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Paper 42
Date: June 8, 2016

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WESTERNGECO, L.L.C.,
Petitioner,

v.

PGS GEOPHYSICAL AS,
Patent Owner.

Case IPR2015-00311
Patent 6,906,981 B2

Before JUSTIN BUSCH, MITCHELL G. WEATHERLY, and BEVERLY M. BUNTING, *Administrative Patent Judges.*

BUSCH, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. BACKGROUND

WesternGeco, L.L.C. ("Petitioner") filed a Petition requesting an *inter partes* review of claims 31–38 of U.S. Patent No. 6,906,981 B2 ("the '981 patent") on November 26, 2014. Paper 1 ("Pet."). On June 8, 2015, the Board instituted an *inter partes* review of claims 31–38. Paper 15 ("Dec. on Inst."), 14. PGS Geophysical AS ("Patent Owner") filed a Patent Owner Response ("PO Resp.") on October 2, 2015. Paper 23. On November 20, 2015, Petitioner filed a Reply ("Pet. Reply") to the Patent Owner Response. Paper 31. We authorized the filing of a Surreply, Paper 34, which Patent Owner filed on December 18, 2015. Paper 35. Oral hearing was held on March 2, 2016.[1]

The Board has jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 31, 32, and 35–37 are unpatentable, but has failed to do so for claims 33, 34, and 38.

A. Related Proceedings

Petitioner states that the '981 patent is involved in *WesternGeco LLC v. Petroleum Geo-Services, Inc.*, Civ. Action No. 4:13-cv-02725 (S.D. Tex.). Pet. 8. The '981 patent is also the subject of two co-pending *inter partes* reviews, IPR2015-00309 and IPR2015-00310.

B. The '981 Patent (Ex. 1001)

The '981 patent is directed to methods and systems for seismic surveying, including firing at least two energy sources in multiple firing

[1] The record includes a transcript of the oral hearing ("Tr."). Paper 41.

sequences.[2] Ex. 1001, Abstract. Each firing sequence includes firing each of the physically spaced apart sources with selected time delays between firing each source and recording signals detected by a seismic sensor system. *Id.* The delay time between firing successive sources is varied from one firing sequence to the next. *Id.* The systems and methods index the firing times of each source in order to enable separately identifying recorded activity attributable to each of the separate sources. *Id.*

According to the '981 patent, "[p]rior art methods for using two or more spaced apart sources . . . include firing the first source, and waiting before firing the second source a sufficient amount of time such that signals detected by the sensors resulting from firing the first source have substantially attenuated." *Id.* at 5:51–56. The near-simultaneous[3] firing of multiple sources creates interference because the shots overlap with each other. *See id.* at 5:56–60. In order to glean useful data from the mixed results, the data attributed to each source must be separated out. *See id.* at 6:29–33. Assuming the data can be sorted properly, near-simultaneous shooting provides surveyors with more data per sensor streamer than when using a single source. *See id.* at 10:52–56. Additionally, near-simultaneous

[2] Source, energy source, and seismic energy source are used interchangeably within the art and throughout this decision. Firing, actuating, and activating also are used interchangeably within the art and throughout this decision.
[3] Simultaneous and near-simultaneous are used interchangeably within the art and throughout this decision, unless otherwise indicated by context. *See* Tr. 15:8–12, 17:1–18:15, 44:15–20; Deposition of Dr. Ikelle (Ex. 2002), 18:23–19:10. These terms indicate simultaneously recording seismic event data from multiple sources, such that the recording needs to have a way to separate the data contributed from each source. *Id.* at 44:15–20.

shooting may increase surveying efficiency by reducing the time necessary to wait between firing sources. *Id.* at 10:56–64.

C. Illustrative Claim

Independent claim 31, which is the only independent claim and is illustrative of the subject matter, is reproduced below:

> 31. A method for determining signal components attributable to a first seismic energy source and to a second seismic energy source in signals recorded from seismic sensors, the first and second sources and the sensors towed along a survey line, the first source and the second source fired in a plurality of sequences, a time delay between firing the first source and the second source in each firing sequence being different than the time delay in other ones of the firing sequences, the method comprising:
>
> determining a first component of the recorded signals that is coherent from shot to shot and from trace to trace;
>
> time aligning die recorded signals with respect to a firing time of the second source in each firing sequence; and
>
> determining a second component of the signals that is coherent from shot to shot and from trace to trace in the time aligned signals.

