanklogix LLC's Petition for *Inter Partes* Review of Claims 1-3, 6, 7, and 9-20 of U.S. Patent No. 11,175,680 ("the '680 Patent"). I submit this declaration based on my personal knowledge and in support of SitePro's Patent Owner Preliminary Response.

2. In formulating my opinions, I have relied upon my knowledge, training, and experience in the relevant art. My qualifications are detailed more fully in my curriculum vitae, which is included as Appendix A. Below, I provide a brief summary of my qualifications.

3. I am being compensated for my time spent in connection with this matter at my usual rate. My compensation is in no way contingent on the substance of my opinions or the outcome of this case.

A. QUALIFICATIONS

4. I am a consulting engineer with experience in a number of technical areas. I have oil and gas industry expertise from drilling and completion to downstream. As a consultant, I have worked with oil field production companies, refining and chemical plants, equipment manufacturers, and technology

development companies for over twenty years. My work relates to the subject matter of the ’680 Patent, which I describe below in Section V (“Overview of the ’680 Patent”).

5. I received both my Bachelor of Science degree in Electrical Engineering and Master of Engineering and Technology Management degrees from the University of Tulsa in 1992 and 1997, respectively. After years of professional work and research, I received my Ph.D. in Engineering Management from Kennedy Western University in 2004.

6. I have also served in leadership positions in the Petroleum and Chemical Industry Committee (PCIC) of the Institute of Electrical and Electronics Engineers (IEEE) for nearly twenty years. IEEE is the world’s largest technical professional association. The PCIC is the premier forum for the exchange of electrical applications technology related to the petroleum and chemical industry. From 2005 to 2012, I served as Secretary, Vice Chair, and ultimately Chair of the Production Subcommittee of the PCIC. The Production Subcommittee is the primary method for PCIC members to communicate technical papers related to drilling, wellhead, and facilities operations of oil and gas wells. In 2013, I was appointed as Vice-Chair of the Standards Subcommittee of the PCIC, a role which transitioned to Chair in 2680. I served as Chair until 2022. The Standards Subcommittee of the

PCIC is the Sponsor of IEEE standards relating to equipment operations in the Oil and Gas Industry. The PCIC Standards Subcommittee sponsors nearly 50 electrical and oil and gas-related standards. In September 2022, I was elected as an Executive Officer of the PCIC. I will serve as an Executive Officer for eight years, holding two-year terms in each position: Secretary, Vice Chair, Chair, and Chair of the Advisory and Awards Committee.

7. My peers have recognized my contributions, particularly in the area of electrical equipment in the oil and gas industry. Because of this recognition, in 2019, I was elevated to the grade of Fellow of the IEEE for "contributions to submersible electrical equipment analysis and multi-point ground methods in hazardous petroleum and chemical environments." The IEEE Fellow grade is limited to the top 0.1% of the IEEE membership worldwide.

8. I have worked directly in the area of electrification of oil and gas fields both as an employee and as a consulting engineer. From 2000 until the end of 2002, I was employed as Manager of Electric Infrastructure for New Dominion, LLC (NDL). In that capacity, I was administratively responsible for all electrical equipment, including overhead power lines, transformers, switchgear, drives, and motors, throughout NDL's production, exploration, and drilling areas.

9. After a brief stint as Vice President for EDG Power Group, where I was responsible for Engineering and Project Management of generation and cogeneration facilities across the U.S., I transitioned to the role of consulting engineer. In that role, I have served as a consulting engineer, designing, constructing, and analyzing various systems, particularly those in the oil and gas industry. This has included the design and selection of equipment, as well as the analysis of equipment failures in the oil and gas field, spanning from drilling and completion sites to production facilities, midstream locations, and downstream (refinery) sites.

10. I am also a Principal of PEDOCS, Inc., an oil and gas production company that has operated over 50 oil and gas production wells in Oklahoma. As such, I am familiar with oil and gas well operations, including well stimulation, completion, hydraulic fracturing, and production.

11. I have been familiar with oil and gas drilling, fracturing (fracing), completion and production operations for nearly twenty years. In addition to being responsible for interfacing with drilling and fracturing operations with regards to electrical needs as an employee of New Dominion, LLC, I have been further educated about drilling, fracturing and operations as I have consulted and investigated incidents on multiple well drilling, fracturing, completion and

production sites over my engineering consulting engagements, including numerous water collection, storage and disposal facilities.

12. I have been familiar with power distribution, including generation, transmission, and distribution equipment. As an employee, I worked as a design and construction engineer for generation facilities for Central and Southwest (now American Electric Power (AEP). I was also responsible for the design and construction of generation facilities when employed by EDG Power Group, as discussed above. While at AEP, I spent three years as a transmission planner, responsible for modeling transmission systems and developing plans for increased power distribution capacities at high voltages. While at New Dominion LLC, I owned and was responsible for the design, construction, and maintenance of several hundred miles of medium-voltage (5–25 kV) distribution lines, switchgear, drives, and motors used for oil and gas drilling, completion, and production. Over the last ~ 20 years, I have consulted with numerous clients, ranging from utilities to oil and gas development and production companies, on the design, upgrades, and maintenance of generation and power distribution facilities.

13. I have been familiar with the design, specification, construction and operation of Adjustable Speed Drive (ASD) systems for over 30 years. While at AEP, I gained my first exposure to ASDs (sometimes referred to as variable

frequency drives or VFDs). Between 1990 and 1992, while employed by Public Service Company of Oklahoma (an AEP company), I was responsible for overseeing the field installation of multiple 4,500+ hp VFDs for fans and pumps. I continued working with ASDs and related technologies, such as back-to-back inverter systems, throughout my career at AEP. When I took over as Manager of Electric Infrastructure at New Dominion, I was responsible not only for overhead lines but also for the specification, installation, and operation of all ASDs for production pump applications on both downhole and surface pumping systems. These ASDs ranged from a few hundred to around 1,000 HP at both medium and low voltages. At EDG Power Group, I was responsible for specifying and overseeing the installation of VFDs that ran pumps and fan motors on power generation facility installations. Since I began consulting nearly 20 years ago, I have specified, installed, analyzed, and torn down ASDs on numerous projects. As Standards Chair of the PCIC, I have been responsible for overseeing the management of several standard working groups for ASD applications in the Oil and Gas Industry, including IEEE 1662, 1826, and 1566. I am comfortable in stating that I have worked with several hundred ASDs throughout my career.

14. I have been familiar with control systems, Supervisory Control and Data Acquisition (SCADA) systems, and remote control operations for over thirty

years. I have become familiar with web-based control systems over the last decade as part of my various consulting engagements, including drilling systems, fluid handling systems, production systems, and others. I have designed control systems, including remote control, for various facilities throughout my career, including oil and gas production, water storage and disposal facilities, water treatment facilities, power generation plants, generator systems, and aggregate conveying systems, among others. The first control system I designed, for a water treatment facility, was as a junior engineer in 1990-1991. I am a licensed controls system engineer and a licensed petroleum engineer.

15. I am the author or co-author of over fifty published papers and five books. A list of publications that I have written over the last thirty years is included in my professional CV, which is attached as Appendix A.

16. Therefore, based on my education, professional experience of over 30 years, and scholarly books and publications, I am an expert in the relevant field of the ’680 Patent and have been an expert in this field since before the ’680 Patent was filed with the United States Patent and Trademark Office (“USPTO”).

II. TASK SUMMARY AND MATERIALS REVIEWED

17. I have been asked to review the Petition for *Inter Partes* Review of Claims 1-3, 6, 7, and 9-20 of the '680 Patent along with the associated patent (Ex. 1001), the prosecution history of the '680 Patent (Ex. 1004), the alleged prior art relied on in Petitioner's invalidity grounds (Ex. 1005, Ex. 1006, Ex. 1007, Ex. 1008), the declaration of Petitioner's expert, Dr. Wooley (Ex. 1002), and other associated exhibits and provide my opinions regarding the Petition and corresponding documents. In forming my opinions, I have reviewed the materials cited in the List of Exhibits Reviewed (**Section III**, below) and the materials cited throughout my declaration.

18. I reserve the right to respond to anything that may be made available to me in the form of (1) information that may be provided in the expert report(s) of Petitioner's expert witness(s); (2) additional discovery information, such as Petitioner's expert(s)'s report(s) and declaration(s), deposition testimony, document production, etc.; and (3) information obtained through my own investigation. Further, should I not include analysis for certain claim limitations or elements in the sections below, this does not imply that I agree with Petitioner's claim that the limitation or element is anticipated by or obvious over the prior art, nor does it imply that I agree with Dr. Wooley's analysis of the claim limitation or element.

III. LIST OF EXHIBITS REVIEWED

Exhibit No.	Description
1001	U.S. Patent No. 11,175,680 ('680 Patent)
1002	Declaration of Dr. Gary Wooley
1003	Curriculum Vitae of Dr. Gary Wooley
1004	File Wrapper for U.S. Patent No. 11,175,680
1005	U.S. Patent No 8,667,091 to Almadi
1006	U.S. Patent Application No. 2015/0308244 to Cardamone
1007	U.S. Patent No. 9,709,995 to Gutierrez
1008	SCADA: Supervising Control and Data Acquisition (4th Edition)

IV. LEGAL STANDARDS

A. LEVEL OF ORDINARY SKILL IN THE ART

19. When interpreting a patent, I understand that it is important to identify the relevant art pertaining to the patent-in-suit as well as the level of ordinary skill in that art at the time of the claimed invention. The "art" is the field of technology to which the patent is related.

20. I have been instructed by counsel that the person of ordinary skill in the art (**"POSITA"**) is a hypothetical person who is presumed to know the relevant prior art. I understand that the actual inventor's skill is not determinative of the level of

ordinary skill. I further understand that the factors that may be considered in determining the level of skill include the types of problems encountered in the art, prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. I understand that not all such factors may be present in every case, and one or more of them may predominate.

21. I am familiar with how a POSITA would have understood and used the terminology found in the ’680 Patent at the time and before the priority date of the ’680 Patent.

B. LEGAL STANDARD FOR CLAIM CONSTRUCTION

22. I understand that the first step in determining whether a patent claim would have been anticipated or obvious is to ascertain how a POSITA would have understood the claim terms.

23. I have been instructed by counsel on the law regarding claim construction and patent claims, and I understand that 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 from an independent claim, or it can further depend from another dependent claim. I

understand that a dependent claim includes all the limitations that it recites, in addition to all the limitations recited in the claim(s) from which it depends.

24. It is my understanding that in proceedings before the USPTO, the claims of a patent are to be construed under what is referred to as the "*Phillips* standard." I understand that this means that the claim terms of a patent are given the meaning the terms would have to a POSITA, in view of the description provided in the patent itself and the patent's file history.

25. I understand that to determine how a person of ordinary skill would understand a claim term, one should look to those sources available that show what a person of skill in the art would have understood the disputed claim language to mean. I understand that, in construing a claim term, one looks primarily to the intrinsic patent evidence, including the words of the claims themselves, the remainder of the patent, and the patent's prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient.

26. I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else. In making this determination, the claims, the remainder of the patent,

and the prosecution history are of paramount importance. Additionally, the patent and its prosecution history must be consulted to confirm whether the patentee has acted as its own lexicographer (i.e., provided its own special meaning to any disputed terms), or intentionally disclaimed, disavowed, or surrendered any claim scope.

27. In comparing the claims of the ’680 Patent to the prior art, I have considered the ’680 Patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

C. ANTICIPATION

28. It is my understanding that a prior art reference anticipates a claim of a patent if each and every element of the claim is found either explicitly or inherently in a single prior art reference or system. I understand that inherency requires a showing that the missing descriptive matter in the claim is necessarily or implicitly present in the allegedly anticipating reference, and that a POSITA would have so recognized it. In addition, I understand that an enabling disclosure is a disclosure that allows a POSITA to make the invention without undue experimentation.

D. OBVIOUSNESS

29. I understand that the prior art may render a patent claim “obvious.” I understand that two or more prior art references (e.g., prior art articles, patents, or publications) that each disclose fewer than all elements of a patent claim may be

combined to render a patent claim obvious if the combination of the prior art collectively discloses all elements of the claim and one of ordinary skill in the art at the time would have been motivated to combine the prior art in such a way. I understand that this motivation to combine need not be explicit in any of the prior art but may be inferred from the knowledge of one of ordinary skill in the art at the time the patent was filed. I also understand that one of ordinary skill in the art is not an automaton but is a person having ordinary creativity. I further understand that one or more prior art references, articles, patents or publications that disclose fewer than all of the elements of a patent claim may render a patent claim obvious if including the missing element would have been obvious to one of skill in the art (e.g., the missing element represents only an insubstantial difference over the prior art or a reconfiguration of a known system).

30. I understand that under the doctrine of obviousness, a claim may be invalid if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSITA to which the subject matter pertains.

31. To assess obviousness, I understand that I am to consider the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and any secondary considerations to the extent they exist.

32. I understand that any evidence of secondary indicia of non-obviousness should be considered when evaluating whether a claimed invention would have been obvious to one of ordinary skill at the time of invention. These secondary indicia of non-obviousness may include, for example:

- a long-felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes claimed by the patent;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others; and
- deliberate copying of the invention.

