

Patent Owner's Presentation
*ProFrac Holding Corporation and U.S. Well Services, LLC v.
Halliburton Energy Services, Inc.*
August 14, 2024

PGR2023-00023 – U.S. Patent No. 11,373,058

Overview Of The '058 Patent


 US011373058B2

(12) **United States Patent**
 Jaaskelainen et al.

(10) Patent No.: **US 11,373,058 B2**
 (45) Date of Patent: **Jun. 28, 2022**

(54) **SYSTEM AND METHOD FOR TREATMENT OPTIMIZATION**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 538 days.

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E21B 43/26 (2006.01)
E21B 47/06 (2012.01)

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 CPC **G06K 9/6248** (2013.01); **E21B 43/26** (2013.01); **G06K 9/6215** (2013.01); **G06K 9/6218** (2013.01); **G06N 5/022** (2013.01); **E21B 47/06** (2013.01)

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 See application file for complete search history.

(56) **References Cited**
 U.S. PATENT DOCUMENTS
 7,516,793 B2* 4/2009 Dykstra E21B 43/267
 166/250.1
 2011/0125476 A1* 5/2011 Craig G01V 1/288
 166/280.1
 2015/0075778 A1* 3/2015 Walters E21B 47/06
 166/250.1
 2016/0258267 A1 9/2016 Payne et al. (Continued)

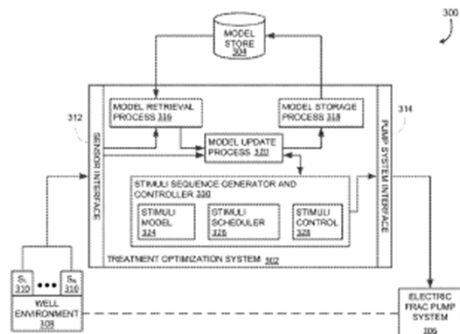
FOREIGN PATENT DOCUMENTS
 WO 2018084871 A1 5/2018
 WO 2018152051 A1 8/2018
 WO 2018160171 A1 9/2018

OTHER PUBLICATIONS
 Ojimaaka, Marcellinus A., et al., "Full-course drilling model for well monitoring and stochastic estimation of kick", Journal of Petroleum Science and Engineering, vol. 166, Jul. 2018, pp. 33-43.*
 (Continued)

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(57) **ABSTRACT**
 A sequence of stimuli produced by an electric frac pump can be generated by a treatment optimization system. Well environment responses to the sequence of stimuli may be measured by sensors and respective sensor data may be received. The sensor data may be used to select a representative system model which can then be used to control the electric frac pump. The representative system model may be used to achieve well stage objectives such as particular cluster efficiencies, complexity factors, or proximity indices.

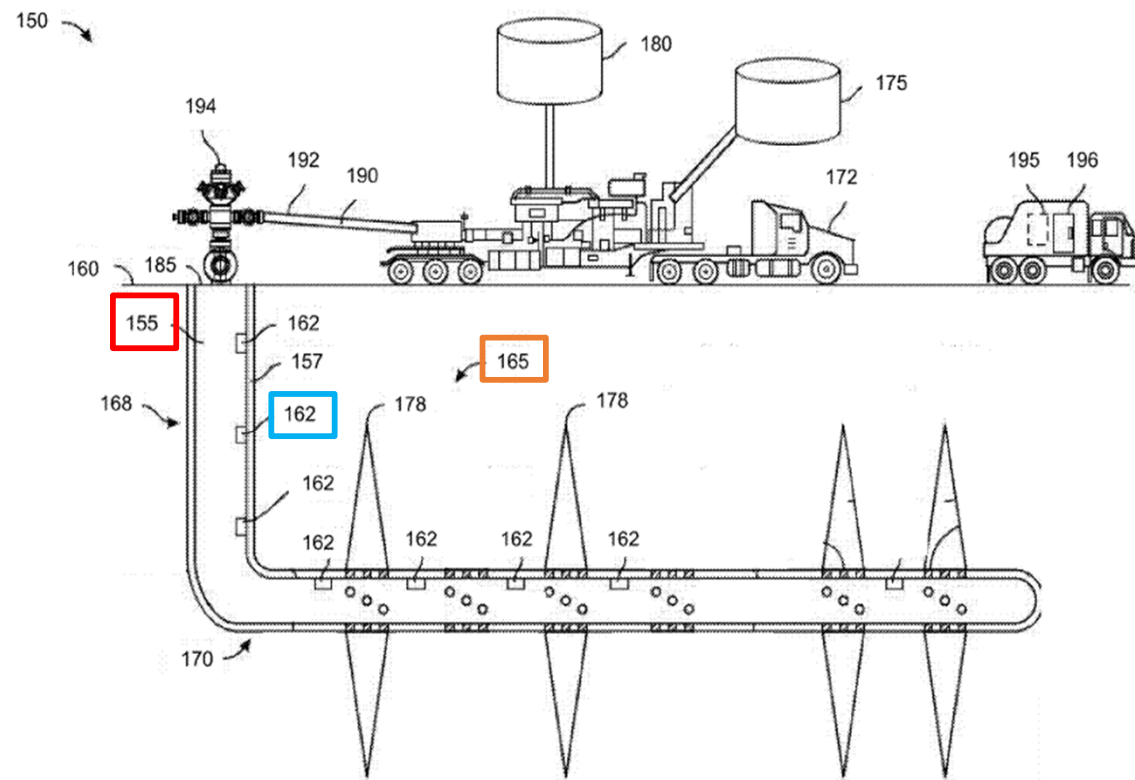
20 Claims, 6 Drawing Sheets



- The '058 Patent is titled "**System and Method for Treatment Optimization.**"
- The claims of the '058 Patent relate to techniques for **controlling electrical fracturing equipment for fracturing a well.**
- Hydraulic fracturing is a **stimulation treatment** performed on oil and gas wells to **restore or enhance the productivity** of a well.
- The process involves **pumping specially engineered fluids at high pressure and rate into the reservoir** interval to be treated, causing fractures to open.

Overview Of The '058 Patent

- Figure 1B depicts a “**wellbore 155**” that extends through “**formation 165**” and includes “**sensors 162** . . . along the length of the wellbore.”
- The subsurface conditions achieved (e.g., the fracturing pattern) **depend on how the fracturing pump is controlled.**
- As Petitioners’ expert confirmed, “**depending on how you use the pump, you will get different outcomes downhole.**”



Overview Of The '058 Patent

- A **representative system model** is one of the tools that an engineer can use to create desirable subsurface conditions to enhance the productivity of a well.
- There is **variability** from well to well, however, and **different wells respond differently** to fracturing operations.
- The '058 Patent recognized that one problem with using a representative system model to control pump settings is that the model "**may not accurately reflect the well** to which it has been deployed":

the representative system model may be a static construct and may not accurately reflect the well to which it has been deployed.

Overview Of The '058 Patent

- The patent provides a technique for selecting a representative system model that **more accurately** reflects the well to which it has been deployed.
- This is done by **selecting** the model **based on both a generated sequence of stimuli and formation response data** received from the sensors.

Response variables (e.g., responsive sensor data values) and respective stimuli (e.g., experimental data) can be used to select, define, and/or construct a representative system model. For example, stimuli and response combination can be mapped to respective system models maintained in an accessible data store. In some examples, a partial model can be generated based on stimuli and response combinations in order to select a pre-constructed representative system model most similar to the partial model. In some examples, a representative system model may be generated based on experimental data and/or data created through simulation with uncertainty parameters.

Overview Of The '058 Patent

- Figure 3 illustrates an operating environment 300 in which a "treatment optimization system 302 may be deployed."

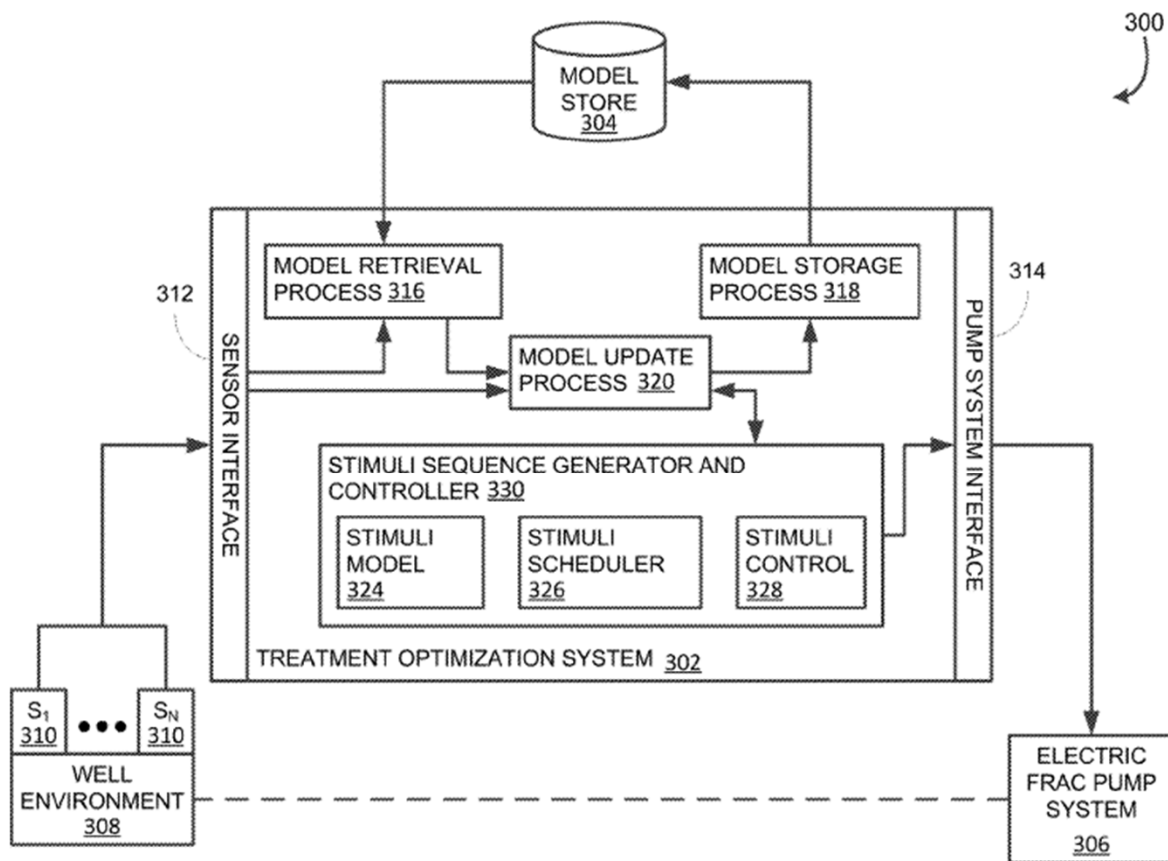


FIG. 3

- Treatment optimization system 302 sends commands to electric frac pump system 306 and receives sensor data from sensors 310.
- Stimuli sequence generator and controller 330 **generates "a sequence of stimuli"** which are provided as commands to electric frac pump system 306" and used to **"produce a response,** and resulting sensor data from sensors 310, **from well environment 308."**

Instituted Grounds

Ground	'058 Patent Claims	Statutory Basis
1	1-4, 6-7, 9-12, 14, 16-19	Obvious under §103 over <i>Pankaj</i> (EX1005) and <i>Payne</i> (EX1006)
2	5, 6, 13	Obvious under §103 over <i>Pankaj</i> (EX1005), <i>Payne</i> (EX1006), and <i>Dawson</i> (EX1024)
3	8, 15, 20	Obvious under §103 over <i>Pankaj</i> (EX1005), <i>Payne</i> (EX1006), and <i>Lecerf</i> (EX1027)
4	3, 11, 18	Obvious under §103 over <i>Pankaj</i> (EX1005), <i>Payne</i> (EX1006), and <i>Klumpen</i> (EX1019)
5	1-20	Invalidity under §101

Claims 1, 9, and 16 are the Challenged Independent Claims

Limitation	Claim 1
[preamble]	A computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:
[1A]	generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
[1B]	receiving formation response data comprising data from one or more downhole sensors or surface sensors;
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and
[1D]	controlling an electrical fracturing pump based on the representative system model.