33. I understand that there must be a nexus between any such secondary indicia and the claimed invention.

34. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

- the claimed subject matter is simply a combination of prior art elements according to known methods to yield predictable results;
- the claimed subject matter is a simple substitution of one known element for another to obtain predictable results;

- the claimed subject matter uses known techniques to improve similar devices or methods in the same way;
- the claimed subject matter applies a known technique to a known device or method that is ready for improvement to yield predictable results;
- the claimed subject matter would have been "obvious to try" choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to a POSITA;
- there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent's claims; and
- there is some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed subject matter.

35. Finally, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

E. PRIORITY DATE

36. I understand that, subject to the next paragraph, the asserted "priority date" of a patent is the earlier of: (a) the date on which a patent application is filed;

or (b) the date on which an earlier-filed patent application is filed if the patentee claims the benefit of priority to that earlier-filed patent application.

37. I understand that it is not enough for a patent to merely claim the benefit of an earlier-filed application, but that additional criteria must be met. In particular, the prior application itself must describe the claimed invention, and must do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. First, I understand that a priority-date analysis is on a claim-by-claim basis. Second, I understand that, in order for a patent claim to be entitled to the filing date of an earlier patent application, a "Section 112 analysis" must be conducted. I am informed that a "Section 112" analysis encompasses looking to the earlier patent application, and ascertaining whether that earlier patent application meets both the written-description and enablement requirements as of the filing date of the earlier application. I understand that it is not enough that the claim would have been obvious from the earlier application, but that application itself must describe the claimed invention.

38. I understand that in order to satisfy the written description requirement, the earlier application must reasonably convey to those skilled in the art that the inventors had possession of the subject matter of the patent as of the filing date of the earlier application. I have been informed that it is the disclosures of the earlier

patent application that count, and that while the meaning of terms, phrases, or diagrams in the earlier patent application must be interpreted from the vantage point of one skilled in the art, all of the claimed limitations must appear in the specification. Further, I understand that this analysis is not a question of whether one skilled in the art might be able to construct the claimed invention from the teachings of the disclosure. The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification; rather, I understand that an earlier application must itself describe each of the claim limitations.

39. I also understand that in order to satisfy the enablement requirement, the earlier application must enable a person of ordinary skill in the art to practice the claimed invention without undue experimentation.

V. OVERVIEW OF THE '680 PATENT

A. PATENT SPECIFICATION AND CLAIMS

40. The '680 Patent, entitled "Remote Control of Fluid Handling Devices," was issued by the USPTO on November 16, 2021.[1] The '680 Patent describes a hosted, web-based, remote industrial monitoring and control system for geographically distributed facilities in oil and gas fields. The system described is

[1] Ex. 1001 ('680 Patent) cover.

designed to receive commands from a user interface, including a web browser, to actuate actuators at an oil and gas facility. The '680 Patent describes several features that enable the system to operate in a hosted web-based environment.

B. PRIORITY DATE

41. I understand that the '680 Patent is a continuation of four prior applications (U.S. App. No 15/867,077, now U.S. Patent No. 10,488,871; U.S. App. No 14/984,422, now U.S. Patent No. 9,898,014; U.S. App. No. 14/147,190, now U.S. Patent No. 9,342,078; and U.S. App. No. 13/708,557, now U.S. Patent No. 8,649,909) and claims a priority date of December 7, 2012, which is the filing date of U.S. App. No. 13/708,557.[2]

VI. OVERVIEW OF PETITIONER'S REFERENCES

A. *ALMADI (EX. 1005)*

42. *Almadi* refers to United States Patent No. 8,667,091 which was filed July 22, 2011 (U.S. Application No 13/188899) and issued March 4, 2014. *Almadi* was published as U.S. Patent Application Publication No. 2012/0084400 on April 5, 2012. *Almadi* claims priority to U.S. Provisional Application No. 61/367,207 ("*Almadi* provisional"), filed on July 23, 2010. My analysis and expert opinion

[2] Ex. 1001 ('680 Patent) cover.

regarding the disclosure and teaching of *Almadi* are directed to the *Almadi* document, i.e., U.S. Patent No. 8,667,091. I do not opine on anything in the *Almadi provisional*.

43. *Almadi* discloses a programmable logic controller (PLC) that uses subsystem communications to communicate with remote and in-plant subsystems. *Almadi* teaches systems to verify that data is valid, such as time-stamped data, exception reporting, and monitoring of communication failures and their re-establishment.[3]

B. CARDAMONE (EX. 1006)

44. *Cardamone* is U.S. Patent Application Publication No. 2015/0308244, which was filed as U.S. App. No. 14/646,970 on May 22, 2015, and published October 29, 2015. *Cardamone* claims priority to PCT Patent Application No. PCT/US2013/071976, filed on November 26, 2013, which ultimately claims priority to U.S. Provisional Application No. 61/729,815 ("*Cardamone provisional*"), which was filed on November 26, 2012.[4] However, I understand that Patent Owner may contend that U.S. Patent Application No. 2015/0308244 (i.e., the document referred to as "*Cardamone*" in the Petition, Dr. Wooley's declaration, and

[3] Ex. 1006 (*Almadi*) at Abstract.
[4] Ex. 1005 (*Cardamone*) front page.

this declaration) may not qualify as prior art to the '680 Patent. Importantly, my analysis and expert opinion regarding the disclosure and teaching of *Cardamone* are directed to the *Cardamone* document, i.e., U.S. Publication No. 2015/0308244. I do not opine whether *Cardamone* is prior art, or on anything in the *Cardamone provisional*.

45. *Cardamone* discloses a system to control a deep-well linear pump system with a "motor driver system (318) connected with the linear motor and configured to provide drive commands to the linear motor, a surface control computer (126) connected with the motor drive system and configured to control the linear motor, a sensor system (224) communicating with the control computer and configured to sense operating parameters of the linear motor, and the sensor system comprising a synchronous serial interface encoder configured to sense position of the motor shaft and a temperature sensor configured to sense the temperature of the motor."[5]

C. ***GUTIERREZ*** **(EX. 1007)**

46. *Gutierrez* refers to United States Patent 9,709,995 titled "Chemical Injection System." *Guiterrez* was filed on December 22, 2014, and was issued July 18, 2017. *Gutierrez* is a continuation of and claims priority to U.S. App. No.

[5] Ex. 1005 (*Cardamone*) at Abstract.

12/794,898 (filed June 7, 2010, which was abandoned), which claims priority to U.S. Provisional Application No. 61/184,890 ("*Gutierrez provisional*", which was filed on June 8, 2009). However, I understand that Patent Owner contends that U.S. Patent No. 9,709,995 (i.e., the document referred to as "*Gutierrez*" in the Petition, Dr. Wooley's declaration, and this declaration) is not prior art to the '680 Patent. Importantly, my analysis and expert opinion regarding the disclosure and teaching of *Gutierrez* are directed to the *Gutierrez* document, i.e., U.S. Patent No. 9,709,995. I do not opine whether *Gutierrez* is prior art, or on anything in the *Gutierrez provisional*.

47. Gutierrez describes a system to inject chemicals into a pipeline via the use of a motor and a reservoir containing the chemical.[6] *Guiterrez* also discloses that the chemical injection system may be controlled by a remote computing device communicating with the injection system via an "enterprise or secure network" such as a VPN.[7]

D. ***SCADA* (Ex. 1008)**

48. *SCADA* is a book entitled "SCADA: Supervisory Control and Data Acquisition" authored by Stuart A. Boyer, and published by the Instrumentation

[6] Ex. 1006 (*Gutierrez*) at Abstract.
[7] Ex. 1006 (*Gutierrez*) 12:55-63.

Society of America. *SCADA* has a copyright of 2010 and an ISBN number of 978-1-936007-09-7. *SCADA* contains "an introduction to SCADA" along with "some side paths that will clarify why things in modern SCADA are done the way they are."[8]

VII. LEVEL OF ORDINARY SKILL IN THE ART

49. The Petition does not discuss or assert the level that a POSITA would have had at the time of the'680 patent.[9] Petitioner's expert, Dr. Wooley, asserts that a POSITA "would have had at least a bachelor's degree in engineering (electrical, chemical, or mechanical), computer science, or a related field and significant experience with remotely controlling fluid-handling devices, like SCADA systems."[10] Dr. Wooley does not opine on what "significant experience" means.

50. It is my opinion that a POSITA would have had at least a bachelor's degree in engineering (electrical, chemical, petroleum or mechanical), computer science, or a related field and at least two years of experience designing control systems for remotely controlling fluid-handling devices, like SCADA systems.

[8] Ex. 1007 (*SCADA*) pg. 7.
[9] *See* Petition, which does not include a section or statement about the level of skill of a POSITA.
[10] *See* Ex. 1002 (*Wooley* declaration) at pg. 9, ¶¶24-25.

Alternatively, a POSITA would have had at least six years of experience in designing control systems for remotely controlling fluid-handling devices, such as SCADA systems.

51. I possess both the education requirements and the field experience of a POSITA. Not only is my formal education in the same technical discipline (electrical engineering) as that of Petitioner's (and my) definition, but I also have additional education beyond a bachelor's degree. Furthermore, I have over thirty years of experience in control system design, including remotely controlling fluid handling devices, as well as SCADA systems. I have over 20 years of experience in oil and gas drilling, completion, and subsurface production operations, including experience with control systems for these operations and associated equipment.

52. For purposes of this declaration, I have applied the level of skill of a POSITA as described above.

VIII. TECHNOLOGY BACKGROUND AND STATE OF THE ART

53. In the subsections below, I describe some of the basic principles of engineering that would be used, or at least considered for use, in the field of oil and gas operations, and particularly in the field of fluid handling during the various stages of drilling, completion, and production. The principles discussed in the

subsections below would have been known to a POSITA in the December 2012 timeframe.

54. I understand that it is important, when viewing the State of the Art and the background technology known to a POSITA, to rely on those materials which would have been known to a POSITA at the time of the filing of the '680 Patent. Reliance on materials published or made publicly available after the filing of the '680 Patent (with the exception of publications specifically documenting the history of an industry) does not show what would have been known to a POSITA in the relevant timeframe.

A. CONTROL SYSTEMS

55. In general, control systems of some variety have been in place since at least the development of water clocks by the Greeks around the 3rd century BC. Automatic control systems for machines were developed in the late 18th century AD, such as the "Watts Fly Ball Governor," which was developed in 1788.[11] Butz's Damper Flapper, a precursor to the thermostat, was developed in 1885 and led to the development of Honeywell.

[11] https://www.electrical4u.com/control-engineering-historical-review-and-types-of-control-engineering/ (accessed June 25, 2025).

56. Basic control system theory was developed in the early 20th Century, with practitioners such as Bode, Nyquist developing analytical methods such as the Bode plots (a graph of the frequency response of a system) or Nyquist stability criterion, which plots the open-loop (no feedback) response of a system to measure system stability.[12] Minorsky, another mathematician, developed proportional, integral and derivative control (PID) in the 1920s. Heaviside provided mathematical functions that are useful in analytical tools, such as Laplace transforms.

57. In the 1950s, Kalman changed control systems in two significant ways. First, with the development of the "Kalman Filter", a mathematical technique to reduce noise in a measurement system, control systems could be tuned with tighter control, as they would not be responding to noise in the system, but more so to the actual values in the physical system. Second, Kalman developed techniques for representing systems (including control systems) in a matrix form, called a state-space representation. Once in matrix form, the matrices can be manipulated algebraically, rather than relying on calculus-based methods of the PID controller.

58. With the development of the Programmable Logic Controller (PLC) by General Motors on New Year's Day 1968, computers entered the realm of automatic

[12] https://www.electrical4u.com/control-engineering-historical-review-and-types-of-control-engineering/ (accessed June 25, 2025).

control.[13] A PLC replaced the previous electromechanical devices (relays, pneumatic plunger timers, electromechanical counters, toggle switches, etc.) with solid-state computer-based control. Thus, a control system for a machine that previously may have occupied an entire wall of a room was replaced by a single computer system. The interface with such systems was still through electromechanical devices such as switches, push buttons and pilot lights. Notably, I worked with versions of the first commercially successful PLC, the Modicon 184, in the early years of my career in the late 1980s.

59. By the late 1980s and early 1990s, companies such as Automation Direct and Allen-Bradley (now Rockwell Automation) began creating computer-based interfaces for programming and interfacing with the PLCs. These were referred to as human-machine interface (HMI) displays.

60. Supervisory Control and Data Acquisition (SCADA) systems were developed around the same time as the PLC, in the late 1960s and early 1970s. SCADA systems were used on private networks or systems under complete control of the SCADA system's owners. One example was the SCADA systems for electric utilities that used the 60Hz electric power signal as a carrier to communicate with

[13] https://library.automationdirect.com/history-of-the-plc/ (accessed June 25, 2025).

breakers in the field. SCADA systems were designed to communicate with sensors and equipment in the field, with control being performed by an operator or an automatic loop at the central control station. With the development of Local Area Networks in the 1980s and 1990s, SCADA utilized these technologies to communicate with equipment, such as throughout an entire plant.

61. The integration of these two technologies led to systems such as Gutierrez, where remote control of the system was possible, again through a network controlled entirely by the system's owner (i.e., private networks or VPN).