Claims 1, 9, and 16 are the Challenged Independent Claims

Limitation	Claim 9
[preamble]	A system for controlling electrical fracturing equipment for fracturing a well, the system comprising: one or more processors; and a memory comprising instructions to:
[9A]	generate a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
[9B]	receive formation response data comprising data from one or more downhole sensors or surface sensors;
[9C]	select a representative system model based on the received formation response data and sequence of stimuli; and
[9D]	control an electrical fracturing pump based on the representative system model.

Claims 1, 9, and 16 are the Challenged Independent Claims

Limitation	Claim 16
[preamble]	A non-transitory computer readable-medium storing instructions that, when executed by one or more processors, cause the one or more processors to:
[16A]	generate a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
[16B]	receive formation response data comprising data from one or more downhole sensors or surface sensors;
[16C]	select a representative system model based on the received formation response data and sequence of stimuli; and
[16D]	control an electrical fracturing pump based on the representative system model.

Ground 5

The Challenged Claims Are Directed To Patent-Eligible Subject Matter Under 35 U.S.C. § 101

The Claims Of The '058 Patent Are Directed To Patent-Eligible Subject Matter

- Claims 1, 9, and 16 recite an improved technique for **controlling an electrical fracturing pump** used for fracturing a well.
- The claimed technique enables selection of a representative system model that **more accurately reflects the well to which the model is deployed** and thereby provides for **more effective control of the electrical fracturing pump**.
- Petitioners argue that Claim 1 is representative.
- Considered **as a whole**, the claims are **patent eligible** under the *Alice/Mayo* test and the USPTO's Guidance.

Guidance Step 1 – The Claims Of The '058 Patent Fall Within The Statutory Categories Of Invention

- Guidance Step 1 asks: “Is the claim a process, machine, manufacture or composition of matter?” MPEP §2106.03(II).
- There is **no dispute** that Claims 1-20 fall within the statutory categories of invention:
 - Claims 1-8 recite “[a] **computer-implemented method** for controlling fracturing equipment for fracturing a well.”
 - Claims 9-15 recite “[a] **system** for controlling fracturing equipment for fracturing a well.”
 - Claims 16-20 recite “[a] **non-transitory computer readable medium.**”

Guidance Step 2 – The Supreme Court's *Alice/Mayo* Test

- Step 2 of the Guidance “is the Supreme Court’s *Alice/Mayo* test.” MPEP § 2106(III).
- Step 2 is a “two-part test to identify claims that are **directed to** a judicial exception (**Step 2A**) and to then evaluate if additional elements of the claim provide an **inventive concept** (**Step 2B**) (also called ‘**significantly more**’ than the recited judicial exception).”
- **Step 2A** “is a two-prong inquiry:”
 1. Prong One asks whether a claim recites a judicial exception.
 2. If so, Prong Two considers whether the judicial exception is integrated into a practical application.

Guidance Step 2A, Prong One Overview – Claim 1 Is Not Directed To An Abstract Idea

- Claims must be “**considered in their entirety** to ascertain whether their character **as a whole** is directed to excluded subject matter.”
 - *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299, 1312 (Fed. Cir. 2016) (emphasis added).
- Such consideration involves examining the ‘058 Patent’s “**claimed advance.**”
 - *Finjan, Inc. v. Blue Coat Sys., Inc.*, 879 F.3d 1299, 1303 (Fed. Cir. 2018).
- Petitioners argue that Claim 1 is directed to the alleged abstract idea of **selecting a plan for a desired result based on information received in response to one or more inquiries.**
 - Claim 1 does not recite this alleged abstract idea, which is **overbroad** and **untethered to the claim language.**
 - Petitioners **ignore key aspects of the claimed advance** and mischaracterize the ‘058 Patent in contending that Claim 1 merely automates a manual process.
 - The ‘058 Patent’s claims are not directed to an abstract mental process.

Claim 1's Claimed Advance –An Improved Approach For Controlling An Electrical Fracturing Pump

- Petitioners' expert confirmed that "**there is variability from well to well**" and different wells respond differently to fracturing operations.
- The '058 Patent recognized that one problem with using a representative system model is that the "representative system model may be **a static construct** and **may not accurately reflect the well** to which it has been deployed."
- Claim 1 "**as a whole**" is directed to an improved approach for controlling an electrical fracturing pump by **selecting** a representative system model based on **both** a sequence of stimuli applied to a well **and** formation response data such that the model **more accurately reflects the well to which it is applied**, thereby improving fracturing operations.

1. A computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:
generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
receiving formation response data comprising data from one or more downhole sensors or surface sensors;
selecting a representative system model based on the received formation response data and sequence of stimuli; and
controlling an electrical fracturing pump based on the representative system model.

Petitioners' Alleged Abstract Idea Is Overbroad And Untethered To The Claim Language

- The Petition alleges that the claims are directed to the abstract idea of ***selecting a plan for a desired result based on information received in response to one or more inquiries.***
- The Petition's alleged abstract idea has **nothing to do with hydraulic fracturing** and **nothing to do with the control of electrical fracturing pumps.**
- Petitioners **oversimplify** the claims and **ignore their specific requirements**, which is improper.
- The Federal Circuit and the Board have **repeatedly rejected eligibility challenges** where the alleged abstract idea is overbroad and untethered to the claim language.

The “Directed To” Inquiry Depends On An Accurate Characterization Of What The Claims Require

- **Federal Circuit precedent *rejects*** eligibility challenges that rely on abstract ideas untethered to the claim language and that fail to accurately capture the claimed advance:
 - “The Step 1 ‘directed to’ analysis called for by [the Federal Circuit’s] cases depends on an **accurate characterization of what the claims require** and of **what the patent asserts to be the claimed advance**.”
 - *TecSec, Inc. v. Adobe Inc.*, 978 F.3d 1278, 1294 (Fed. Cir. 2020).
 - Describing claims at a “**high level of abstraction** and **untethered from the language of the claims** all but ensures that the exceptions to § 101 swallow the rule.”
 - *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1337 (Fed. Cir. 2016).
 - When **characterized at a high enough level**, all claimed inventions “embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas.”
 - *In re TLI Commc’ns LLC Patent Litg.*, 823 F.3d 607, 611 (Fed. Cir. 2016).
- **The Board has agreed, e.g.:**
 - “[P]ost-grant proceedings have found § 101 arguments deficient . . . where the petitioner asserted an **overgeneralized abstract idea** and **fails to sufficiently tie** that alleged idea to the language of the claims.”
 - *Gain Capital Holdings, Inc. v. Oanda Corp.*, CBM2020-00022, Paper 10 at 26 (P.T.A.B. Mar. 18, 2021).

The Petition Demonstrates That The Alleged Abstract Idea Is Overbroad

- Petitioners' mapping of the **same** alleged abstract idea to **unrelated technologies**—allergy skin tests and wireless probe messages—demonstrates Petitioners' failure to account for the **specific requirements** of Claim 1.
- Petitioners' expert, Dr. Nikolaou, agrees these technologies are **not** within the scope of Claim 1:

Q. Is it fair to say that an allergy skin test would not fall within the scope of Claim 1?

A. So an allergy skin test is not in the scope of Claim 1 -- no, I don't think it's in the scope of it.

Q. Is it fair to say that sending message, any type of message in a wireless communication network, would not fall within the scope of Claim 1?

A. I cannot see the immediate relevance, what you just said about messaging, wireless messaging, within the scope of Claim 1.

Petitioners Ignore The Claimed Advance And Mischaracterize Claim 1 As Automating A Manual Process

- Petitioners' alleged abstract idea entirely omits part of the claimed advance—selecting the system model based on **both** the sequence of stimuli **and** the formation response data.
- Petitioners **mischaracterize** the '058 Patent to contend that the claims “merely automate a method that was . . . previously performed manually.”

⁴ We agree with Patent Owner that the Background does not support a position that claim 1 merely automates a method that was entirely known to be performed manually. *See* Prelim. Resp. 41. At a minimum, the Background does not appear to teach selecting a representative system model based on the sequence of stimuli.

Petitioners' Argument That The Federal Circuit Endorses Characterizing Abstract Ideas Broadly Is Incorrect

- *Plotagraph Inc. v. Lightricks Ltd.*, 2024 WL 223185 (Fed. Cir. Jan 22, 2024), **does not support** Petitioners' position that "[t]he Federal Circuit has repeatedly endorsed characterizing abstract ideas broadly."

Relevant Features of Claim at Issue	Abstract Idea
a method for automating a shifting of pixels within an image file, the method comprising . . . shifting the first set of pixels , in the first image frame, in the first direction;	" Shifting pixels to create the illusion of movement within an image."