B. OIL AND GAS WELL DRILLING AND PRODUCTION

62. Oil and gas exploration and production operations depend on identifying, locating and collecting hydrocarbon (i.e., oil and gas (natural gas)) reserves for sale, use as a fuel, lubrication, or for the development of chemicals, pharmaceuticals and plastics used in modern society. For most of human history, petroleum products such as natural asphalts, coal, and surface seeps of oil have been used for various purposes, including paving, construction, waterproofing boats, and as fuel.[14] For the most part, these materials were naturally occurring on the Earth's surface and were collected by simply digging them up and transporting them for use. Some reservoirs of hydrocarbons, however, are located beneath the surface of the

[14] (Vassiliou 2018) at xxv - xxvi

earth and must be reached by some well-drilling technique. The first recorded petroleum wells were drilled circa 347 AD during the Jin dynasty in modern-day China.[15] These were percussion-type wells similar to cable tool drilling, widely used in the 1800s. Modern oil and gas production relies heavily on wells drilled to reach hydrocarbon-bearing formations located below the Earth's surface.

63. In 1859, the first commercial oil well in the United States was drilled by Edwin Drake near Titusville, PA. This well was drilled with a cable-tool percussion drilling rig and struck oil at a depth of 69 feet.[16] A Cable tool drilling rig uses a heavy chisel-type tool that is suspended from a cable (usually a rope) and repeatedly dropped to chip away at the rock formation. After a certain amount of rock has been chipped, a bucket-type tool (bailer) is lowered to collect and remove the rock chips. The use of cable-tool rigs was widespread through the end of the 19th century, and led to the discovery of many large oil and gas fields in the United States including the NW Pennsylvania fields, Pico Canyon and Los Angeles fields in California, the Neodesha fields in Kansas (Norman No 1), and the Bartlesville-Dewey field in Oklahoma (Nellie Johnstone No. 1).[17]

[15] (Brewer 2022)
[16] (Vassiliou 2018) at xxix, 147, 174-175
[17] (Vassiliou 2018) at 149

64. Rotary drilling techniques, where a drill stem is spun and a drill bit cuts into the rock, had been used as far back as the Egyptian era but had limited use until the invention of the roller cone drill bit in 1908 by Howard Hughes. In a rotary drilling system, the drill bit cuts or pulverizes the rock. A fluid, known as drilling mud, is circulated down the hollow drill stem, out of orifices in the bit and then up the annulus, or the area between the drill stem and the wellbore walls. The drill mud serves the dual purpose of lubricating and cooling the bit teeth and grinding surfaces, as well as carrying detritus from the drilling process out of the hole and to the surface, where it is observed for its characteristics (logged), collected (using shale shakers), and discarded.

65. Traditional well drilling techniques, including both cable tool and rotary methods, focused on maintaining a vertical well and keeping a "straight hole" to reach the target formation at a known location. However, this means that the hydrocarbon-bearing formation is only exposed to the wellbore for the vertical depth of the formation at the wellbore location, which is often only tens of feet. Furthermore, surface drilling locations must be directly above the target formations, limiting access to those formations that are located under geographical features (such as lakes, mountains, oceans), buildings, or other environs that would prevent or make it difficult to locate a traditional drilling pad. In some locations, such as central

Oklahoma and the Permian Basin of Texas, vertical wells were spaced every 330 feet above productive formations to effectively drain the formation of hydrocarbons. This resulted in some locations with as many as 196 wells per square mile. Directional drilling (sometimes referred to as horizontal drilling) overcame these shortcomings of traditional oil well drilling.

C. SEPARATION AND STORAGE FACILITIES

66. Economic production from oil (and natural gas) wells requires the flow of significant volumes of fluid from the wells, to the surface, and then to storage tanks. The fluid from oil wells is typically a three-phase fluid comprising liquid (oil and salt water), gas (methane and other gases) and solids (sand and rock remnants). At the wellhead, these components are part of a single flow stream. For the sale of commercially valuable components (oil and hydrocarbon gases), the three phases are initially separated in a three-phase separator. A three phase separator is a vessel that "slows down" the production stream (often in a pressurized vessel) and allows for settling of the solids to the bottom of the separator (where they are collected and discarded) as well as allowing the gaseous products to "break out" of the liquid stream. The gas is then collected, often compressed, and delivered to a natural gas pipeline for sale or, in cases where no pipeline is available, burned off in a controlled manner using a flare system.

67. The liquid stream, comprised primarily of salt water and oil (along with treating chemicals and other trace minerals), is then delivered to a processing facility, typically on site or near the wellhead, where another settling process separates the oil and salt water, sometimes accelerated by heat. As oil has a lower density than salt water, most of the oil "floats" to the surface of a settling tank (heater treater, gun barrel, free water knockout or other names). The oil is collected and delivered to storage tanks or a pipeline for sale. The saltwater (i.e., produced water) is directed to storage tanks or a pipeline for eventual disposal. In many wells, the volume of produced water is ten times or greater than the volume of produced oil.

68. A typical oil and gas production facility is diagramed in Figure 1.[18]

[18] Source: https://kimray.com/training/what-does-lact-unit-do

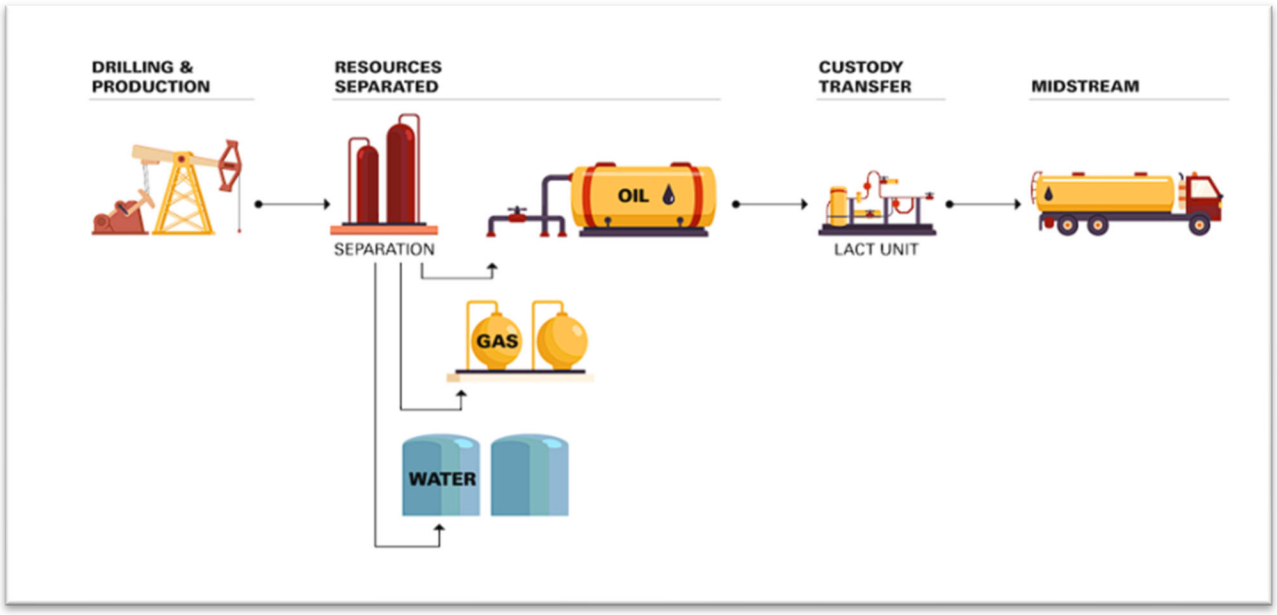


Figure 1 – Typical Oil and Gas Production facility

D. SALT WATER DISPOSAL

69. The most common method of disposal of produced water is re-injection into a disposal, or injection, well. These wells are typically drilled into non-producing (i.e., no commercial oil and gas) that have high permeability, which allows the formation to accept large quantities of fluid. The produced water from the production facility (discussed above) is delivered to the saltwater disposal (SWD) facility either through pipelines or via tank trucks. The produced water typically contains trace amounts of oil which were not collected at the production facility, along with the waste brine (salt water). At the SWD facility, the produced water is pumped from the trucks (or the pipeline) into a series of separators and tanks where the skim of oil is collected and stored in oil storage tanks for sale. The remaining

saltwater is prepared for injection, typically by running the water stream through filters to process out any remaining sand or other solids. The remaining clean saltwater is then injected into the injection well using large injection pumps. These facilities are typically sized to handle 100,000 bbl. of liquid a day and more.[19] A typical SWD facility is shown in Figure 2, with the primary components of the facility labeled.

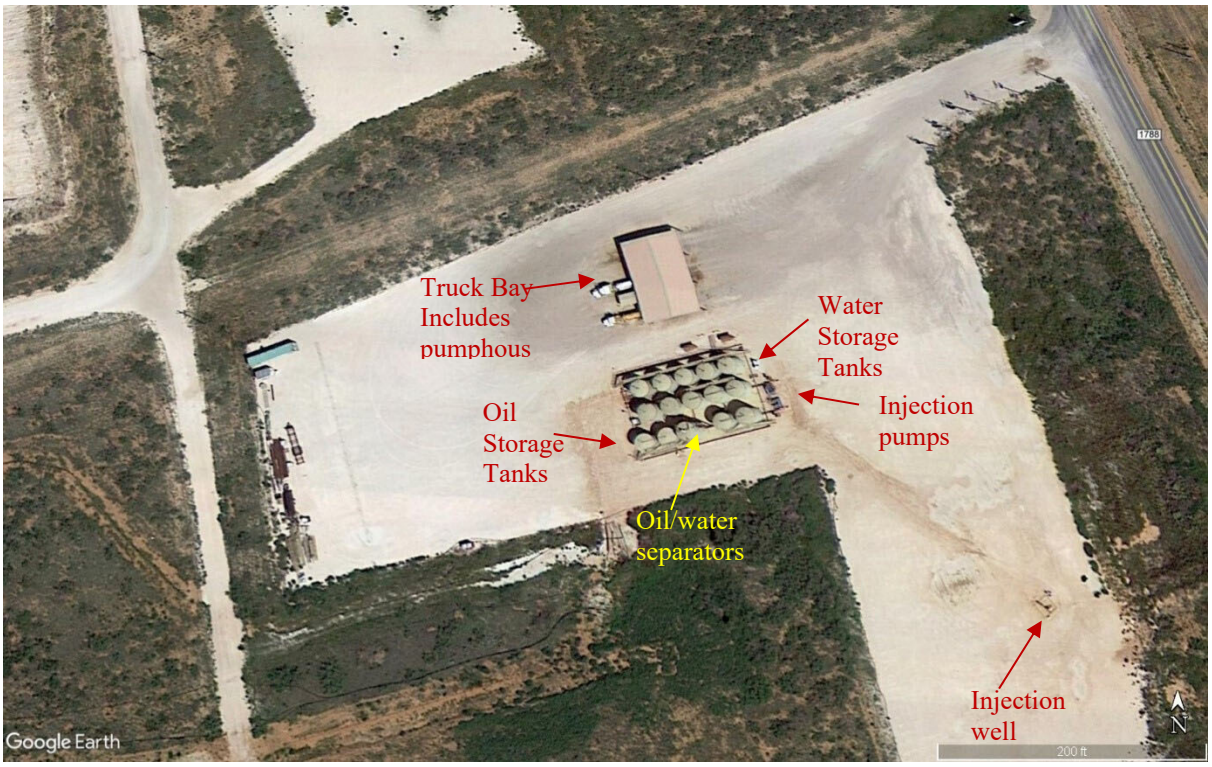


Figure 2- 1788 SWD Facility 31.861538 ºN, 102.201746 ºW (Aug 2017)

[19] A barrel (bbl.) is 42 gallons

E. PETROLEUM PUMPING STATIONS

70. As discussed above, when oil and/or produced water are collected at the production facility, they are stored on-site and then sent off-site for either sale (oil) or disposal (produced water). In many locations, the transportation of these liquids is performed using tank trucks, which collect the liquid at the production facility and then are driven to a SWD facility (for produced water) or a commercial LACT (lease automatic custody transfer) facility.