- Federal Circuit accepted the abstract idea because it captured the steps involving shifting pixels recited in the claims and the specification "**unambiguously describe[d] pixel-shifting as a way to create the illusion of movement.**"
- *In re Killian*, 45 F.4th 1373, 1379 (Fed. Cir. 2022):

Relevant Features of Claim at Issue	Abstract Idea
a computerized method for determining overlooked eligibility for social security disability insurance (SSDI)/adult child benefits	"a search algorithm for identifying people who may be eligible for SSDI benefits they are not receiving. "

- In *Plotagraph* and *Killian*, the abstract idea **accurately characterized what the claim required and the claimed advance** of the patent.
- Here, the alleged abstract idea of "selecting a plan for a desired result based on information received in response to one or more inquiries" **does neither.**

Claim 1 Is Not Directed To An Abstract Mental Process

- Considered as a whole, **Claim 1 is not directed to an abstract mental process.**
- The mental processes grouping includes “concepts **performed in the human mind** (including an observation, evaluation, judgment, opinion)[.]” MPEP §2106.04(a).
- The Petition **does not allege** that “generating a sequence of stimuli for application to a well environment” can be performed in the human mind.
- Controlling the settings on an electrical fracturing pump **is not something that can be performed in the human mind.**
- The portions of the claim that Petitioners identify as alleged abstract mental processes—selecting a system model based on the received sensor data—**are inextricably tied to steps that involve physically stimulating a given formation in the Earth to determine how the formation responds.**

Petitioners Improperly Shift Theories In The Reply

Petition:

Claim 1 is thus directed to the abstract idea of *selecting a plan* (“representative system model”) *for a desired result* (“controlling” a pump) *based on information received* (“response data”) *in response to one or more inquiries* (“sequence of stimuli”). This type of abstract idea has been employed for years in

Reply:

identified hardware is used in its conventional manner as explained *supra*. The claims here are directed to mere automation of known fracturing steps.

- A reply **may not** “proceed in a new direction with a new approach as compared to the positions taken in a prior filing.” Consolidated Trial Practice Guide (Nov. 2019) (“CTPG”), 74.
 - It is “**improper** for a reply to **present new evidence** (including new expert testimony) that could have been presented in a prior filing[.]” *Id.* (emphasis added).
- Even if considered, the Reply’s new arguments lack merit.

Petitioners' New Theory Still Fails To Show That The Claims Are Directed To An Abstract Idea

- "Automation of a task previously performed by humans . . . **does not mean** the claimed system is necessarily directed to an abstract idea." *EcoServices, LLC v. Certified Aviation Services, LLC*, 830 Fed. App'x. 634, 643 (Fed. Cir. 2020).
- Petitioners' cases do not support their position:
 - *Chamberlain Grp. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1346 (Fed. Cir. 2019):
 - Did not involve "automation" or "automating" an alleged manual process
 - The claim was directed to "wirelessly communicating status information about a system," which was the only difference from the prior art.
 - *cxLoyalty, Inc. v. Maritz Holdings Inc.*, 986 F.3d 1367, 1377 (Fed. Cir. 2021):
 - Claims ruled abstract because they were "directed to transfers of information relating to a longstanding commercial practice."
 - Neither case supports a finding that the claimed method for controlling an electrical fracturing pump for fracturing a well is abstract.

Petitioners' New Reply Arguments About Conventionality Fail

- The Reply includes thirteen pages of new Step One argument alleging that each step of Claim 1, individually, was conventional.
- “[T]he subject matter eligibility analysis under section 101 **is separate and apart** from the novelty and obviousness considerations of sections 102 and 103.” *Dynaenergetics Europe GmbH v. Qinetiq Ltd.*, PGR2023-00003, Paper 19 at 18-19 (P.T.A.B. Apr. 11, 2024).
- “The ‘novelty’ of any element or steps in a process, or even of the process itself, **is of no relevance** in determining whether the subject matter of a claim falls within the § 101 categories of possibly patentable subject matter.” *Intell. Ventures I LLC v. Symantec Corp.*, 838 F.3d 1307, 1315 (Fed. Cir. 2016)
- “Step 2A **specifically excludes** consideration of whether the additional elements represent well-understood, routine, **conventional** activity.” MPEP § 2106.04(d)(I).

Petitioners' Automation Argument Fails To Address The Specific Requirements Of The Claims

- Claim 1 requires “selecting a representative system model based on the received formation response data **and** sequence of stimuli.”
- **Reply:** “Selecting models **based on response data** from an injection test was also well-known and conventional.”
- Neither the Petition nor the Reply account for this aspect of the claims, which is described in the specification:

Response variables (e.g., responsive sensor data values) and respective stimuli (e.g., experimental data) can be used to select, define, and/or construct a representative system model. For example, stimuli and response combination can be mapped to respective system models maintained in an accessible data store. In some examples, a partial model can

- Alleged abstract ideas that “**fail to mention**” a key aspect of the claim are “**untethered**” from the specific requirements of the claims. *Mentone Sols. LLC v. Digi Int’l Inc.*, 2021 WL 5291802, at *6 (Fed. Cir. Nov. 15, 2021).

Guidance Step 2A, Prong Two – Claim 1 Integrates The Alleged Abstract Idea Into A Practical Application

- Considered as a whole, Claim 1 recites additional elements that **integrate the Petition's alleged abstract idea into a practical application**.
- "A claim that integrates a judicial exception into a practical application will apply, rely on, or use the judicial exception in a manner that **imposes a meaningful limit** on the judicial exception." MPEP § 2106.04(d).
- Examples include "[a]n improvement in the functioning of a computer, or **an improvement to other technology or technical field**" and "[a]pplying or using the judicial exception in some other meaningful way." MPEP § 2106.04(d)(I).

Claim 1 Imposes Meaningful Limits On The Petition's Alleged Abstract Idea Of "Selecting A Plan"

"Additional elements" of Claim 1:

generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
receiving formation response data comprising data from one or more downhole sensors or surface sensors;
selecting a representative system model based on the received formation response data and sequence of stimuli; and
controlling an electrical fracturing pump based on the representative system model.

- Considered as a whole, Claim 1's additional elements use the alleged judicial exception in a manner that **imposes a meaningful limit**. MPEP § 2106.04(d).

Claim 1 Imposes Meaningful Limits On The Petition's Alleged Abstract Idea Of "Selecting A Plan"

- The Petition itself demonstrates that Claim 1 imposes a meaningful limit. The Petition argues that the alleged abstract idea "has been employed for years **in multiple environments**," including **allergy skin tests** and **wireless communication systems**.
- "The concern underlying the exceptions to § 101 is not tangibility, but **preemption**." *McRO*, 837 F.3d at 1315.
- Claim 1's method for controlling electrical fracturing equipment does **not** read on, **let alone preempt**, the techniques for allergy skin tests and wireless messaging communication systems.
 - Petitioners' expert, Dr. Nikolaou, agrees these technologies are **not** within the scope of Claim 1:

Q. Is it fair to say that an allergy skin test would not fall within the scope of Claim 1?

A. So an allergy skin test is not in the scope of Claim 1 -- no, I don't think it's in the scope of it.

Q. Is it fair to say that sending message, any type of message in a wireless communication network, would not fall within the scope of Claim 1?

A. I cannot see the immediate relevance, what you just said about messaging, wireless messaging, within the scope of Claim 1.

Claim 1 Improves Fracturing Operations

- Petitioners **do not meaningfully dispute** that the claimed approach improves fracturing operations.
- The Reply merely—but incorrectly—argues that there is no improvement or practical application at Step 2A, Prong 2, “because the limitations **were well-known and used in their conventional manner.**”
- “Step 2A **specifically excludes** consideration of whether the additional elements represent well-understood, routine, conventional activity.” MPEP § 2106.04(d)(I).

Dr. Durham's Testimony Shows Claim 1 Improves Fracturing Operations

139. By stimulating the well with a sequence of stimuli, and then selecting a representative system model based on sensor data *and* the sequence of stimuli, the process of the '058 Patent improves fracturing operations by enabling the selection of a more accurate representative system model to use for controlling an electrical fracturing pump. Using a representative system model that more accurately reflects the well to which it is applied, in turn, results in improved control of the electrical fracturing pump to generate subsurface fractures that are favorable for enhancing the productivity of the well.

Dr. Nikolaou's Testimony Shows Claim 1 Improves Fracturing Operations

Q. Is it desirable to have a representative system model that accurately reflects the well to which it is applied?

...

A. **Yes.** Yes, and let me explain very briefly why.

A representative system model will give answers to questions raised about the particular task. So to the extent that that model can provide answers to these questions, that model would be desirable.

Q. Is it fair to say that knowing how a given well responds to stimuli allows you to better understand how to generate desirable subsurface conditions during fracturing?

A. **It's fair to say that having data from the response of a well to stimuli can help you build a better model that captures the effect of these stimuli on the things that are measured.** A model in the sense that we discussed a few minutes ago of making a mathematical connection between the data.

Dr. Nikolaou's Testimony Shows Claim 1 Improves Fracturing Operations

Q. And building a better model may allow you to generate more desirable subsurface conditions during fracturing?

MR. HOPKINS: Objection. Form.

A. The conditions you build with a better model are not going to be worse than the conditions you would build with a worse model, that's absolutely correct. How different they would be depends.

Q. They may be better?

A. They may be better.

Petitioners' Reply Confirms Claim 1 Integrates The Alleged Abstract Idea Into A Practical Application

- Petitioners' **new** evidence in the Reply regarding step-rate tests ("SRTs") and "mini-frac" testing merely confirms there is **nothing abstract** about altering pump rates, determining a well's response, and controlling a fracturing pump to fracture a well.

1. A computer-implemented method for controlling electrical fracturing equipment for fracturing a well, the method comprising:

generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;

receiving formation response data comprising data from one or more downhole sensors or surface sensors;

selecting a representative system model based on the received formation response data and sequence of stimuli; and

controlling an electrical fracturing pump based on the representative system model.

- Claim 1's features are
 - "events that take[] place in the 3-dimensional world,"
 - "not merely an output or display of information," and
 - are "something more substantial than mere insignificant extra-solution activity."
- *Dynaenergetics Europe GmbH v. Qinetiq Ltd.*, PGR2023-00003, Paper 19 at 21 (P.T.A.B. Apr. 11, 2024).

Claim 1 Integrates The Alleged Abstract Idea Into A Practical Application Even If Some Elements Were Known

- The Board's preliminary view was that "claim 1 seems to cover steps that are **conventional**, or **at least known**, as taught by the Background of the '058 patent and/or Pankaj."
- But step 2A **specifically excludes** consideration of whether the additional elements represent well-understood, routine, **conventional** activity. MPEP § 2106.04(d)(I).
- A proper Prong Two analysis requires giving "weight to all additional elements, ***whether or not they are conventional.***" *Id.*
- "Additional elements that represent well-understood, routine, conventional activity **may integrate a recited judicial exception into a practical application.**" *Id.*

Claim 1 Is Analogous To The Eligible Claims In *EcoServices, LLC v. Certified Aviation Services, LLC*

'058 Patent Claim 1	<i>EcoServices</i> (Claim 1)
an electrical fracturing pump	a washing unit for providing a washing liquid to the turbine engines
generating a sequence of stimuli; and receiving formation response data	an information detector configured to gather information related to engine type
selecting a representative model based on the received formation response data and sequence of stimuli	a control unit configured to accept the information related to engine type . . . and to determine a washing program to be used as a function of the information relating to engine type from a set of preprogrammed washing programs
controlling an electrical fracturing pump based on the representative system model	a control unit configured to . . . regulate the washing unit according to washing parameters associated with the washing program used

- *EcoServices* claim 1 was directed to “**an improved system for washing jet engines**” and not “a result or effect that itself is the abstract idea’ of, e.g., automated jet engine washing.”
- Similarly, '058 Patent claim 1 provides **an improvement to fracturing operations** by providing improved control of electrical fracturing pumps.
- Just because “the claimed system achieves automation of a task previously performed by humans . . . **does not mean the claimed system is necessarily directed to an abstract idea.**” *EcoServices*, 830 Fed. App’x. at 643.

Claim 1 Is Analogous To The Eligible Claims In *Diamond v. Diehr*

Diehr:

- Claims described a physical and chemical process for molding precision synthetic rubber products.
- Claims used a computer to:
 - repeatedly calculate cure time based on sensor data; and
 - signal a device to open a press when the actual time that has elapsed equals the recalculated cure time.
- Claims patent eligible because they improved an existing technological process.
- “[I]ndustrial processes such as this are the types which have historically been eligible to receive the protection of our patent laws.” *Diamond v. Diehr*, 450 U.S. 175, 184 (1981).

'058 Patent:

- Claims cover:
 - physically stimulating a well by generating a sequence of stimuli;
 - eliciting formation response data;
 - selecting a representative system model based on formation response data and sequence of stimuli
- Claimed process similarly ends with controlling an electrical fracturing pump to create favorable subsurface conditions for enhancing well productivity.

Claim 1 Is Analogous To The Eligible Claims In *Diamond v. Diehr*

- Petitioners' reading of *Diehr* is **too narrow**.
- Although the '058 Patent claims do not transform uncured synthetic rubber into a different state, they **similarly solve a practical problem**: control of electrical fracturing pumps to effectively fracture a well.
- Thus, the '058 Patent's claims:
 - transform the way electrical fracturing pumps are operated; and
 - involve physical transformation of a formation (e.g., generation of fractures) through a sequence of stimuli applied to a well environment.

Claim 1 Is Analogous To The Eligible Claims In *Canrig Drilling Tech. Ltd. v. Trinidad Drilling L.P.*

Canrig Claim 1:

1. A drill string drive comprising:
a motor adapted to rotate a drill string;
a sensor adapted to detect [the rotation] *a rotational position* of said drill string at the surface, *wherein the sensor is at the surface*; and
a computer receiving *the rotational* [information] *position* from said sensor, said computer transmitting control signals to said motor, said computer programmed to control said motor to advance said drill string to a pre-determined angle.

- *Canrig* claim 1 was **not** an attempt to “patent the abstract concept of rotation.” It was eligible at Alice step one because the claims “address **specific challenges** in directional drilling through a **concrete process** for controlling the rotation of the long drill strings to and between predetermined angles.” *Canrig*, 2015 WL 5458576, at *4.
- Similarly, '058 Patent claim 1 addresses **specific challenges** in hydraulic fracturing through a **concrete process** for controlling an electrical fracturing pump based on a representative system model selected based on received formation response data and a sequence of stimuli.

Claim 1 Is Analogous To The Eligible Claims In *Nabors Drilling Techs. USA Inc. v. Helmerich & Payne Int'l Drilling Co.*

Nabors Claim 1:

A method of using a quill to steer a hydraulic motor when elongating a wellbore in a direction having a horizontal component, wherein the quill and the hydraulic motor are coupled to opposing ends of a drill string, the method comprising:

monitoring an actual toolface orientation of a tool driven by the hydraulic motor by monitoring a plurality of drilling operation parameters each indicative of a difference between the actual toolface orientation and a desired toolface orientation; and

adjusting a position of the quill by an amount that is dependent upon each of the plurality of the monitored drilling operation parameters.

<i>Nabors</i>	<i>'058 Patent</i>
Claim not directed to "adjusting a device . . . based on monitored parameters."	Claims not directed to "selecting a plan for a desired result based on information received in response to one or more inquiries."
Claim focused on " an improvement in the physical realm , namely an improved method for steering a hydraulic motor using a quill."	Claim focused on an improvement in the physical realm , namely an improved method for controlling an electrical fracturing pump during fracturing operations.
Patent disclosed an improved method for steering that involved parameters that " previously have not been used for automatic toolface orientation."	Patent describes selecting a representative system model for controlling an electrical fracturing pump based on a sequence of stimuli applied to the well and formation response data to the sequence of stimuli, which had not previously been used to select a representative system model.

Claim 1 Is Analogous To Claims Deemed Eligible By The USPTO

- Claim 1 is analogous to eligible Claim 2 in Example 45 in Appendix 1 to the October 2019 Update: Subject Matter Eligibility *Life Sciences & Data Processing Examples* (EX2009):

Limitation [1D]	Example 45 (Claim 2)
controlling an electrical fracturing pump based on the representative system model	send control signals to the injection molding apparatus once the polyurethane has reached a target percentage, the control signals instructing the apparatus to open the mold and eject the molded polyurethane from the mold

- Like Example 45, limitation [1D] of Claim 1 “**adds a meaningful limitation** in that it **employs the information provided by the judicial exception** [*i.e.*, the selected representative system model] . . . to “control[] an electrical fracturing pump based on the representative system model” and thereby achieve more favorable subsurface conditions for fracturing operations.

Claim 1 Is Distinguishable From The Ineligible Claims In *Automation Middleware Solutions* (“AMS”)

AMS Patent	'058 Patent
Related to “interface software that facilitates the creation of hardware independent motion control software.”	Directed to a concrete solution geared toward improving how electrical fracturing pumps are controlled during fracturing operations.
Directed to “abstract idea of ‘a middle translating layer’” that “does not improve the functioning of a computer.”	Claims include steps that occur in the physical world (not just software) : <ul style="list-style-type: none"> • Stimulating a well with a specific sequence of stimuli. • Obtaining formation response data responsive to the sequence of stimuli. • Using both to select a more accurate representative system model to use to control an electrical fracturing pump during fracturing operations.
Claims merely required “translating” inputs from the application program’s language to the drivers’ programming language.	

- Petitioners’ **isolated** focus on the control command and operating a motion control device **overlooks** that the *AMS* claims were directed to the **abstract idea of a middle translating layer**.
- A “middle translating layer” has **no analogue** in '058 Patent Claim 1.

Claim 1 Is Distinguishable From The Ineligible Claims In *Ficep Corp. v. Peddinghaus Corp.*

- Petitioners are incorrect in asserting that the patent ineligible claims in *Ficep Corp.* are akin to Claim 1.

<i>Ficep</i>	'058 Patent
Claimed advance was “ automating a previously manual process of transferring information [intersection parameters] from a CAD design model to a manufacturing machine” to reduce human error.	Does not merely automate a previously manual process to reduce human error.
	Improves fracturing operations by using a representative system model that more accurately reflects the well to which it is deployed.
Claim did not require any “ novel means of garnering the intersection parameters. ”	Uses a novel approach to select a more accurate representative system model—i.e., based on the received formation response data and sequence of stimuli.

TDE Petroleum And FairWarning—Relied Upon In Petition—Are Inapposite Cases

- *TDE Petroleum* merely involved “collecting information” (e.g., mechanical and hydraulic data reported for a well operation” and “analyzing it” (e.g., determining that some data is valid and selecting a state of the well operation). ‘058 Patent Claim 1 recites significantly more.
- *FairWarning* dealt with claims directed “to the concept of analyzing records of human activity to detect suspicious behavior,” which is far afield from the method of controlling electrical fracturing equipment for fracturing a well recited in ‘058 Patent Claim 1
- The Board **agreed** that “*TDE Petroleum Data Solutions* and *FairWarning* are not a perfect fit.”
 - Petitioners **did not dispute this**—or even mention *TDE Petroleum Data Solutions* or *FairWarning*—in the Reply.

Petitioners Failed to Meet Their Burden As To Step 2A, Prong 2

Petition:

in MPEP 2106.04(a). And as to *Guidance* Step 2A, Prong 2, the 058 patent claims do not integrate the abstract idea into a practical application. For the reasons explained, the claims do not reflect an “improvement in the functioning of a computer” but merely use a computer as a tool. MPEP 2106.04(d)(I).

- But improving the functioning of a computer is **not** the only way to integrate an alleged abstract idea. See MPEP § 2106.04(d).

Reply:

Regardless, Step 2A, Prong 2 does not save PO. The limitations do not improve computer performance, nor do they improve another technical field because the limitations were well-known and used in their conventional manner.

- But “[s]tep 2A **specifically excludes** consideration of whether the additional elements represent well-understood, routine, or conventional activity.” MPEP § 2106.04(d)(I).

Petitioners Failed to Meet Their Burden As To Step 2A, Prong 2

- The cases Petitioners rely upon in the Reply are distinguishable.
- ***Ex Parte Fung***, 2019 Pat. App. LEXIS 3189, *31 (PTAB May 1, 2019):
 - Additional claim elements included: (1) computer-implemented method; (2) performing steps by one or more processors; and (3) providing a near-well unstructured grid to a parallel reservoir simulator.”
 - (1) and (2) → apply abstract idea on a computer
 - (3) → **ancillary** to the claimed invention: “**generating** a near-well unstructured grid.”
- ***Ex Parte Allen***, 2022 Pat. App. LEXIS 2811, *16 (PTAB May 26, 2022):
 - Simply involved a “processor, communication interface, and memory.”
- **Additional Elements of ‘058 Patent Claim 1:**
 - Petition does not characterize the “claimed steps of applying a sequence of stimuli and receiving sensor data” as part of the abstract idea.
 - “[C]ontrolling an electrical fracturing pump based on the representative system model” is **not ancillary** to Claim 1’s focus of improved control of electrical fracturing equipment for fracturing a well.

Guidance Step 2B/*Alice* Step 2 – Petitioners Did Not Meet Their Burden To Show No Inventive Concept

- It was Petitioner's burden to prove, in the Petition, that the claims fail to recite an inventive concept.
- The Response explained **how the Petition failed to meet its burden** to show that the claim elements (alone or in combination) recite no more than conventional activity.
- Petitioners' Reply abandons the evidence relied upon in the Petition and instead relies on fifty pages of new expert testimony and seventeen new exhibits, which only **highlights the gaps in the Petition**.
- It is "**improper for a reply to present new evidence (including new expert testimony) that could have been presented in a prior filing . . . to 'gap-fill'** by teaching a claim element that was not present in the prior art presented with the petition." CTPG at 74-75.

Guidance Step 2B/*Alice* Step 2 – The Additional Elements Of Claim 1 Constitute Inventive Concepts

- Claim 1 recites unconventional steps involving generating a sequence of stimuli for application to a well environment, receiving corresponding formation response data, and selecting a representative system model based on **both the formation response data and the sequence of stimuli**. (limitations [1A-C]).
- Claim 1 then controls an electrical fracturing pump based on the selected representative system model.
- These steps **improve** the fracturing operations by enabling the selection of a more accurate representative system model to use for controlling the electrical fracturing pump, which in turn **improves** subsurface conditions for enhancing the productivity of the well.