71. However, in areas of highly concentrated production (e.g., some parts of the Permian Basin), there is sufficient volume of liquid flow to justify the installation of pipeline gathering systems, rather than relying on over-the-road tank trucks. In these locations, the liquid is transported through pipelines via a series of petroleum pumping stations, which handle oil, produced water, or both. These pumping stations, sometimes co-located with storage facilities, add energy to the liquid through the use of pumps and direct the liquid to its proper destination using valves. In these locations, as well as at the production and disposal facilities, sensors are used to determine the properties of the fluid, such as pressure, flow rate, tank

level, temperature, and viscosity, allowing the operator to pressurize and direct the flow appropriately. A typical pumping station is shown in Figure 3.[20]

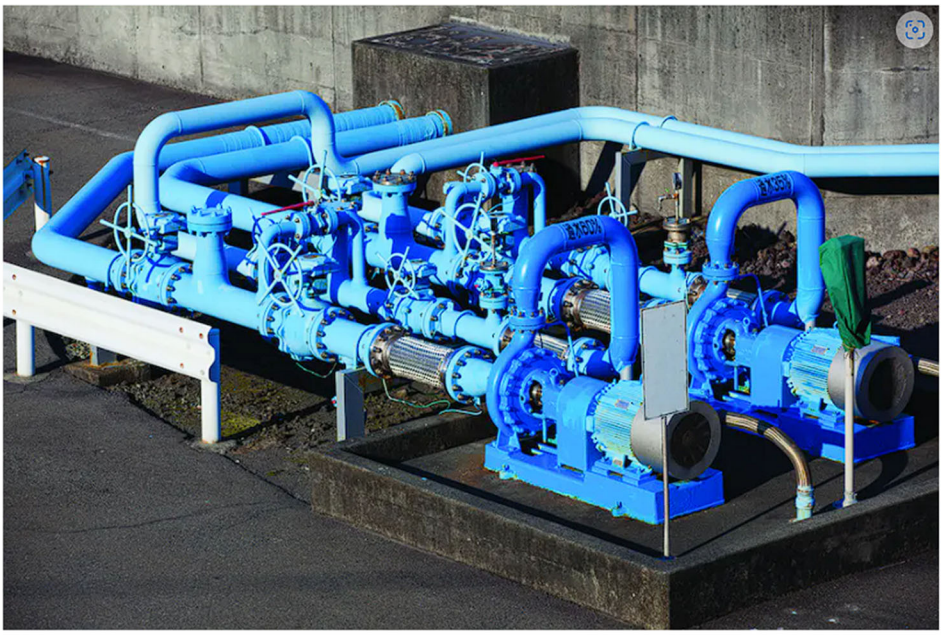


Figure 3 - Petroleum Pump Station

F. FLUID HANDLING

72. In each of the locations described above, and in many others, proper operation of the facilities depends on proper handling of the fluids. As mentioned above, many facilities handle as much as 500,000 gallons of fluid every day, or more. Proper operation of these facilities requires the coordination of a system of pumps, valves, storage tanks, and piping systems to move the liquid to its desired destination without damaging the system or creating environmental hazards, such as spills.

[20] Source: https://www.processingmagazine.com/process-control-automation/instrumentation/article/15586455/fit-the-pumping-technology-to-the-task

73. While the basics of fluid handling (pumps, valves, tanks, pipes) have existed since antiquity, by the time of the ’680 Patent, pumps were typically electrically operated, and valves were manually, pneumatically, or electrically operated. Tanks and pipes were constructed of materials suitable for the fluid they were handling (steel for oil, fiberglass, or various plastics for produced or salt water).

74. By the time the ’680 Patent was filed, facilities had little to no automation. Production facility pumps were operated continuously or on a timer-based system. Production levels and the overall condition of the facility were typically checked daily by a “pumper,” who would physically drive to each production site within their area of responsibility. Valve positions were usually set manually (or by simple level switches) by the pumper, and tank levels were “gauged” daily to determine production. A SWD facility typically had an on-site operator (e.g., “pumper”) either 24 hours a day or at least daily. This operator would be responsible for starting and stopping pumps as necessary, monitoring tank levels, pressures, and flow rates, and adjusting valves as needed. Some supervisory control and data acquisition (SCADA) systems were available to enable off-site monitoring of equipment; however, these were of limited value due to the lack of communication facilities at the often remote and isolated production and SWD facilities.

IX. CLAIM CONSTRUCTION

75. It is my opinion that a POSITA would understand all the claim terms to have their plain and ordinary meaning, and I have applied the plain and ordinary meaning, in the context of the ’680 Patent, for all claim terms.

X. GROUND 1: *ALMADI* DOES NOT ANTICIPATE THE CLAIMS, NOR DOES IT RENDER THE CLAIMS OBVIOUS

76. After review of the evidence submitted in support of the Petition, including the Prior Art relied on and the declaration of Dr. Wooley, it is my opinion that *Almadi* does not anticipate Claims 1-3, 6, 14, 17, 19 and 20 of the ‘680 Patent, nor does it render them obvious. There are claim elements missing from *Almadi* that neither Dr. Wooley nor the Petition shows are disclosed, taught, or suggested by *Almadi*.

77. Initially, I note that throughout the declaration of Petitioner’s expert, Dr. Wooley relies on certain references that fall after the time of the ’680 Patent, i.e., later than December 2012. Dr. Wooley does not attempt to show these references are prior art, and in some cases clearly are not prior art on their face, as they have a publication date that postdates the priority date of the ’680 Patent.

78. It is my understanding that, when analyzing the patentability of any claim, Dr. Wooley and I must look at the claims through the lens of a POSITA at the

time of the invention (i.e., the priority date). Accordingly, when analyzing the claims of the ’680 Patent, one should look to what a POSITA would have known as of the priority date of the ’680 Patent. Despite this, Dr. Wooley points to several pieces of art in his declaration that are not prior art references, and he makes no attempt to show that they are. In several examples, the cited information is substantially belated and would not have been understood by a POSITA at the time of the ’680 Patent, which raises questions about Dr. Wooley’s analysis. The references will be addressed with regard to each claim or limitation for which they are used.

A. INDEPENDENT CLAIM 1

79. It is my opinion that *Almadi* neither anticipates Claim 1 nor renders it obvious. There are key elements of Claim 1 that are missing from the disclosure of *Almadi* that (1) preclude anticipation and (2) would not have been obvious to a POSITA based on the disclosure of *Almadi*, as discussed in the subsections below.

80. Claim 1 contains the following limitations, which have been subdivided in the same manner that Dr. Wooley and Petitioner subdivided them:

> [1.1] A non-transitory, machine-readable medium comprising instructions to effectuate operations, the operations comprising:
>
> [1.2] receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;

[1.3] determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;

[1.4] sending, with the server, the target value to the network address via the network;

[1.5] receiving, with the controller, a measurement of the fluid by the sensor;

[1.6] determining, with the controller, whether the measurement satisfies the target value;

[1.7] in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and

[1.8] controlling, with the controller, the actuator based on the set point.

81. My opinion is in disagreement with Dr. Wooley. I note that Dr. Wooley makes a conclusory statement in ¶62 that "*Almadi* anticipates claim 1 or is obvious to a POSITA in view of *Almadi*." However, there is no rationale or analysis anywhere in Dr. Wooley's declaration regarding Claim 1 as to *why* the elements not disclosed by *Almadi* would have been obvious to a POSITA at the time of the '680 Patent.

1. [1.2]: "receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;"

82. Petitioner does not demonstrate that limitation 1.2 is disclosed or taught by *Almadi*. For instance, neither the Petition nor Dr. Wooley show how *Almadi* discloses the claimed "target value" feature as recited in limitation 1.2 and Claim 1 as a whole.[21]

83. Dr. Wooley points to three sections of *Almadi* that he alleges discloses the claimed limitation: Ex. 1005, 11:51-63, 12:10-15, 22:32-26. While these sections describe communication between various components and verification of sensor data, there is no suggestion of receiving a command comprising a target value, receiving that command from a computing device via a control interface, or that the command is received in association with a record stored on a datastore. Dr. Wooley does not attempt to explain how these components and functions disclose the claimed limitation or point to a mapping of any of the components or functions.

84. Additionally, Dr. Wooley points to references that are not prior art in an attempt to show that this limitation is "disclosed" by *Almadi*. However, these are not prior art references, and Dr. Wooley makes no attempt to show that they are. In

[21] Petition at 13-14; Ex. 1002 (Wooley declaration) ¶¶44-45.

¶43, Dr. Wooley points to https://www.techopedia.com/definition/3333/command-cmd.[22] However, a visit to the site referenced shows that the page dates from October 3, 2023, long after the '680 Patent. An analysis should look through the lens of a POSITA at the time of the invention, not current references.

85. I disagree with Dr. Wooley's analysis that a "target value" is simply a sensed parameter or "the particular operating conditions that a device is in at a particular time."[23] This is not the plain and ordinary meaning of the term, nor is it consistent with its use in the '680 Patent. A "target value" is a state the fluid handling device is desired to be in, in some future time, which can include but is not limited to examples like a tank level, a valve position, or a motor speed.[24]

[22] https://www.techopedia.com/definition/3333/command-cmd (accessed June 19, 2025).
[23] Ex. 1002 ¶44.
[24] See, e.g., '680 Patent 11:48-60.

86. Accordingly, *Almadi* does not disclose limitation 1.2, nor would limitation 1.2 have been obvious based on the teachings of *Almadi* as claimed by Dr. Wooley and Petitioner.

2. [1.3]: "determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;"

87. Petitioner does not demonstrate that limitation 1.3 is disclosed or taught by *Almadi*.[25] Dr. Wooley discusses "intelligent field devices" in general but does not explain how that discloses the claimed limitation. Dr. Wooley points to three sections of *Almadi* that he alleges disclose limitation 1.3: Ex. 1005, 1:53-57, 12:40-43 and 15:62-67. However, an examination of these sections reveals no reference to a server, network address, or datastore record, much less the claimed limitation 1.3 in the full context of Claim 1. Dr. Wooley does not attempt to show how the referenced sections, or any section of *Almadi*, disclose a server, a network address or a datastore record, or *why* such elements would have been obvious.

88. Dr. Wooley, again, points to references that are not prior art in an attempt to show that *Almadi* discloses limitation 1.3. In paragraph 46, Dr. Wooley

[25] Petition at 14-15; Ex. 1002 (*Wooley* declaration) ¶¶46-51.

references https://www.infosecinstitute.com/resources/scada-ics-security/process-control-network-pcn-evolution/.[26] However, a visit to the referenced website shows that this page was published August 27, 2019, long after the '680 Patent. An analysis should look through the lens of a POSITA at the time of the invention, not current references.


CRITICAL INFRASTRUCTURE

Process control network (PCN) evolution

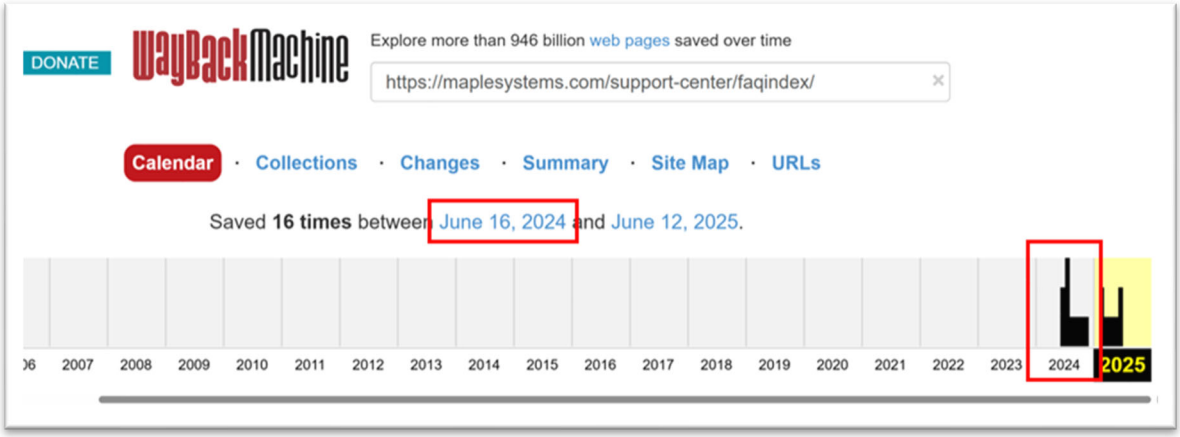
August 27, 2019 by Nitesh Malviya

A Process Control Network (PCN) is a network composed of real-time industrial control systems

89. Further, in ¶47, Dr. Wooley points to https://www.maplesystems.com/supportcenter/faq?qid=201&q=Define+Media+Access+Control+Address+%28+MAC+%29%3F,[27] which brings up a general "Technical Support Help Topics" page, which does not contain any reference to Ethernet MAC address, or any of the other functionality described in the paragraph.

[26] https://www.infosecinstitute.com/resources/scada-ics-security/process-control-network-pcn-evolution/ (accessed June 19, 2025).
[27] https://www.maplesystems.com/supportcenter/faq?qid=201&q=Define+Media+Access+Control+Address+%28+MAC+%29%3F (accessed June 19, 2025).

To determine the age of the reference, I examined a superset of the provided link: https://maplesystems.com/support-center/faqindex/.[28] I referenced the Internet Archive database for this address and found that the general "FAQ Index" portion of the Maple Systems website was published only on June 16, 2024, and after.[29] An analysis should look through the lens of a POSITA at the time of the invention, not current references.



90. Continuing the trend, in ¶48, Dr. Wooley points to https://www.techtarget.com/searchnetworking/definition/MAC-address.[30] A visit to this webpage revealed that it was published on October 25, 2024. An analysis should

[28] https://maplesystems.com/support-center/faqindex/ (accessed June 19, 2025).
[29] https://web.archive.org/web/20250000000000*/https://maplesystems.com/support-center/faqindex/ (accessed June 19, 2025).
[30] https://www.techtarget.com/searchnetworking/definition/MAC-address (accessed June 19, 2025).

look through the lens of a POSITA at the time of the invention, not current references.

91. Accordingly, *Almadi* does not disclose limitation 1.3, nor would limitation 1.3 have been obvious based on the teachings of *Almadi* as claimed by Dr. Wooley and Petitioner.