Guidance Step 2B/*Alice* Step 2 – The Additional Elements Of Claim 1 Constitute Inventive Concepts

- The Petition relied on *Pankaj* and *Gottumukkala* to assert that “[s]timulating a well using ‘one or more particulate concentrations, chemical concentrations, or pump rate control’ . . . was a well-known technique used to determine and simulate well performance.
- Petitioners’ contention that *Pankaj* “discloses sending sequence of stimuli” fails for the reasons discussed with respect to Petitioners’ Ground 1.
- Petitioners’ reliance on *Gottumukkala* is also misplaced.

Gottumukkala Fails To Demonstrate That Claim 1 Was Well-Understood, Routine, And Conventional

Actual Limitation [1A]	Dr. Nikolaou's Simplification
generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;	a sequence of stimuli ... comprising one or more of particulate concentrations, chemical concentrations, or pump rate control

Gottumukkala does not teach the claim element:

[0029] The processor-based control system 44 is able to work with a variety of modules, e.g. software modules, for implementing the flow control valve setting methodology. For example, the real time acquisition and control system/processor 62 may be used in cooperation with a network module 76 which comprises a wellbore network model, e.g. Pipesim, representing the various components of multilateral well completion 20. Additionally, the control system 44 may comprise a deconvolution module 78; and the processor 62 may work in cooperation with the deconvolution software module to perform deconvolution of pressure transient responses to continuous zonal rate changes instigated by the actuation of flow control valves 36. The deconvolution module 78 may utilize a standard/multiwell deconvolution algorithm to process the data.

[0031] Referring generally to FIG. 4, a further explanation of deconvolution module 78 is provided. As sensors 64 provide data, e.g. flow rate and pressure data while the flow areas of the flow control valve 66 are manipulated, the multi-rate data is deconvolved via module 78. Deconvolution of data is a process for manipulating data known to those of ordinary skill in the art as using pressure transient analysis. In this example, the data is deconvolved to estimate near well bore parameters, such as skin, permeability, productivity, and/or other desired parameters. This deconvolved data is then input into the well model, e.g. processed according to network well module 76, for accuracy and optimization. FIG. 4 provides examples of various plots related to the deconvolution data which may be output for viewing on output device 74 or another suitable device. The illustrated examples comprise a log-log deconvolution plot 84 of the data, a semi-log plot 86 of the data, and a historical data plot 88. Various other data plots or display formats may be used to show the deconvolved data.

Gottumukkala Fails To Demonstrate That Claim 1 Was Well-Understood, Routine, And Conventional

- There is **no mention** of particulate concentrations or chemical concentrations in the relied-upon portions of *Gottumukkala*.
- Dr. Durham explains how the **flow rate** described in *Gottumukkala* is **not** the same thing as the claimed **pump rate control**:

142. The sections of Gottumukkala that Dr. Nikolaou cites (paragraphs [0029] and [0031]) do not at all discuss generating a sequence of stimuli for application to a well environment (*i.e.*, a predetermined sequence). Further, these paragraphs discuss manipulation and actuation of control valves and measuring flow responses. This is not at all teaching “particulate concentrations, chemical concentrations, or a pump rate control” as recited in the independent claims of the ’058 Patent. There is no mention of either chemical concentration or particulate concentrations in these paragraphs. Further, manipulating flow rate control valves is not the same as pump rate control. Gottumukkala’s control valves control the rate of flow into the well, and between different well zones of a lateral bore, but does not

impact the rate of the pump. Fracturing pumps are known to be positive-displacement (*i.e.*, plunger) pumps. The flowrate of the pump is directly proportional to the speed (*i.e.*, rate) of the pump, regardless of downstream conditions. Manipulating a valve downstream may cause the flow to go different places in the well, or may change the pressure conditions, but will not affect either the speed or the flowrate of the pump. Thus, while pump rate can influence fluid flow rate in different portions of the wellsite or well, the manipulation of flow control valves in the wellbore does not impact pump rate. A “pump rate control” would have been understood by a POSITA to mean controlling the rate that the pump is operating. Actuating flow control valves is not the same as controlling the rate the pump is operating.

Gottumukkala Fails To Demonstrate That Claim 1 Was Well-Understood, Routine, And Conventional

- *Gottumukkala* **never** mentions a pump anywhere in its disclosure.
- Dr. Nikolaou confirms that *Gottumukkala* discusses flow rate rather than pump rate control:

Q. Okay. If the pump control rate for this site was held constant, then you could still change fluid flow rate between well zones 34 using the fluid control valves, correct?

A. What pump are you referring to?

Q. I presume that this Figure 1 well site would include a pump. Would it not?

MR. HOPKINS: Objection. Form.

A. I don't see a pump here in Figure

1.

Q. So might there not be a pump in Figure 1?

A. I don't see a pump in Figure 1. This is valves that are adjusted to control flow rate.

Selecting A Representative System Model As Recited In Claim 1 Constitutes An Inventive Concept

- Petitioners' have introduced **no evidence** that it was conventional activity in the hydraulic fracturing industry to select a representative system model to use for controlling an electrical fracturing pump based on **both** a particular sequence of stimuli applied to the well **and** the formation response data to the sequence of stimuli.
- As noted by Dr. Durham, Petitioners **do not even address** this aspect of the claims in the Petition's *Alice* step two analysis—despite this part of the claimed advance not being captured in the alleged abstract idea:

143. Further, Dr. Nikolaou points to no additional reference for the limitation of “selecting a representative system model based on the received formation response data and sequence of stimuli” as claimed in the independent claims. As discussed above, *Pankaj* and *Payne* do not disclose or suggest such a

Selecting A Representative System Model As Recited In Claim 1 Constitutes An Inventive Concept

- Petitioners omit this part of the '058 Patent's claimed advance:

– with conventional technology to achieve its desired result”). Here, the claimed steps are performed in a conventional order – apply stimuli, receive data in response, **select a model based on the data**, and use the model to control the pump – using conventional technology, as explained above. *See TDE Petroleum*, 657 F. App’x at 993.

- A proper Step 2B analysis, however, “**considers all claim elements.**” MPEP § 2106.05.
- At most, the Petition relies on *Pankaj*, which fails for the reasons discussed with respect to Petitioners’ Ground 1.
- Even if it did, “[t]he mere fact that something is disclosed in a piece of prior art . . . does not mean it was well-understood, routine, and conventional.” *Berkheimer v. HP Inc.*, 881 F.3d 1360, 1369 (Fed. Cir. 2018).

Petitioners' Reply Fails To Correct The Deficiencies Of The Petition

- The Reply relies on **50 pages of new expert testimony and 17 new exhibits** in its attempt to fill in the gaps of the Petition.
 - For example, the Reply does **not** discuss *Gottumukkala* at all, let alone attempt to show how *Gottumukkala's* manipulation of flow control valves discloses generating a sequence of stimuli.
 - Instead, the Reply relies on 10 new exhibits describing step-rate and mini-frac tests.
- It is “**improper** for a reply to present **new evidence** (including new expert testimony) that could have been presented in a prior filing . . . to ‘gap-fill’ by teaching a claim element that was not present in the prior art presented with the petition.” CTPG at 74-75.
 - Examples of indications that a new issue has been raised in a reply include **new evidence necessary to make out a prima facie case** for the patentability or unpatentability of an original or proposed substitute claim. *Id.* at 74.

Petitioners' Reply Fails To Correct The Deficiencies Of The Petition

- Despite the new evidence, Petitioners still fail to show that it was well-understood, routine, and conventional to select a representative system model based on **both** the received formation response **and sequence of stimuli**, as claimed.
- The Reply purports to show little more than "**model selection based on sensor data.**"
- Accordingly, Petitioners **have not met their burden at Step 2B/Alice Step Two** to show that the additional elements of the independent claims were well-understood, routine, or conventional.

Claim 2, 10, and 17 Are Directed To Patent-Eligible Subject Matter

Limitation	Claim 2
[2A]	The method of claim 1, wherein the representative system model is retrieved from a data store based on the received formation response data.

- The Petition cites Rashid, Fig. 6 and ¶10067, to allege that “data stores for storing well models were well-known in the art.”
- Dr. Nikolaou confirmed that the relied-upon portion of Rashid **does not teach** how models are retrieved, let alone that they are retrieved based on formation response data:

Q. So paragraph 67 of Rashid does not describe how model 626 or 628 are retrieved from mass storage 610, does it?

A. How they're retrieved, in an electronic way. They don't give details, but they just say -- the model is stored and then retrieved. So I don't see anything more specific than that there.

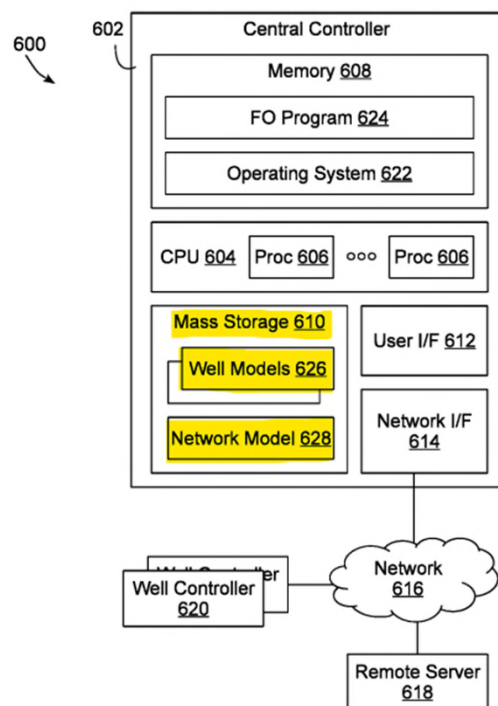


FIG. 6

Claim 2, 10, and 17 Are Directed To Patent-Eligible Subject Matter

Petitioners' Reply:

Claims 2, 10, 17 add that the system model is retrieved “from a data store” based on the response data. A “data store” is merely computer memory. EX-1001 [7:19-21]. The references discussed herein confirm that retrieving models from memory “based on” sensor data was known and conventional. *See* pp. 6-10; EX-1050, ¶¶39-43 (collecting prior art).

- “pp. 6-10” references the Reply’s discussion of the “selecting” step.
- But the Reply’s “selecting” step discussion **does not address how a model is retrieved from memory**, let alone establish that it was conventional to do so “based on sensor data.”

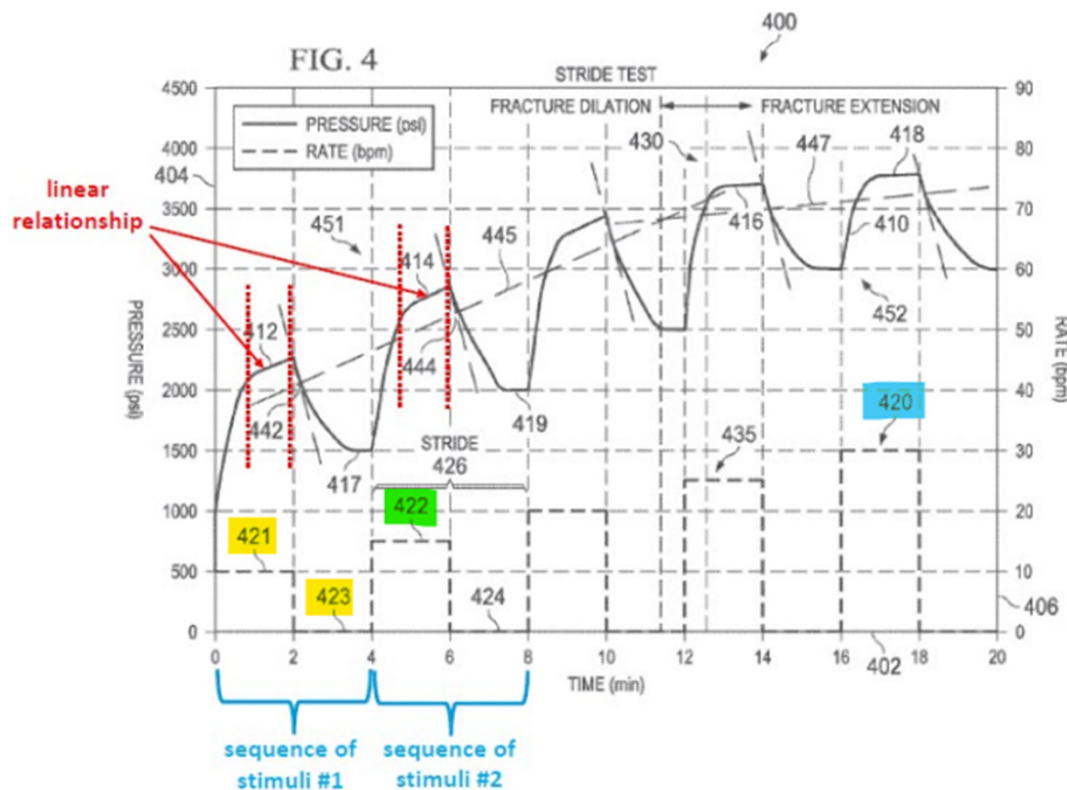
Claim 4, 12, and 19 Are Directed To Patent-Eligible Subject Matter

Limitation	Claim 4
[preamble]	The method of claim 1, wherein selecting the representative model further comprises:
[4A]	determining one of a linear or a non-linear relationship between the sequence of stimuli and received formation response data; and
[4B]	updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

- The Petition failed to show that the *Pankaj-Payne* combination teaches Claim 4 for the reasons discussed in Ground 1.
- The Petition also provided no explanation regarding how *Husen* showed that Claim 4 was conventional. This is **undisputed** in the Reply.
- Instead, the Reply **improperly** relies on new step-rate test evidence, which should not be considered.

Claim 4, 12, and 19 Are Directed To Patent-Eligible Subject Matter

- Even with the new evidence, Petitioners fail to meet their burden in the Reply.



EX-1038, Fig. 4 (annotated)

- EX1038 describes a succession of injection periods (e.g., 421, 422) where the injection rate 420 is **increased** over time across different injection periods.
- Claim 4, however, recites “updating the one of the linear or the non-linear relationship based on multiple **iterations** of **the** generated sequence of stimuli” (i.e., the **same** sequence of stimuli).
- EX1038 does not teach updated “based on multiple iterations of the generated sequence of stimuli.”

Claim 5 and 13 Are Directed To Patent-Eligible Subject Matter

Limitation	Claim 5
[5A]	The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop, the changes in flow distribution used to determine the representative system model.

- The Petition's and Reply's reliance on various combinations of references undermines Petitioners' assertion that Claim 5 was well-understood, routine, and conventional. An **obviousness-type** analysis **fails** to show that claims were **conventional**.
- Further, the Reply merely asserts that it was "commonplace to measure the **pressure** response to diverters," which is not the same as "determine changes in **flow distribution** in response to a diverter drop" and use "the changes in flow distribution . . . **to determine the representative system model.**"
- '058 Patent specification differentiates pressure and flow distribution:

medium, low, etc.). Accordingly, response variables (e.g., responsive sensor data values such as **pressure** or **flow distribution** or microseismic events or strain events) can be measured over time to generate a record of a dynamic formation response.

Grounds 1-4

The Petition Has Not Shown That The
Challenged Claims Would Have Been Obvious

The Petition's Obviousness Grounds

Ground	'058 Patent Claims	Statutory Basis
1	1-4, 6-7, 9-12, 14, 16-19	Obvious under §103 over <i>Pankaj</i> (EX1005) and <i>Payne</i> (EX1006)
2	5, 6, 13	Obvious under §103 over <i>Pankaj</i> (EX1005, <i>Payne</i> (EX1006), and <i>Dawson</i> (EX1024)
3	8, 15, 20	Obvious under §103 over <i>Pankaj</i> (EX1005, <i>Payne</i> (EX1006), and <i>Lecerf</i> (EX1027)
4	3, 11, 18	Obvious under §103 over <i>Pankaj</i> (EX1005, <i>Payne</i> (EX1006), and <i>Klumpen</i> (EX1019)

- Petitioners' obviousness grounds fail because the various combinations of references do not disclose or render obvious the challenged claims.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitations [1A], [1C], and [1D]

Limitation	Claim 1
[1A]	generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and
[1D]	controlling an electrical fracturing pump based on the representative system model.

- Claims 9 and 16 recite similar limitations.

Limitation [1A]— “Generating a Sequence of Stimuli”

Limitation	Claim 1
[1A]	generating a sequence of stimuli for application to a well environment , the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;

- **Sequence** must be an **order of stimuli**
- **Sequence** must be **generated ahead of time**

Limitation [1A]— Sequence must be an Order of Stimuli

- Generating a **sequence** of stimuli for application to a well environment
- **'058 Patent:**

fluid rate, or an adjustment to pressure, etc. Further, stimuli may be modified over a span of time as part of a sequence of stimuli. For example, concentrations of particulates and/

- modified **"over a span of time"**
- sequence is a **"scheduled sequence"**

Stimuli sequence generator and controller 330 includes a stimuli model 324, a stimuli scheduler 326, and a stimuli control 328. Stimuli model 324 may be used to determine which stimuli to produce and/or modify to generate, update, or apply a representative system model. Stimuli scheduler 326 may generate a stimuli sequence based on the stimuli determined by stimuli model 324. Stimuli control 328 may execute the generate stimuli sequence by generating respective commands, based on the scheduled sequence, to provide to pump system interface 314.

- **Dictionary definitions of "sequence":**
 - New Oxford American: "A **particular order** in which related events, movements, or things follow each other."
 - American Heritage: "A following of **one thing after another; succession.**"

Limitation [1A]— Sequence must be Generated Ahead of Time

- Generating a sequence of stimuli **for application to a well environment**
- Claim language “for application to a well environment” **requires the sequence be generated ahead of time**
- **‘058 Patent is consistent:**
 - concentrations can be varied “in **predetermined patterns over time**”
 - sequence is a “**scheduled sequence**”

of stimuli. For example, concentrations of particulates and/or chemicals can be periodically varied in predetermined patterns over time to induce various formation responses detectable via deployed sensors. Electric pumps can be

Stimuli sequence generator and controller 330 includes a stimuli model 324, a stimuli scheduler 326, and a stimuli control 328. Stimuli model 324 may be used to determine which stimuli to produce and/or modify to generate, update, or apply a representative system model. Stimuli scheduler 326 may generate a stimuli sequence based on the stimuli determined by stimuli model 324. Stimuli control 328 may execute the generate stimuli sequence by generating respective commands, based on the scheduled sequence, to provide to pump system interface 314.

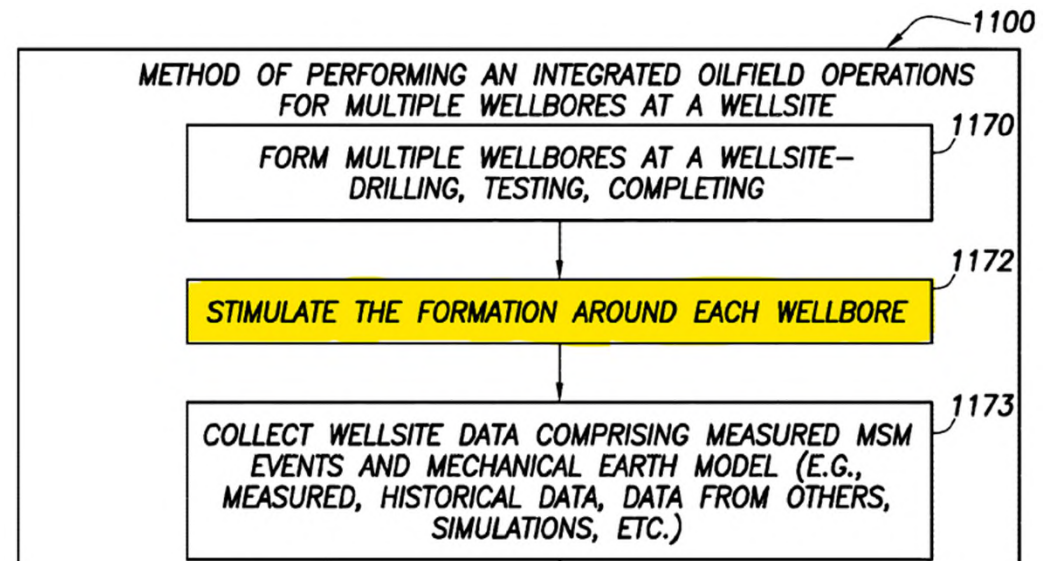
Limitation [1A]—“for application to a well environment” Is Not Intended Use Language

- Petitioners argue that “for application to a well environment” is intended use language, citing cases addressing intended use language in preambles
- But “for application to a well environment” is a **fundamental characteristic** and the **essence** of the claimed invention of the ‘058 Patent.
 - “[T]he ‘**for decoding**’ language ... is properly construed as a claim limitation, and not merely a statement of purpose or intended use for the invention, **because ‘decoding’ is the essence or a fundamental characteristic of the claimed invention.**” *Vizio, Inc. v. Int’l Trade Comm’n*, 605 F.3d 1330, 1340 (Fed. Cir. 2010) (emphasis added).

Limitation [1A]—Pankaj Does Not Disclose Generation of a Sequence of Stimuli

Limitation	Claim 1
[1A]	generating a sequence of stimuli for application to a well environment , the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;

- Petitioners rely solely on *Pankaj*
- “The method 1100 . . . involves 1172 stimulating the formation around each wellbore (e.g., perforating, injecting).”
- Petitioners provide a conclusory statement that a POSITA would understand Pankaj to disclose applying a sequence of stimuli to the well by adjusting one or more properties of the fracturing fluid.
- Ignores the requirement that a “**sequence**” be generated.