3. [1.4]: "sending, with the server, the target value to the network address via the network;"

92. Petitioner does not demonstrate that limitation 1.4 is disclosed or taught by *Almadi*.[31] Both Petitioner and Dr. Wooley provide no explanation or discussion of the actual claim language other than a conclusory statement (e.g. *Wooley* declaration at ¶53), followed by a single reference to the specification text and four figures (Ex. 1005, 3:13-17; see also id., FIGS. 8-11). The cited section of *Almadi's*

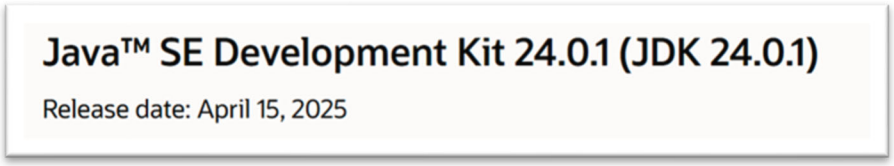
[31] Petition at 15-16; Ex. 1002 (*Wooley* declaration) ¶¶52-53.

specification references certain network hardware and discusses transmitting "process data" (i.e. sensor data) *to* a "remote host server", but makes no reference to sending **target values**, much less sending target values, with the server, to the network address via the network as claimed. The referenced figures of *Almadi* do not fill in the missing elements. Dr. Wooley does not attempt to show how the referenced sections, or any section of *Almadi*, disclose a server, a network address or a datastore record, or provide any rationale as to *why* these elements would have been obvious.

93. Again, Dr. Wooley points to references that are not prior art in an attempt to show that this limitation is "disclosed" by *Almadi*. However, these are not prior art references, and Dr. Wooley makes no attempt to show that they are. In ¶52, Dr. Wooley points to a Java SE reference: https://docs.oracle.com/javase%2Ftutorial%2F/networking/nifs/definition.html#:~:text=A%20network%20interface%20is%20the,can%20be%20implemented%20in%20software.[32] However, a visit to that page shows no description of a network interface. Further, Java SE 24 was released on April 15, 2025, well after the '680

[32] https://docs.oracle.com/javase%2Ftutorial%2F/networking/nifs/definition.html#:~:text=A%20network%20interface%20is%20the,can%20be%20implemented%20in%20software (accessed June 19, 2025).

patent. An analysis should look through the lens of a POSITA at the time of the invention, not current references.



94. Accordingly, *Almadi* does not disclose limitation 1.4, nor would limitation 1.4 have been obvious based on the teachings of *Almadi* as claimed by Dr. Wooley and Petitioner.

4. [1.7]: "in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and"

95. Petitioner does not demonstrate that limitation 1.7 is disclosed or taught by *Almadi*. Neither the Petition nor Dr. Wooley show how *Almadi* discloses the claimed "set point" feature as recited in limitation 1.7 and Claim 1 as a whole.[33] Both the Petition and Dr. Wooley reference two sections of *Almadi* that he claims "disclose" limitation 1.7: Ex. 1005, 1:45-49 and 25:26-37. The first reference in *Almadi* (1:45-49) generally discusses "field devices" receiving commands. The second reference in *Almadi* (25:26-37) discusses a data reconciliation module. This second reference belies Petitioner's and Dr. Wooley's contention that "a set point

[33] Petition at 17-18; Ex. 1002 (*Wooley* declaration) ¶61.

would have to be obtained and compared" and therefore discloses the limitation. The portion of the reference that the Petition and Wooley declaration quote, "switching a pump off if the flow is below a certain limit or activating some bounds or streams based on some readings/conditions," does not reference "set points"[34] at all, but rather "bounds" or limits. For example, "switching a pump off if the flow is below a certain limit" does not suggest a flow setpoint, but rather that the pump can operate at any flow rate above "a certain limit."

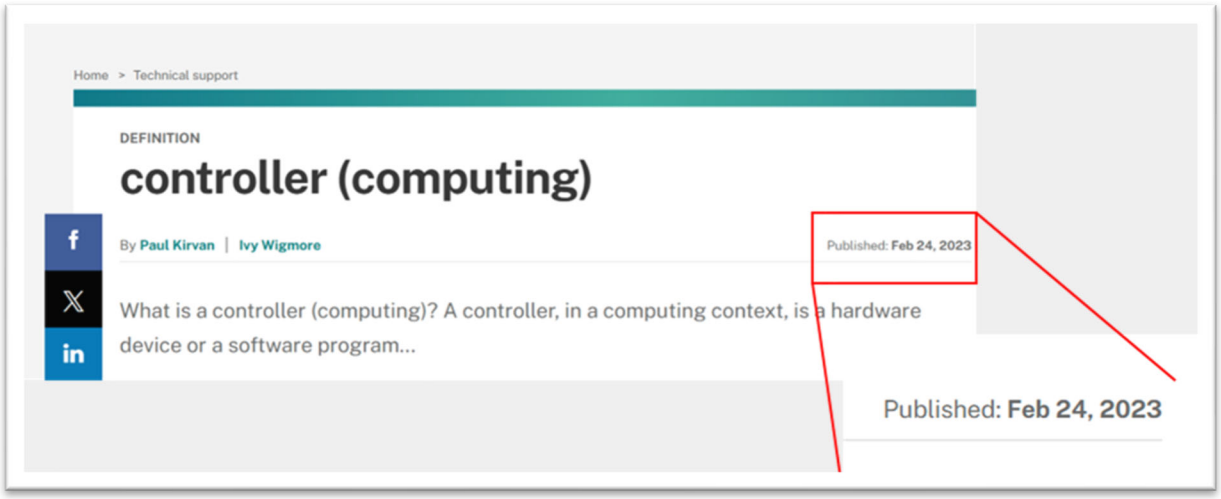
96. There is simply no reference in *Almadi* to obtaining, with the controller, a set point based on the command. A POSITA would read the above cited sections of *Almadi* and understand that the "bounds or limits" would have been pre-programmed in, for example, based on safety considerations or to prevent equipment damage, not obtained based on the command. Dr. Wooley does not attempt to show how the referenced sections, or any section of *Almadi*, disclose the missing elements or provide any rationale as to *why* these elements would have been obvious.

97. Further, Dr. Wooley again points to references that are not prior art in an attempt to show that this limitation is "disclosed" by *Almadi*. However, these are not prior art references, and Dr. Wooley makes no attempt to show that they are. In

[34] A set point is a desired target value of a system: a "flow setpoint" would be a desired flow condition; a "level setpoint" would be a desired level of a tank, for example.

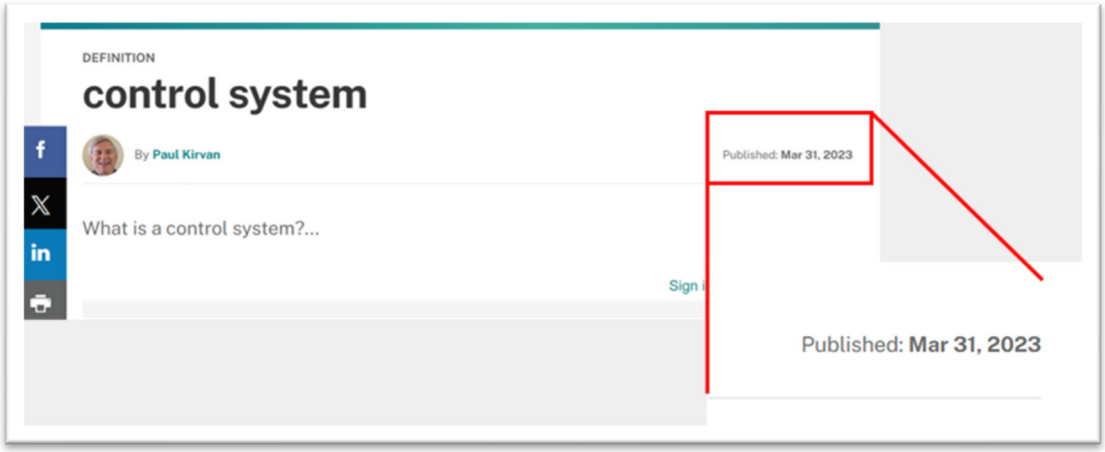
¶61, Dr. Wooley points to "above discussion of controllers." Upon reviewing Dr. Wooley's declaration, I determined that the "above discussion of controllers" must be referencing paragraphs 54 -59. These paragraphs contain many of the postdated references that do not disclose the knowledge of a POSITA at the time of the '680 Patent.

98. For example, in ¶54 and ¶57, Dr. Wooley points to https://www.techtarget.com/whatis/definition/controller.[35] A visit to the site referenced shows that this is a current reference, with a publication date of Feb 24, 2023, long after the '680 Patent. An analysis should look through the lens of a POSITA at the time of the invention, not current references.



[35] https://www.techtarget.com/whatis/definition/controller (accessed June 19, 2025).

99. Still further, in ¶55, Dr. Wooley points to https://www.techtarget.com/whatis/definition/control-system.[36] A visit to the site referenced shows that this is a current reference, with a publication date of March 31, 2023, which is again long after the '680 Patent. An analysis should look through the lens of a POSITA at the time of the invention, not current references.



100. Accordingly, *Almadi* does not disclose limitation 1.7, nor would limitation 1.7 have been obvious based on the teachings of *Almadi* as claimed by Dr. Wooley and Petitioner.

[36] https://www.techtarget.com/whatis/definition/control-system (accessed June 19, 2025).

B. DEPENDENT CLAIMS 2-3, 6, 14, & 19

101. Claims 2-3, 6, 14, and 19 all depend from Claim 1. As there are multiple limitations from Claim 1 that are not disclosed, taught, or suggested by *Almadi*, none of the dependent claims can be anticipated or rendered obvious by *Almadi.*

C. INDEPENDENT CLAIM 20

102. It is my opinion that *Almadi* neither anticipates Claim 20 nor renders it obvious. There are key elements of Claim 20 that are missing from the disclosure of *Almadi* and would not have been obvious to a POSITA based on the disclosure of *Almadi*, as discussed below.

103. According to Dr. Wooley, "Claim 20's preamble is analogous to limitation 1.1, limitation 20.2 is analogous to limitation 1.2, limitation 20.3 is analogous to limitation 1.3, limitation 20.4 is analogous to limitation 1.4, limitation 20.5 is analogous to limitation 1.5, limitation 20.6 is analogous to limitation 1.6, limitation 20.7 is analogous to limitation 1.7, and limitation 20.8 is analogous to limitation 1.8."[37] No additional analysis regarding the limitations of Claim 20 is offered other than those already discussed regarding Claim 1.

104. As there are elements of at least limitations 1.2, 1.3, 1.4 and 1.7 missing from the disclosure of *Almadi,* as discussed above in **Sections X.A.1–X.A.4**, these

[37] Ex. 1002 ¶89.

elements are missing from Claim 20 as well. Accordingly, *Almadi* fails to anticipate Claim 20 and fails to render Claim 20 obvious.

XI. GROUND 2: *CARDAMONE* DOES NOT ANTICIPATE THE CLAIMS, NOR DOES IT RENDER THE CLAIMS OBVIOUS

105. After review of the evidence submitted in support of the Petition, including the Prior Art relied on and the declaration of Dr. Wooley, it is my opinion that *Cardamone* does not anticipate Claims 1, 9-13, 15-18, and 20 of the '680 Patent, nor does it render them obvious. There are claim elements missing from *Cardamone* that neither Dr. Wooley nor the Petition shows are disclosed, taught, or suggested by the disclosure of *Cardamone*.

A. INDEPENDENT CLAIM 1

106. It is my opinion that *Cardamone* neither anticipates Claim 1 nor renders it obvious. There are key elements of the Claim that are missing from the disclosure of *Cardamone* that (1) preclude anticipation and (2) would not have been obvious to a POSITA based on the disclosure of *Cardamone*, as discussed in the subsections below.

107. Claim 1 contains the following limitations, which have been subdivided in the same manner that Dr. Wooley and Petitioner subdivided them:

[1.1] A non-transitory, machine-readable medium comprising instructions to effectuate operations, the operations comprising:

[1.2] receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;

[1.3] determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;

[1.4] sending, with the server, the target value to the network address via the network;

[1.5] receiving, with the controller, a measurement of the fluid by the sensor;

[1.6] determining, with the controller, whether the measurement satisfies the target value;

[1.7] in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and

[1.8] controlling, with the controller, the actuator based on the set point.

108. My opinion is in disagreement with Dr. Wooley. I note that Dr. Wooley makes a conclusory statement in ¶97 that "would be obvious to a POSITA in view of *Cardamone*." However, there is no rationale or analysis anywhere in Dr. Wooley's declaration regarding Claim 1 as to *why* the elements not disclosed by *Cardamone* would have been obvious to a POSITA.

1. [1.2]: "receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;"

109. Petitioner does not demonstrate that limitation 1.2 is disclosed or taught by *Almadi*. I disagree with the Petition's and Dr. Wooley's contention that receiving "sensory data" is equivalent to "receiving, with a server, a command."[38] "Sensory data", as discussed in the sections of *Cardamone*, is just that: data from sensors. A POSITA would not equate data from sensors with a command. The referenced sections of *Cardamone* do not contain any discussion of commands or target values.[39]

110. Further, Dr. Wooley does not attempt to tie his analysis to the actual claim language. Dr. Wooley does not even attempt to analyze, map, or equate receiving the command from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore, as claimed. Dr. Wooley does not attempt to show how the referenced sections, or any section of *Cardamone*, disclose the missing elements or provide any rationale as to *why* these

[38] Petition at p. 34; Ex. 1002 (Wooley declaration) ¶91.
[39] *See* section X.A.1 above discussing the difference between a "target value" and sensor data.

elements would have been obvious. The Petition does not attempt this showing either.

111. Accordingly, *Cardamone* does not disclose limitation 1.2, nor would limitation 1.2 have been obvious based on the teachings of *Cardamone* as claimed by Dr. Wooley and Petitioner.

2. [1.3]: "determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;"

112. Again, Dr. Wooley does not attempt to tie his analysis to the claim language. Other than conclusory statements and references to paragraphs that contain information published after the '680 Patent, Dr. Wooley points to a single paragraph of *Cardamone* ([0031]) for support for his contention that *Cardamone* discloses the claimed limitations. A close examination of [0031] reveals that this paragraph discusses communications between the local computer 126 and the motor drive unit 318. There is no reference to a "server," much less determining a network address, using that address to identify a controller, or a controller accessing a sensor to measure fluid handled by the fluid-handling device. Dr. Wooley provides no

rationale to explain how these elements are "disclosed" by the reference paragraph, or any section of *Cardamone*, or why these elements would have been obvious.

113. The Petition cites [0031] several more sections in *Cardamone* (i.e., ¶0024, ¶0042, ¶0011, ¶0021, ¶0026, ¶0041, ¶¶0044-45, ¶0006, and *Cardamone's* claim 1),[40] but like Dr. Wooley does not show how these sections reveal the claimed "determining" step involving the server, the datastore record, and a network address of a network based on the record, let alone the entirety of the claimed limitation 1.3 in the full context of Claim 1.

114. Accordingly, *Cardamone* does not disclose limitation 1.3, nor would limitation 1.3 have been obvious based on the teachings of *Cardamone* as claimed by Dr. Wooley and Petitioner.

3. [1.4]: "sending, with the server, the target value to the network address via the network;"

115. Again, the Petition and Dr. Wooley do not attempt to tie their analysis to the claim language. Other than conclusory statements and references to paragraphs that contain information published after the '680 Patent, Dr. Wooley points to two paragraphs of *Cardamone* ([0044], [0045]) for support for his contention that *Cardamone* discloses the claimed limitations. The Petition points to

[40] Petition at p. 34-35.

the same paragraphs and offers nothing more pertaining to the "target value" that was previously missed in limitation 1.2, discussed above.[41]

116. An examination of these paragraphs reveals that there is no mention of a server or a network address. Limitation 1.4 does not just reference sending a target value, but sending a target value with the server to the network address via the network. The Petition and Dr. Wooley do not attempt to show how the referenced sections, or any section of *Cardamone*, disclose a server, or sending with the server, the target value to the network address via the network, or *why* these elements would have been obvious.

117. Accordingly, *Cardamone* does not disclose limitation 1.4, nor would limitation 1.4 have been obvious based on the teachings of *Cardamone* as claimed by Dr. Wooley and Petitioner.

4. [1.7]: "in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and"

118. Except for conclusory statements and references to paragraphs that contain information that was not prior art, Dr. Wooley only relies on Claim 4 of *Cardamone* for support for his position that *Cardamone* "discloses" limitation 1.7.

[41] Petition at p. 36; Ex. 1002 (Wooley declaration) ¶93.

119. Neither Claim 4 nor its parent claims (Claim 3 and Claim 1) make any reference to a target value, much less obtaining a set point based on the command which was received by the server. The antecedent of "the command" in limitation 1.7 is "a command" from limitation 1.2 that was received by the server. The "output command" in Claim 4 is provided between the local computer and the motor driver. There is no server in the mix, much less a server that provides the functions described in the antecedent limitations. Dr. Wooley does not attempt to show how the referenced claims, or any section of *Cardamone*, disclose these missing elements or any rationale as to *why* they would have been obvious.

120. Accordingly, *Cardamone* does not disclose limitation 1.7, nor would limitation 1.7 have been obvious based on the teachings of *Cardamone* as claimed by Dr. Wooley and Petitioner.

B. DEPENDENT CLAIMS 9-13, AND 15-18

121. Claims 9-13, and 15-18 all depend from Claim 1. As there are multiple limitations from Claim 1 that are not disclosed, taught or suggested by *Cardamone* none of the dependent claims are anticipated by *Cardamone* or rendered obvious by *Cardamone.*

C. INDEPENDENT CLAIM 20

122. It is my opinion that *Cardamone* neither anticipates Claim 20 nor renders it obvious. There are key elements of Claim 20 that are missing from the disclosure of *Cardamone* and would not have been obvious to a POSITA based on the disclosure of *Cardamone.*

123. According to Dr. Wooley, "Claim 20's preamble is analogous to limitation 1.1, limitation 20.2 is analogous to limitation 1.2, limitation 20.3 is analogous to limitation 1.3, limitation 20.4 is analogous to limitation 1.4, limitation 20.5 is analogous to limitation 1.5, limitation 20.6 is analogous to limitation 1.6, limitation 20.7 is analogous to limitation 1.7, and limitation 20.8 is analogous to limitation 1.8."[42] No additional analysis regarding the limitations of Claim 20 is offered other than those already discussed regarding Claim 1.

124. As there are elements of at least limitations 1.2, 1.3, 1.4 and 1.7 missing from the disclosure of *Cardamone,* as discussed above in **Sections XI.A.1–XI.A.4**, these elements would be missing from Claim 20 as well. Accordingly, *Cardamone* fails to anticipate Claim 20, and fails to render Claim 20 obvious.

[42] Ex. 1002 ¶114.

XII. GROUND 3: *GUTIERREZ* DOES NOT ANTICIPATE THE CLAIMS, NOR DOES IT RENDER THE CLAIMS OBVIOUS

125. After reviewing the evidence submitted in support of the Petition, including the Prior Art relied on and Dr. Wooley's declaration, it is my opinion that *Gutierrez* does not anticipate nor render obvious Claims 1, 7, and 20 of the '680 Patent. There are claim elements missing from *Gutierrez* that neither Dr. Wooley nor the Petition shows are disclosed, taught, or suggested by *Gutierrez*.

A. INDEPENDENT CLAIM 1

126. It is my opinion that *Gutierrez* neither anticipates Claim 1 nor renders it obvious. There are key elements of Claim 1 that are missing from Gutierrez's disclosure that (1) preclude anticipation and (2) would not have been obvious to a POSITA based on *Gutierrez's* disclosure, as discussed in the subsections below.

127. Claim 1 contains the following limitations, which have been subdivided in the same manner that Dr. Wooley and Petitioner subdivided them:

> [1.1] A non-transitory, machine-readable medium comprising instructions to effectuate operations, the operations comprising:
>
> [1.2] receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;
>
> [1.3] determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a

fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;

[1.4] sending, with the server, the target value to the network address via the network;

[1.5] receiving, with the controller, a measurement of the fluid by the sensor;

[1.6] determining, with the controller, whether the measurement satisfies the target value;

[1.7] in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and

[1.8] controlling, with the controller, the actuator based on the set point.

128. My opinion is in disagreement with Dr. Wooley. I note that Dr. Wooley makes a conclusory statement in ¶123 that Claim 1 "would be obvious to a POSITA in view of *Gutierrez*." However, there is no rationale or analysis anywhere in Dr. Wooley's declaration regarding Claim 1 as to *why* the elements not disclosed by *Gutierrez* would have been obvious to a POSITA.

1. [1.2]: "receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;"

129. *Gutierrez* does not disclose or suggest a server. Dr. Wooley does not even attempt to show that *Gutierrez* discloses a server, because he cannot. Instead,

Dr. Wooley ignores that limitation requiring "receiving, with a server a command" and instead analyzes "receiving a command."[43]

130. Accordingly, *Gutierrez* does not disclose limitation 1.2, nor would limitation 1.2 have been obvious based on the teachings of *Gutierrez* as claimed by Dr. Wooley and Petitioner.

2. [1.3]: "determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;"

131. Limitation 1.3 similarly requires a server, which is missing from *Gutierrez* as discussed above regarding limitation 1.2. Additionally, *Gutierrez* does not disclose a "network address" or that the network address identifies a controller. The word "address" appears nowhere in *Gutierrez*. Other than conclusory statements, Dr. Wooley provides no rationale or analysis of how and *why Gutierrez* discloses a "network address," or that the network address identifies as a controller, or that the network address as a controller would have been obvious based on the disclosure of *Gutierrez.*

[43] Ex. 1002 ¶116.

132. Accordingly, *Gutierrez* does not disclose limitation 1.3, nor would limitation 1.3 have been obvious based on the teachings of *Gutierrez* as claimed by Dr. Wooley and Petitioner.

3. [1.4]: "sending, with the server, the target value to the network address via the network;"

133. Limitation 1.4 similarly requires a server, which is missing from *Gutierrez* as discussed above regarding limitation 1.2.

134. The antecedent of "the network address" in the claim limitation is "a network address" of limitation 1.3. *Gutierrez* does not disclose a network address, as discussed in limitation 1.3, and therefore cannot disclose "the network address."

135. Accordingly, *Gutierrez* does not disclose limitation 1.4, nor would limitation 1.4 have been obvious based on the teachings of *Gutierrez* as claimed by Dr. Wooley and Petitioner.

4. [1.7]: "in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and"

136. The antecedent of "the command" in limitation 1.7 is "a command" from limitation 1.2 that was received by the server. As *Gutierrez* does not disclose or suggest a server, as discussed above regarding limitation 1.2, *Gutierrez* does not disclose or suggest "the command."

137. Accordingly, *Gutierrez* does not disclose limitation 1.7, nor would limitation 1.7 have been obvious based on the teachings of *Gutierrez* as claimed by Dr. Wooley and Petitioner.

B. DEPENDENT CLAIM 7

138. Claim 7 depends from Claim 1. As there are multiple limitations from Claim 1 that are not disclosed, taught, or suggested by *Gutierrez,* none of the dependent claims are anticipated by *Gutierrez* or rendered obvious by *Gutierrez.*

C. INDEPENDENT CLAIM 20

139. It is my opinion that *Gutierrez* neither anticipates Claim 20 nor renders it obvious. There are key elements of Claim 20 that are missing from the disclosure of *Gutierrez* and would not have been obvious to a POSITA based on the disclosure of *Gutierrez.*

140. According to Dr. Wooley, "Claim 20's preamble is analogous to limitation 1.1, limitation 20.2 is analogous to limitation 1.2, limitation 20.3 is analogous to limitation 1.3, limitation 20.4 is analogous to limitation 1.4, limitation 20.5 is analogous to limitation 1.5, limitation 20.6 is analogous to limitation 1.6, limitation 20.7 is analogous to limitation 1.7, and limitation 20.8 is analogous to

limitation 1.8."[44] No additional analysis regarding the limitations of Claim 20 is offered other than those already discussed regarding Claim 1.

141. As there are elements of at least limitations 1.2, 1.3, 1.4 and 1.7 missing from the disclosure of *Gutierrez,* as discussed above in **Sections XII.A.1–XII.A.4**, these elements would be missing from Claim 20 as well. Accordingly, *Gutierrez* fails to anticipate Claim 20 and fails to render Claim 20 obvious.

XIII. GROUND 4: SCADA DOES NOT ANTICIPATE THE CLAIMS, NOR DOES IT RENDER THE CLAIMS OBVIOUS

142. After review of the evidence submitted in support of the Petition, including the Prior Art relied on and the declaration of Dr. Wooley, it is my opinion that *SCADA* does not anticipate Claim 1 of the '680 Patent, nor does it render them obvious. There are claim elements missing from *SCADA* that neither Dr. Wooley nor the Petition shows are disclosed, taught, or suggested by *SCADA*.

A. INDEPENDENT CLAIM 1

143. It is my opinion that *SCADA* neither anticipates Claim 1 nor renders it obvious. There are key elements of Claim 1 that are missing from the disclosure of

[44] Ex. 1002 ¶114.

SCADA and would not have been obvious to a POSITA based on the disclosure of *SCADA*, as discussed in the subsections below.

144. Claim 1 contains the following limitations, which have been subdivided in the same manner that Dr. Wooley and Petitioner subdivided them:

> [1.1] A non-transitory, machine-readable medium comprising instructions to effectuate operations, the operations comprising:
>
> [1.2] receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;
>
> [1.3] determining, with the server, a network address of a network based on the record, wherein the network address identifies a controller of the fluid-handling device, and wherein the controller accesses a sensor to measure a fluid being handled by the fluid-handling device and an actuator of the fluid-handling device;
>
> [1.4] sending, with the server, the target value to the network address via the network;
>
> [1.5] receiving, with the controller, a measurement of the fluid by the sensor;
>
> [1.6] determining, with the controller, whether the measurement satisfies the target value;
>
> [1.7] in response to a determination that the measurement does not satisfy the target value, obtaining, with the controller, a set point based on the command; and
>
> [1.8] Controlling, with the controller, the actuator based on the set point.