Limitation [1A]—Pankaj Does Not Disclose Generation of a Sequence of Stimuli

- Petitioners cite *Pankaj*'s disclosure that "injection may be manipulated by adjusting the material **being injected** and/or the way it **is injected** to achieve the fractures which draws fluid from formations into the wellbore and up to the surface." EX1005 ¶10061 (emphasis added).
- This relates to **starting the fracturing process** and **making adjustments based on how it is proceeding**, as confirmed by Dr. Durham:

as opposed to generating a sequence of stimuli for subsequent application. For example, it discusses manipulating by "adjusting" the material being injected and/or the way it is injected, steps that are taken during a fracturing process or while the fracturing process is being conducted. Moreover, the *Pankaj* disclosure specifically states material "being injected" and the way it "is injected" as opposed to "to be injected." The claim language of the '058 Patent, however, is consistent with "to be injected" (*i.e.*, "for application to a well environment"). There is no disclosure in *Pankaj* of generating a sequence of stimuli for application to a well environment.

- Pankaj does not disclose a **sequence** of stimuli generated **ahead of time**

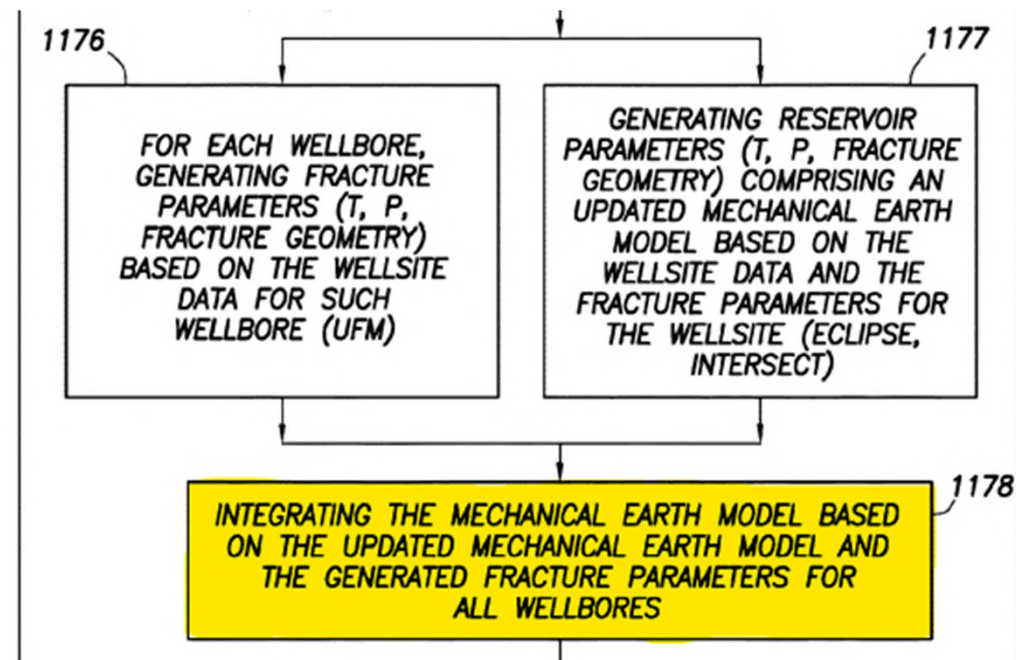
Limitation [1A]—*Pankaj* Table I Fails To Disclose Limitation [1A]

- The Reply newly identifies Table I of *Pankaj* as allegedly showing a “predetermined” pumping schedule.
- But *Pankaj* states “[t]he **simulation** 1200 is generated by inputting wellsite data into the **fracture simulator** to generate fracture parameters. The input wellsite data includes a pumping schedule for one stage **as input for the simulator** as shown in TABLE I below.” ¶[0116] (emphasis added).
- It is merely for simulation.
- It does not describe generation of sequence of stimuli upon which actual formation response data from sensors **is actually received for selection of a representative system model and controlling a fracturing pump.**

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1C]

Limitation	Claim 1
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and

- Petitioners assert that “Pankaj **discloses** this.”
- “**Integrating**” fracture parameters into an updated mechanical earth model does not teach or suggest “**selecting**” the model.
- Petitioners **provide no explanation** as to how integrating fracture parameters into an updated model teaches selecting
- Declaration merely parrots the Petition



Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1C]

Limitation	Claim 1
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and

- **Selecting** a model requires **choosing** a model **out of a number or group** of models.
- **Dictionary** definitions of “**select**”:
 - “to **choose** (as by fitness or excellence) **from a number or group**”
 - “to **take as a choice from among several**”
- ‘058 Patent distinguishes “**selecting**” a model from “**defining**” or “**constructing**” a model:

Response variables (e.g., responsive sensor data values) and respective stimuli (e.g., experimental data) can be used to **select, define, and/or construct** a representative system model. For example, stimuli and response combination *can be mapped to respective system models maintained in an accessible data store*. In some examples, a partial model can be generated based on stimuli and response combinations in order to **select a pre-constructed representative system model most similar to** the partial model.

- Model store 304 **stores** representative system models **available for selection**:

Treatment optimization system 302 includes a model retrieval process 316 for retrieving representative systems models from model store 304.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1C]

Limitation	Claim 1
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and

- Dr. Durham confirms that *Pankaj* does **not** teach “selecting” a representative system model:

the MEM in *Pankaj* is “updated” based on the sensor data.⁸⁹ Updating is not the same process as selecting. Selecting a model requires choosing a model out of a number or group of models. Updating would be part of constructing the MEM, which is a separate process in the '058 Patent. For example, the '058 Patent

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1C]

- The **Reply fails to cure the deficiencies** of the Petition:

⁷ Even if the claims have such a requirement, the petition explains the claim would have been obvious. For example, Pankaj's models are "built-in," see Petition, 53-54, showing that the models are predetermined.

- **Petition:**

Pankaj also discloses that the MEMs may be based on "built-in unconventional hydraulic fracture models like UFM™ (or other unconventional fracture models)." EX-1005, [0075]. A POSITA would have understood that the

- A **UFM is not** a model—it is a software simulator:
 - "Modeling software and/or simulators that may be used, such as UFM™[.]" EX1005 at ¶[0031].
- Any reliance on a "built-in" model is **inconsistent** with Petitioners' theory to satisfy limitation [1D] that it is *Pankaj's updated mechanical earth model* that is selected and used to control the pump.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1C]

Limitation	Claim 1
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli ; and

- Petitioners' mapping:
 - Pankaj's "wellsite data" → "received formation response data"
 - Pankaj's "fracture parameters/stimulating step" → "sequence of stimuli"
- No suggestion in *Pankaj* that any alleged "selecting" is **based on both sets of data**—i.e., formation response data **and** sequence of stimuli.
- The "fracture parameters" referenced in *Pankaj* ¶[0105]—the paragraph relied upon to allegedly teach selecting a model based on both "wellsite data" and "fracture parameters and stimulation step"—are "**conductivity, pressure in fractures, temperature.**"
- These are explicitly **downhole conditions** and are **not a sequence of stimuli**.
- *Pankaj* ¶[0105] relates to UFM **simulation** techniques—not selecting a representative system model.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Limitation [1D]

Limitation	Claim 1
[1D]	controlling an electrical fracturing pump based on the representative system model.

- Dr. Nikolaou confirmed that *Pankaj* step 1182 relied on for limitation 1[D] relates to **production operations—not controlling a fracturing pump**:

Q. Dr. Nikolaou, I believe you testified earlier that step 1182 of Figure 11 of *Pankaj* related to production operations as opposed to controlling a fracturing pump, is that right?

A. That is correct, yes.

Q. Earlier today counsel asked you whether step 1182 of Figure 11 of *Pankaj* related to the production operations as opposed to controlling a fracturing pump, is that right?

And you responded: That is correct.

Is that consistent with your declaration?

A. Yes.

Q. During step 1182, are there changes to how a fracturing pump is controlled?

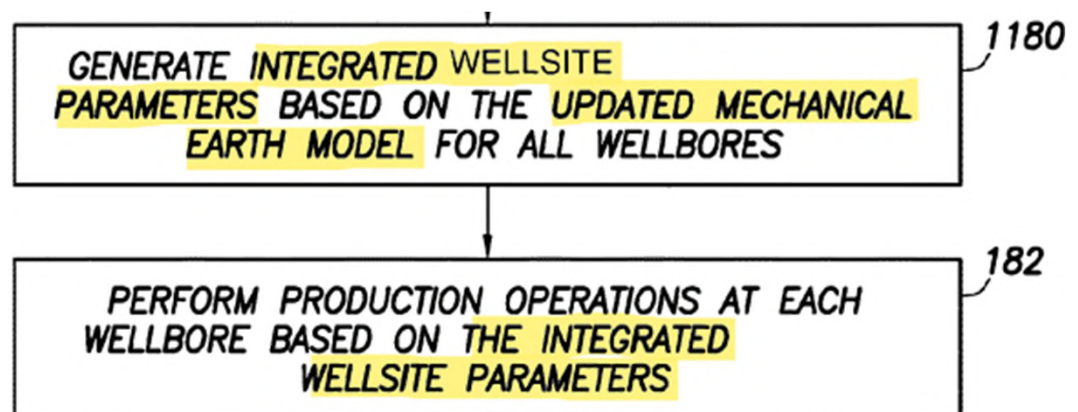
A. Oh, in step 1182, the fracturing pump is no longer at play because fracturing has already been completed. It has been already performed. And 1182 refers to performing production operations.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 2, 10, and 17

Limitation	Claim 2
[2A]	The method of claim 1, wherein the representative system model is retrieved from a data store based on the received formation response data.

- Petition relies on **existing** MEM in *Pankaj* ¶[0099]:
- In the Reply Petitioners point to disclosure about *Pankaj*'s UFM, which is **a software simulator**.
- In the Reply Petitioners again point to *Pankaj*'s MEM, which is **an existing model**
- Neither aligns with Petitioners' invalidity theory, which **relies on the "updated mechanical earth model"** allegedly being selected to satisfy limitation [1D].

[0099] The wellsite may also include a mechanical earth model (MEM). The MEM may be a model that is provided, or may be calculated from the other wellsite data. The MEM is a numerical representation of the geomechanical state of the wellsite (e.g., reservoir, field, and/or basin). In addition



Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 2, 10, and 17

- Dr. Durham’s testimony confirms that *Pankaj* is deficient:

103. Further still, Dr. Nikolaou points to a single section of *Pankaj* generally describing “computer facilities for receiving, storing, processing, and/or analyzing data from the operation”¹¹⁸ as teaching “retrieving the model from a data store based on the received formation response data” as claimed. However, there is no support for Dr. Nikolaou’s conclusory statement. There is no retrieving step in *Pankaj*. Further, Dr. Nikolaou does not even attempt to explain how this statement teaches retrieving “based [on] the received formation response data.” This is no surprise since there is no disclosure in *Pankaj* teaching this claim element.