145. My opinion is in disagreement with Dr. Wooley. I note that even though Dr. Wooley makes a conclusory statement in the heading to Ground 4 (pg 52) and

in ¶127 that "*SCADA* anticipates claim 1 or is obvious to a POSITA in view of *SCADA*," there is no rationale or analysis anywhere in Dr. Wooley's declaration regarding Claim 1 as to *why* the elements not disclosed by *SCADA* would have been obvious to a POSITA. Further, throughout Dr. Wooley's analysis relating to Ground 4 he points to sections of *SCADA* that he alleges anticipates Claim 1 (these references does not), and he provides no discussion of obviousness of Claim 1 other than conclusory statements at the beginning and end of the section.

1. [1.2] receiving, with a server, a command comprising a target value of a fluid-handling device from a computing device via a control interface, wherein the command is received in association with a record stored on a datastore;

146. Dr. Wooley's analysis of *SCADA* anticipating "wherein the command is received in association with a record stored on a datastore" does not show that *SCADA* discloses this limitation. The section of *SCADA* that Dr. Wooley points to, Ex. 1008 ppg. 92-93 does not contain any reference to a datastore nor does it contain reference to any record stored on a datastore. This section of *SCADA* discusses a communications link and "special equipment [] to interface with the sensors, actuators, and calculators in the process."[45] The cited portion of *SCADA* also discusses modems and a protocol driver program, but makes no mention or

[45] Ex. 1008 ppg. 92-93.

suggestion of associating the command with a record stored on a datastore, as claimed in limitation 1.2.

147. Dr. Wooley provides no explanation of how this section discloses or renders obvious "wherein the command is received in association with a record stored on a datastore."

148. Accordingly, *SCADA* does not disclose limitation 1.2, nor would limitation 1.2 have been obvious based on the teachings of *SCADA* as claimed by Dr. Wooley and Petitioner.

2. [1.4]: "sending, with the server, the target value to the network address via the network;"

149. I disagree with Petitioner's and Dr. Wooley's analysis that a "target value" is simply a sensed parameter ("collect[ed] data, such as measurements of fluid pressure, temperature, or flow") or "process data" as the Petition and Dr. Wooley contend, respectively.[46] This is not the plain and ordinary meaning of the term, nor is it consistent with its use in the '680 Patent. As discussed before in prior sections, a "target value" is a state the fluid handling device is desired to be in, which can include but is not limited to a valve position, a tank level, or a motor speed.[47]

[46] Petition at 61; and Ex. 1002 (*Wooley* declaration) ¶138; see also ¶137.
[47] See, e.g., '680 Patent 11:55 – 60.

150. The claim language is clear that a "target value" is not the same as sensor data ("process data," as referred to by Dr. Wooley at ¶138), such as "a measurement of the fluid by the sensor." For example, limitation [1.6] describes comparing the target value to "measurement" data and determining whether the measurement satisfies the target value. Thus a "measurement" of process data is different from a "target value." Therefore, sensing process data is not obtaining a target value, as Dr. Wooley describes, but *SCADA* may describe sensing the present value of a fluid handling device. Moreover, the Petition and Dr. Wooley do not show that *SCADA* discloses or teaches obtaining a target value based on the instructions. Further, *SCADA's* description of sensing parameters does not disclose or suggest sending, with the server, the target value to the network address via the network.

151. Accordingly, *SCADA* does not disclose limitation [1.4], nor would limitation [1.4] have been obvious based on the teachings of *SCADA* as claimed by Dr. Wooley and Petitioner.

XIV. CONCLUSION

152. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. I further understand that willful false statements and the like are punishable by fine or

imprisonment, or both under Section 1001 of Title 18 of the United States Code. I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 14, 2025 

Dr. Robert A. Durham

Dr. ROBERT A DURHAM, PhD, FIEEE

Resume
Specialization
Honors & Awards
Publications

Dr ROBERT A DURHAM, PhD, FIEEE

Robert A Durham is the Principal of D^2 Tech Solutions, a technology related firm concentrating on Mechanical and Electrical systems and energy conversions. He also serves as a Principal Scientist of THEWAY LABs, Tulsa, OK, an engineering and energy consulting firm that provides design and failure analysis of facilities and system installations.

Dr. Durham's work experience is broad and encompasses all areas of the energy industry. Dr. Durham spent 11 years with AEP/CSW, at the time the country's largest utility, in electrical engineering positions in the power generation and transmission planning departments. He then accepted a position as Manager of Electric Infrastructure for New Dominion, LLC., a major independent energy producer in Oklahoma. Dr. Durham then moved on to hold the position of Vice President of Engineering and Project Management for EDG Power Group, an Engineering Procurement and Construction company specializing in design and construction of small to medium size power generating facilities. Dr. Durham left EDG Power Group to accept his current positions. Dr. Durham has been accepted as an expert and offered testimony in several jurisdictions.

Dr. Durham's extensive client list includes the development of a broad spectrum of forensic, electrical and facilities projects for many companies. He has also taught University offered courses in electrical engineering review for board licensure. He has published five books, six magazine articles and over 40 other technical papers and articles. Dr. Durham's extensive work on standards and electrical systems has resulted in his elevation to Fellow of the IEEE, the highest grade of recognition in the electrical technology industry.

Dr. Durham received the B.S. in electrical engineering from the University of Tulsa in 1992 and the M.E. in Technology Management from The University of Tulsa in 1997. Tulsa, OK. In 2004, Dr. Durham received a PhD in Engineering Management from Kennedy Western University.

Degrees Earned

BSEE, with Honors, The University of Tulsa
Master of Engineering, The University of Tulsa
PhD , Kennedy Western University

Area of Specialization

lightning & grounding
failure analysis & forensic engineering
electrical power systems & safety
economics & management
petroleum & chemical industry
- drilling
- completion
- production
- transportation
- refining

electrical / mechanical energy conversion

Registration

Professional Engineer - Oklahoma
Professional Engineer – Texas
Professional Engineer – California
Professional Engineer – New Hampshire (Inactive)
Professional Engineer – Kansas
Professional Engineer – North Carolina (Inactive)
Professional Engineer – Missouri
Professional Engineer – Arkansas
Professional Engineer – Virginia (Inactive)
Professional Engineer – Illinois (Inactive)
Electrical Contractor - Oklahoma

Work History

D^2 Tech Solutions, Inc. 2002 - 2025
Principal

THEWAY Corp. 2004 - 2025
Principal Scientist

EDG Power Group, Inc. 2002 - 2004
Vice President Engineering & Project Management

New Dominion, LLC 2000 - 2002
Mgr Electric Infrastructure

Central & Southwest, Inc 1989 - 2000
Electrical Engineer

Professional Memberships

Fellow	Institute of Electrical and Electronic Engineers
Diplomate	American College of Forensic Examiners, International
Member	National Association of Fire Investigators
Voting Member	National Fire Protection Institute, Electrical Section
Executive Member	Petroleum and Chemical Industry Committee, IEEE
Diplomate, Past Board Member	American Board of Forensic Engineering and Technology
Member	IEEE Standards Association
Past Chair	Production Subcommittee, IEEE IAS/PCIC
CFC	American College of Forensic Examiners
Member	International Association of Arson Investigators
CFEI, CVFEI	National Association of Fire Investigators
Past Chair	Tulsa Section IEEE
Chair	IEEE RP1017.1 Working Group
Chair	IEEE RP1017.2 Working Group
Chair	IEEE RP1017.3 Working Group
Chair	IEEE RP1017.4 Working Group
Past Chair	IEEE PCIC Standards Subcommittee
Secretary	IEEE Petroleum and Chemical Industry Committee

Honors and Awards

Fellow of the IEEE

For contributions to submersible electrical equipment analysis and multi-point ground method in hazardous petroleum and chemical environments.

Honor Societies

Tau Beta Pi, national engineering honors
Eta Kappa Nu, national electrical engineering honors

Dr. Durham's publications have often successfully competed for outstanding paper awards from journals of the Institute of Electrical and Electronic Engineers (PCIC and IAS). This is an international competitive peer review and evaluation of papers that provide a significant contribution to the advancement and understanding of electrical applications.

IEEE Industry Applications Society, New Orleans, LA: Prize Article for "Data Quality and Grounding: Considerations in a Mixed Use Facility"

PCIC, Cincinnati, OK: Prize Paper for "Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated"

PCIC, New Orleans, LA: Prize paper for "Industrial Design Application for Power Distribution over Extra-Long Distances"

PCIC, Philadelphia, PA: Prize paper for "Paradigm Shifts and Impact on Engineers and Industry"

Transactions on Industry Applications, Orlando, FL: Prize Paper for "Lightning, Grounding, and Protection for Control Systems".

PCIC, Denver, CO: Prize Paper for "Grounding System Design for Isolated Locations and Plant Systems"

PCIC, St. Louis, MO: First place for "Lightning, Grounding, and Protection for Distributed Control and Communications Systems: A Retrofit".

Publications

Electrical Engineering in a Nutshell, Dr. Robert A Durham, Dr. Marcus O. Durham, ISBN 978-1466236795, 2011

Electrical Failure Analysis for Fire and Incident Investigations, Marcus O. Durham, Robert A. Durham, Rosemary Durham, Jason Coffin, ISBN 978-1463773472, 2011

Leadership and Success in Relationships and Communication, Marcus O. Durham and Robert A Durham, ISBN 978-1463758769, 2011

Leadership and Success in Organizations, Culture & Ethics: Group or Horizontal Interactions, Marcus O. Durham and Robert A Durham, ISBN 978-1466250338, 2011

Leadership and Success in Economics, Law & Technology: Society or External Influence, Marcus O. Durham and Robert A Durham, OK,ISBN 978-1466250461, 2011

How Should Generating Asset Acquisitions by Regulated, Vertically Integrated Utilities be Overseen in Today's Quasi-Regulated Electric Utility Environment? A Dissertation Presented to the Faculty of the School of Engineering Kennedy-Western University, KWU Press, Thousand Oaks, CA, 2004

R. A. Durham, C. Chung and M. O. Durham, "IEEE 1017 Family of ESP Cable Standards – A Major Update," *2024 IEEE IAS Petroleum and Chemical Industry Technical Conference (PCIC)*, Orlando, FL, USA, 2024, pp. 1-10.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 3 Alternative Systems," *2022 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, Denver, CO 2021.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 2 Standards Requirements," *2021 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, San Antonio, TX, 2021.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Petrochemical Facility Lightning Protection Primer: Part 1: History and Basic Science," in IEEE Industry Applications Magazine, vol. 27, no. 2, pp. 47-56, March-April 2021, doi: 10.1109/MIAS.2020.3024492.

R. A. Durham, S. J. Szczecinski and M. O. Durham, "Factors Impacting Selection of Grounding and Bonding Conductors," in *IEEE Transactions on Industry Applications*, vol. 56, no. 5, pp. 4652-4661, Sept.-Oct. 2020, doi: 10.1109/TIA.2020.3005637.

R. A. Durham, M. O. Durham and T. W. Gillaspie, "Lightning Protection at Petrochemical Facilities - Part 1 History and Background Science," *2019 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, Vancouver, BC, Canada, 2019, pp. 205-214, doi: 10.1109/PCIC30934.2019.9074531.

R. A. Durham, S. J. Szczecinski and M. O. Durham, "Grounding and Bonding Conductors: Solid, Stranded, Bare or Insulated?: Copyright Material IEEE, Paper No. PCIC-2018-03," *2018 IEEE Petroleum and Chemical Industry Technical Conference (PCIC)*, Cincinnati, OH, USA, 2018, pp. 19-28, doi: 10.1109/PCIC31437.2018.9080442.

F. P. Feletto, R. Durham, E. Bortoni and J. Costa, "IMPROVENT OF MV CASCADED H BRIDGE INVERTER (CHBI) VFD AVAILABILITY FOR HIGH POWER ESP OIL WELLS," in *IEEE Transactions on Industry Applications*.
doi: 10.1109/TIA.2018.2866481
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8443149&isnumber=4957013

F. Feletto, R. A. Durham, E. da Costa Bortoni and J. G. C. Costa, "Techniques to improve MV cascaded H bridge inverter (CHBI) VFDs availability applied to drive high power esp oil wells," *2017 Petroleum and Chemical Industry Technical Conference (PCIC)*, Calgary, AB, Canada, 2017, pp. 363-370.
doi: 10.1109/PCICON.2017.8188756
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8188756&isnumber=8188605

R. A. Durham, M. Azambuja, F. P. Feleto and M. O. Durham, "PD testing of motors for hostile environments," *2015 IEEE Petroleum and Chemical Industry Committee Conference (PCIC)*, Houston, TX, 2015, pp. 1-8.
doi: 10.1109/PCICON.2015.7435106
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7435106&isnumber=7435079

Durham, Robert A.; Brinner, Thomas R., "Oilfield electric power distribution," Petroleum and Chemical Industry Technical Conference (PCIC), 2014 IEEE , vol., no., pp.429,442, 8-10 Sept. 2014 doi: 10.1109/PCICon.2014.6961908
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6961908&isnumber=6961868

Durham, Robert; Durham, M.O. "What Does Grounding Have To Do with Fire & Injury", Fire Protection vol 40 no 2, Fire Protection Association of Southern Africa, June 2014.

Durham, M.O.; Durham, R.A., "Does a Unified Energy Equation Contain the Higgs Field?," Access, IEEE , vol.1, no., pp.505,508, 2013
doi: 10.1109/ACCESS.2013.2276623
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6574202&isnumber=6336544

Durham, R.A.; Durham, M.O.; , "Does Corrugated Tubing +Lightning =Catastrophic Failure?," *Industry Applications, IEEE Transactions on* , vol.48, no.4, pp.1243-1250, July-Aug. 2012
doi: 10.1109/TIA.2012.2200069
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6202685&isnumber=6238414

Durham, R.A.; Durham, M.O.; , "Lightning, grounding, and protection for control and communications systems: Re-evaluated," *Petroleum and Chemical Industry Conference Europe Conference Proceedings (PCIC EUROPE), 2011* , vol., no., pp.1-11, 7-9 June 2011
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5936962&isnumber=5936950

Durham, M.O.; Durham, R.A.; , "Lightning dangers on corrugated tubing carrying hydrocarbons," *Petroleum and Chemical Industry Conference (PCIC), 2010 Record of Conference Papers Industry Applications Society 57th Annual* , vol., no., pp.1-9, 20-22 Sept. 2010 doi: 10.1109/PCIC.2010.5666860
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5666860&isnumber=5666816

Brinner, T. R.; Durham, R. A.; , "Transient-Voltage Aspects of Grounding," *Industry Applications, IEEE Transactions on* , vol.46, no.5, pp.1796-1804, Sept.-Oct. 2010
doi: 10.1109/TIA.2010.2059551

URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5523987&isnumber=5577442

"CSST Response to Lightning and Transients – A Technical Analysis", Marcus O Durham and Robert A Durham, *Fire & Arson Investigator*, July 2009 Vol 60, No 1.

Brinner, T.R.; Durham, R.A.; , "Transient voltage aspects of grounding," *Petroleum and Chemical Industry Technical Conference, 2008. PCIC 2008. 55th IEEE* , vol., no., pp.1-9, 22-24 Sept. 2008
doi: 10.1109/PCICON.2008.4663969
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4663969&isnumber=4663961

Durham, M.O.; Durham, R.A.; Hulett, R.H.; , "History and Development of IEEE Standards for Downhole Cable," *Industry Applications, IEEE Transactions on* , vol.43, no.2, pp.436-443, March-april 2007
doi: 10.1109/TIA.2006.890022
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4132867&isnumber=4132857

Durham, R.A.; Durham, M.O.; , "What to do when Things go Wrong an Ethical Solution," *Petroleum and Chemical Industry Technical Conference, 2007. PCIC '07. IEEE* , vol., no., pp.1-7, 17-19 Sept. 2007
doi: 10.1109/PCICON.2007.4365790
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4365790&isnumber=4365767

Durham, M.O.; Durham, R.A.; , "Data quality and grounding," *Industry Applications Magazine, IEEE* , vol.12, no.3, pp. 67- 73, May-June 2006
doi: 10.1109/MIA.2006.1628848
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1628848&isnumber=34165

Durham, M.O.; Durham, R.A.; Hulett, R.; , "Submersible cable standards history newly revised," *Petroleum and Chemical Industry Conference, 2005. Industry Applications Society 52nd Annual* , vol., no., pp. 189- 197, 12-14 Sept. 2005
doi: 10.1109/PCICON.2005.1524554
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1524554&isnumber=32590

Durham, M.O.; Durham, R.A.; , "Cathodic Protection: Consequences and Standards From Using CP Systems to Prevent Corrosion"
Industry Applications Magazine, IEEE , vol.11, no.1, pp. 41- 47, Jan-Feb 2005
doi: 10.1109/MIA.2005.1380326
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1380326&isnumber=30100

Durham, M.O.; Durham, R.A.; , "Data quality and grounding considerations in a mixed-use facility," *Petroleum and Chemical Industry Technical Conference, 2004. Fifty-First Annual Conference 2004* , vol., no., pp. 1- 7, 13-15 Sept. 2004
doi: 10.1109/PCICON.2004.1352768
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1352768&isnumber=29719

Durham, R.A.; Durham, M.O.; , "Covering all the bases - industrial power system design in a utility environment," *Industry Applications Magazine, IEEE* , vol.9, no.6, pp. 14- 20, Nov.-Dec. 2003
doi: 10.1109/MIA.2003.1245791
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1245791&isnumber=27919

Durham, R.A.; Durham, M.O.; , "Corrosion impact of cathodic protection on surrounding structures," *Petroleum and Chemical Industry Conference, 2003. Record of Conference Papers. IEEE Industry Applications Society 50th Annual* , vol., no., pp. 303- 309, 15-17 Sept. 2003
doi: 10.1109/PCICON.2003.1242626
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1242626&isnumber=27844

Durham, M.O.; Durham, K.D.; Durham, R.A.; , "TVSS designs," *Industry Applications Magazine, IEEE* , vol.8, no.5, pp. 31- 36, Sep/Oct 2002
doi: 10.1109/MIA.2002.1028388
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1028388&isnumber=22082

Durham, M.O.; Durham, R.A.; Durham, K.D.; , "Applications engineering approach to Maxwell and other mathematically intense problems," *Petroleum and Chemical Industry Conference, 2002. Industry Applications Society 49th Annual* , vol., no., pp. 31- 38, 2002
doi: 10.1109/PCICON.2002.1044982
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1044982&isnumber=22397

Durham, M.O.; Durham, R.A.; , "Ground systems design considerations for vessels [in petroleum industry]," *Industry Applications Magazine, IEEE* , vol.7, no.6, pp.41-49, Nov/Dec 2001
doi: 10.1109/2943.959115
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=959115&isnumber=20727

Durham, R.A.; Durham, M.O.; , "Industrial design application for power distribution over extra-long distances," *Petroleum and Chemical Industry Conference, 2001. IEEE Industry Applications Society 48th Annual* , vol., no., pp.217-224, 2001
doi: 10.1109/PCICON.2001.960556
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=960556&isnumber=20752

Durham, M.O.; Durham, R.A.; Durham, K.D.; , "2," *Petroleum and Chemical Industry Conference, 2000. Record of Conference Papers. Industry Applications Society 47th Annual* , vol., no., pp.207-215, 2000
doi: 10.1109/PCICON.2000.882777
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=882777&isnumber=19100

Durham, R.A.; Durham, M.O.; , "Electric re-regulation impact," *Industry Applications Magazine, IEEE* , vol.5, no.5, pp.47-56, Sep/Oct 1999

doi: 10.1109/2943.783122
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=783122&isnumber=16987

Durham, M.O.; Durham, R.A.; , "Interaction and design of grounded systems for tanks and vessels ," *Petroleum and Chemical Industry Conference, 1999. Industry Applications Society 46th Annual* , vol., no., pp.195-202, 1999
doi: 10.1109/PCICON.1999.806437
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=806437&isnumber=17478

Durham, M.O.; Durham, R.A.; Anderson, D.; , "What are standardized equations for acceptance of hi-pot tests and for voltage drop?," *Petroleum and Chemical Industry Conference, 1998. Industry Applications Society 45th Annual* , vol., no., pp.281-287, 28-30 Sep 1998
doi: 10.1109/PCICON.1998.727989
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=727989&isnumber=15690

Durham, M.O.; Durham, R.A.; , "Changing paradigms for engineering," *Industry Applications Magazine, IEEE* , vol.4, no.2, pp.52-60, Mar/Apr 1998
doi: 10.1109/2943.655661
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=655661&isnumber=14297

Durham, R.A.; Durham, M.O.; , "Electric re-regulation and effects on industrial customers," *Petroleum and Chemical Industry Conference, 1997. Record of Conference Papers. The Institute of Electrical and Electronics Engineers Incorporated Industry Applications Society 44th Annual* , vol., no., pp.69-78, 15-17 Sep 1997
doi: 10.1109/PCICON.1997.648168
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=648168&isnumber=14127

Durham, M.O.; Durham, R.A.; , "Grounding system design for isolated locations and plant systems ," *Industry Applications, IEEE Transactions on* , vol.33, no.2, pp.374-382, Mar/Apr 1997
doi: 10.1109/28.567998
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=567998&isnumber=12339

Durham, M.O.; Durham, R.A.; , "Paradigm shifts and impact on industry and technology [R&D management]," *Petroleum and Chemical Industry Conference, 1996, Record of Conference Papers. The Institute of Electrical and Electronics Engineers Incorporated Industry Applications Society 43rd Annual* , vol., no., pp.27-35, 23-25 Sep 1996
doi: 10.1109/PCICON.1996.564859
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=564859&isnumber=12267

Durham, M.O.; Durham, R.A.; , "Grounding system design for isolated locations and plant systems ," *Petroleum and Chemical Industry Conference, 1995. Record of Conference Papers., Industry Applications Society 42nd Annual* , vol., no., pp.145-153, 11-13 Sep 1995
doi: 10.1109/PCICON.1995.523949
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=523949&isnumber=11530

Durham, M.O.; Durham, R.A.; , "Lightning, grounding and protection for control systems," *Industry Applications, IEEE Transactions on* , vol.31, no.1, pp.45-54, Jan/Feb 1995 doi: 10.1109/28.363051
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=363051&isnumber=8319.

Durham, M.O.; Durham, R.A.; , "Lighting, grounding, and protection for distributed control and communications systems: a retrofit," *Petroleum and Chemical Industry Conference, 1993, Record of Conference Papers. The Institute of Electrical and Electronics Engineers Incorporated. Industry Applications Society 40th Annual* , vol., no., pp.293-302, 13-15 Sep 1993 doi: 10.1109/PCICON.1993.337392
URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=337392&isnumber=7922

"Generalized Electrical Failures", Durham, R.A., Durham, M.O., Coffin, J.A. *Proceedings of 46th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2013.

"Common Ways your Electrical Installation does you Harm", Durham, R.A., Durham, M.O., Coffin, J.A. *Proceedings of 44th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2011.

"Ignition or Shock, is Grounding the Culprit?", Marcus O Durham, Robert A Durham, Rosemary Durham, Jason A. Coffin, *Proceedings of 43rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2010.

"Unraveling the Myths of Low Energy Ignition", Marcus O Durham, Robert A Durham, Curtis L. Ozment, Jason A. Coffin, *Proceedings of 42nd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2009.

"Lightning, Transient & High Frequency Impact on Material Such As Corrugated Tubing", Marcus O. Durham & Robert Durham, Proceedings of 41st Annual Frontiers in Power Conference, OSU, Stillwater, OK, October 2008.

"Lightning Damage an Act of God, or Act of Negligence?", Marcus O. Durham, Robert Durham, Randall Overton, Curtis Ozment, Proceedings of 40th Annual Frontiers in Power Conference, OSU, Stillwater, OK, October 2007.

"The Flat Earth Society Perception of Grounding", Marcus O. Durham & Robert Durham, Proceedings of 39th Annual Frontiers in Power Conference, OSU, Stillwater, OK, October 2006.

"The IEEE Standards Process, A Case Study", Marcus O. Durham & Robert Durham, *Proceedings of 38th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2005.

"Engineering Management: A Course For Survival", Marcus O. Durham, Robert A. Durham, & Rosemary Durham, *American Society of Engineering Educators*, Pittsburg, KS 2004.

"Eleven Ground Systems and Connections", Marcus O. Durham & Robert Durham, *Proceedings of 37th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2004.

"Engineering Management, An Oxymoron?", Marcus O. Durham, Robert Durham & Rosemary Durham, *Proceedings of 37th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2004.

"Corrosion and Electrical Safety", Marcus O. Durham & Robert Durham, *Proceedings of 36th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2003.

"Applications Engineers Don't Do Hairy Math", Marcus O. Durham, Robert A. Durham, and Karen D. Durham, *Proceedings of 35th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2002.

“Tests and Correlations for TVSS”, Marcus O. Durham, Karen Durham, and Robert Durham, *Proceedings of 34th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2001.

"Grounding Systems Interaction," Robert A. Durham and Marcus O. Durham, *Proceedings of 33rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2000.

"A Cost Effective, Numeric Technique for Projecting Quality of Insulation and Impending Failures," Marcus O. Durham and Robert A. Durham, *Proceedings of 33rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2000.

"An Engineering Selection for Size of Long Conductors Considering Factors in Addition to NEC," Marcus O. Durham and Robert A. Durham, *Proceedings of 33rd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 2000.

“Grounding Systems Interaction,” Robert A. Durham and Marcus O. Durham, *Proceedings of 32nd Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1999.

“Can Electrical Insulation and Conductor Performance Be Predicted?” Marcus O. Durham and Robert A. Durham, *Proceedings of Production Operations Symposium*, SPE 52161, Oklahoma City, OK, March 1999

“Engineering Paradigms: Change, Opportunity and Benefit,” Robert A. Durham and Marcus O. Durham, *Proceedings of 31st Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1998.

"Electric Re-regulation and Impact on Users," Robert A. Durham and Marcus O. Durham, *Proceedings of 30th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1997.

"Remote Transmitter and Distributed Control Grounding and System Protection," Robert A. Durham and Marcus O. Durham, *Proceedings of 27th Annual Frontiers in Power Conference*, OSU, Stillwater, OK, October 1994.

APPENDIX A