104. Dr. Nikolaou’s analysis of Claim 2 seems to be that there is a computer in *Pankaj*, and therefore a POSITA would understand that there is disclosure of each of the elements of Claim 2. Claim 2 requires more than just a computer, it requires retrieving the representative system model from a data store based on the received formation response data. Neither *Pankaj* nor *Payne* suggest this limitation.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

Limitation	Claim 4
[preamble]	The method of claim 1, wherein selecting the representative model further comprises:
[4A]	determining one of a linear or a non-linear relationship between the sequence of stimuli and received formation response data ; and
[4B]	updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

- Petitioners, without analysis, allege that equations (1)-(5) of *Pankaj* represent a **linear** relationship between the sequence of stimuli and received formation response data.
- Equations (1)-(5) are **not linear** equations.
- **Reply** suggests (1)-(5) **may not be linear equations**, but Petitioners **cannot reverse their invalidity theory** in the Reply. 37 CFR 42.104(b)(4); *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1357 (2018); CTPG, 74.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

Equations (1)-(5):

$$(1) \quad \frac{\partial q}{\partial s} + \frac{\partial(H_{\beta}\bar{w})}{\partial t} + q_L = 0$$

$$(2) \quad \frac{\partial p}{\partial s} = -\alpha_0 \frac{1}{\bar{w}^{2n'+1}} \frac{q}{H_{\beta}} \left| \frac{q}{H_{\beta}} \right|^{n'-1}$$

where

$$(3) \quad \alpha_0 = \frac{2K'}{\phi(n')^{n'}} \cdot \left(\frac{4n'+2}{n'} \right)^{n'}; \phi(n') = \frac{1}{H_{\beta}} \int_{H_{\beta}} \left(\frac{w(z)}{\bar{w}} \right)^{\frac{2n'+1}{n'}} dz$$

$$(4) \quad w(x,y,z)=w(p(x,y),H,z)$$

$$(5) \quad \int_0^t Q(t)dt = \int_0^{L(t)} H(s, t)\bar{w}(s, t)ds + \int_{H_L} \int_0^t \int_0^{L(t)} 2g_t ds dt dh_t$$

Linear Equation:

$$a_1x_1 + a_2x_2 + \cdots a_nx_n + C = 0$$

where

$a_1, a_2, \dots a_n, C$ are coefficients comprised of real numbers

$x_1, x_2, \dots x_n$ are variables or unknowns

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

- Equations (1)-(5) do not show any relationship **between the sequence of stimuli and formation response data**
- The equations show the relationship between the wellsite data (which Dr. Nikolaou says is the formation response data) and the flow rate **inside** the fracture or **physical characteristics** of the fracture
 - (1) relates flow rate **inside** the fracture to dimensions of the fracture
 - (2) describes laminar flow **inside** the fracture
 - (3) addresses laminar flow **inside** the fracture
 - (4) not a true equation; shows **width inside** the fracture is function of height, location, depth of the fracture
 - (5) represents a volume balance of fluid **inside** the fracture
- **None** show any relationship of flowrate at output of pump or other **potential sequence of stimuli**

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

- Dr. Durham explains that Equations (1)-(5) do not represent **any** relationship between formation response data and a sequence of stimuli:

not the sequence of stimuli. Moreover, instead of showing a relationship between the sequence of stimuli applied to the well and the received formation data, as discussed above, Equations 1-5 show the relationship between the wellsite data (alleged by Dr. Nikolaou to be the formation response data) and the physical characteristics of the fractures. *Pankaj* states with respect to step 1176 utilizing Equations 1-5 that the method involves for each wellbore “generating fracture parameters *based on wellsite data*.”¹³¹ The equations do not show a relationship between formation response data and the sequence of stimuli. In addition, as discussed above, the mere allegation that *Pankaj*’s reference to a “nonlinear system of equations” somehow discloses a nonlinear relationship between formation response data and the sequence of stimuli is just that – a mere allegation without any explanation or support. There is no such disclosure in *Pankaj*.

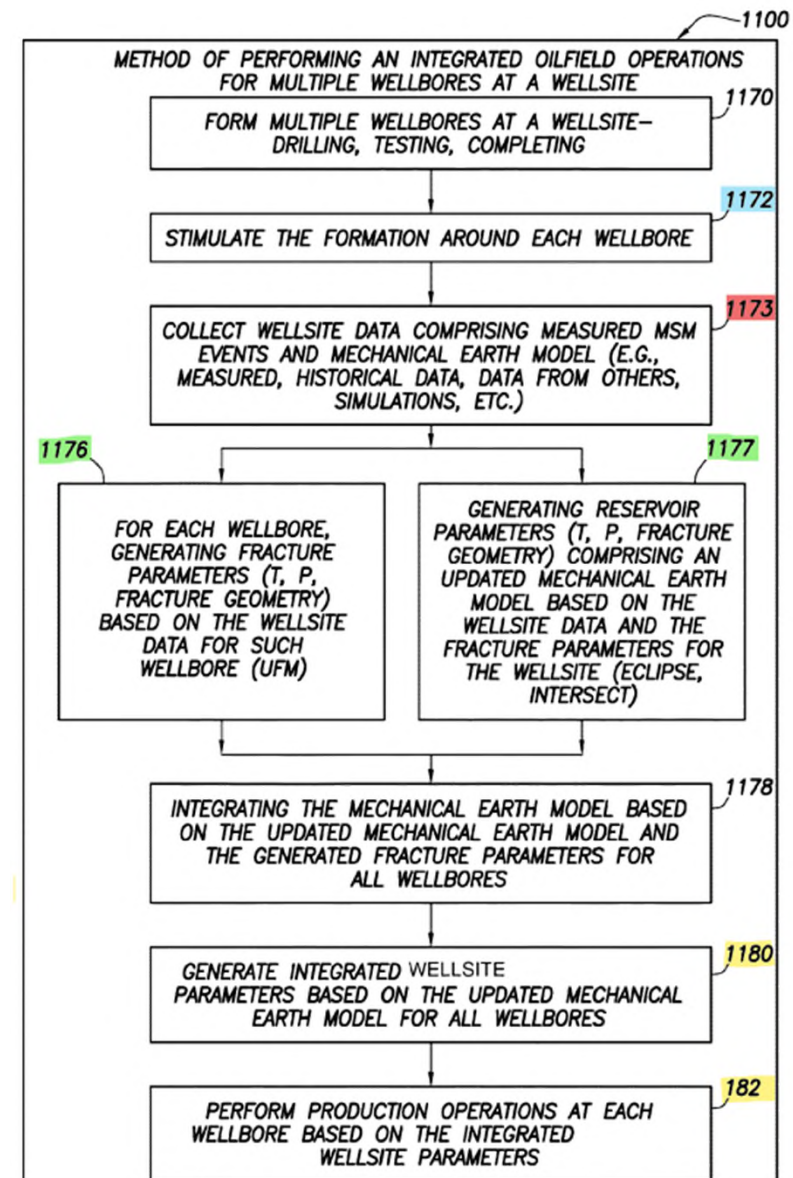
Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

- With respect to a “non-linear relationship,” Petitioners rely on *Pankaj* ¶[0111]:
governing equations. Combining these equations and discretizing the fracture network into small elements may lead to a nonlinear system of equations in terms of fluid pressure p in each element, simplified as $f(p)=0$, which may be solved by using a damped Newton-Raphson method.
- But claim requires **determining** one of a linear or non-linear relationship **between the sequence of stimuli and received formation response data**
- Petitioners provide **no support** (other than a cite to the expert declaration, which merely copies the paragraph from the Petition) that this discloses a non-linear relationship **between sequence of stimuli and received formation response data**.
- Further, Petitioners **ignore** the “**determining**” requirement altogether.

Ground 1—The *Pankaj-Payne* Combination Does Not Disclose Or Render Obvious Dependent Claims 4, 12, and 19

Limitation	Claim 1/4
[1A]	generating a sequence of stimuli for application to a well environment, the sequence of stimuli comprising one or more of particulate concentrations, chemical concentrations, or a pump rate control;
[1B]	receiving formation response data comprising data from one or more downhole sensors or surface sensors;
[1C]	selecting a representative system model based on the received formation response data and sequence of stimuli; and
[4B]	updating the one of the linear or the non-linear relationship based on multiple iterations of the generated sequence of stimuli.

- Petition points to 1180 and 1182 for **updating**
- Petition makes **no attempt** to explain **why or how** steps 1180 and 1182 **relate in any way** to equations (1)-(5), especially in view of their relation to steps 1172, 1173, and 1176-77 relied upon for limitations [1A-C].



Dependent Claims 4, 12, and 19—Petitioners' Reply Fails To Cure The Deficiencies Of The Petition

- After the PO Response noted the lack of explanation or relevance of Figure 4.2 to updating the alleged linear/non-linear relationship, the Reply attempts to explain such relevance.
- The Reply's Claim 4 discussion is all attorney argument **without any expert support**.
- Additionally, Petitioners' reliance on Fig. 4.2 is misplaced as it shows "simulations to design operations:"

permeability reservoirs. An example workflow for using simulations to design operations to facilitate production is depicted in FIG. 4.2.

- Dr. Durham also explains how Pankaj **fails to describe any "updating"** of an alleged linear or non-linear relationship:

mentioned above for future models."¹³³ At most, what Pankaj is teaching is using the relationships described by Pankaj (i.e., the equations) at different locations in the fracture, and perhaps at different times, to calculate the size and location of the fractures. There is no explanation of how the "relationships" (i.e., equations) change (they do not), they are just calculated using different values for the inputs. Thus,

there is no updating of the relationships disclosed or suggested.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ground 2—The *Pankaj-Payne-Dawson* Combination Does Not Disclose Or Render Obvious Dependent Claims 5 and 13

Limitation	Claim 5
[5A]	The method of claim 1, wherein the data from the one or more downhole sensors or surface sensors is used to determine changes in flow distribution in response to a diverter drop , the changes in flow distribution used to determine the representative system model.

- Petition states it would have been obvious to combine *Dawson* with *Pankaj* for **2 reasons**:
 1. To allow for a “more effective assessment of the diverter” which may be used to **“improve the use of diverters”** and **“to improve diverters in *Pankaj*”**
 - But *Pankaj* **does not relate to the use of diverters and never mentions using a diverter**
 2. Because using *Dawson*’s effectiveness technique in *Pankaj* “would result in a more accurate representation of **any well with a diverter**”
 - Again, *Pankaj* does not describe a well with a diverter. It would not be obvious to monitor the effectiveness of a diverter in a system that **does not even describe the use of a diverter**.