D. Asserted Grounds of Unpatentability

We instituted review based on Petitioner's allegation that claims 31, 32, and 36–38 are anticipated 35 U.S.C. § 102 by de Kok[4] and claims 31–37

[4] Robbert Jasper de Kok, U.S. Patent No. 6,545,944 B2 (Apr. 8, 2003) (Ex. 1003) ("de Kok").

would have been obvious under 35 U.S.C. § 103(a) in view of Beasley[5] and Edington.[6]

Petitioner submitted testimonial evidence from Dr. Luc T. Ikelle, Ex. 1002, in support of its Petition. Patent Owner submitted testimonial evidence from Dr. Walter S. Lynn, Ex. 2001, in support of its Response. Patent Owner also submitted the transcript of Dr. Ikelle's deposition, Ex. 2002, with its Response. Petitioner submitted the transcript of Dr. Lynn's deposition, Ex. 1022, with its Reply.

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms of an unexpired patent are given their broadest reasonable interpretation in light of the specification in which they appear and the understanding of others skilled in the relevant art. *See* 37 C.F.R. § 42.100(b). Applying that standard, we interpret the claim terms of the '981 patent according to their ordinary and customary meaning in the context of the patent's written description. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007) (quoting *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc)). We construe only those claim terms or phrases in controversy, and we do so only to the extent necessary to resolve the controversy. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

[5] Craig J. Beasley et al., U.S. Patent No. 5,924,049 (July 13, 1988) (Ex. 1004) ("Beasley").
[6] Bruce L. Edington, U.S. Patent No. 4,953,657 (Sept. 4, 1990) (Ex. 1006) ("Edington").

Petitioner initially argued for a specific construction of "wavelet time" as "the duration of the source signature." Pet. 14–15. For purposes of the Decision on Institution, we preliminarily construed wavelet time consistent with Petitioner's proposed construction. Dec. on Inst. 14–15. Now, with the full record before us, we determine an explicit construction of "wavelet time" is not necessary to resolve this controversy. Petitioner does not clearly set forth a proposed construction for any other term in its Petition.

Patent Owner argues for specific constructions of "quasi-randomly" and "randomly." PO Resp. 15–19. The constructions of "quasi-randomly" and "randomly" are not in dispute, and an explicit construction is not necessary to resolve the controversy; accordingly, we do not provide an explicit construction of "quasi-randomly" or "randomly." Therefore, we determine there is no need to construe explicitly any term for purposes of this decision.

B. Asserted Anticipation of Claims 31, 32, and 36–38 by de Kok

Petitioner challenges claims 31, 32, and 36–38 under 35 U.S.C. § 102 as anticipated by de Kok. Pet. 16–24. Petitioner argues de Kok discloses every limitation of claims 31, 32, and 36–38 of the '981 patent, and includes claim charts mapping a portion of de Kok to each recited limitation. *Id.*

1. De Kok

De Kok is a United States patent directed to "method[s] of seismic surveying and seismic data processing using a plurality of simultaneously recorded seismic-energy sources." Ex. 1003, Abstract. De Kok uses activation sequences to allow separation of simultaneously recorded data from multiple seismic sources into source records, each of which includes data of seismic signals from only one source. *Id.* Each simultaneous

recording of data from multiple seismic sources (i.e., data resulting from one activation sequence) in de Kok is a shot record. *Id.* at 4:47–50. De Kok takes multiple shot records, separates the contributions from each source for each shot, and combines the contributions from each source for all of the shot records to generate a source record for each source that "contain[s] energy responsive to the individual seismic sources." *Id.* at 4:50–55.

2. Independent Claim 31

With respect to the preamble, Petitioner asserts Figures 2, 4, and 5A of de Kok, and the related description, disclose towing two spaced apart energy sources and a seismic sensor system and firing the sources in a series of firing sequences, where the time delay between firing the sources varies from one sequence to the next. *Id.* at 19–21 (quoting Ex. 1003, 3:38–39, 4:32–35, 5:23–24, 5:36–39, 6:18–23, Figs. 2, 4, 5A). Petitioner argues de Kok's description of separating the simultaneous recording of the energy from the various energy sources in seismic processing using common mid-point ("CMP") gathers meets the recited steps of "determining a first component of the recorded signals that is coherent from shot to shot and from trace to trace," and, post-alignment, determining a second component that is coherent from shot to shot and trace to trace. *Id.* at 21, 22 (quoting Ex. 1003, 4:47–55). Petitioner contends de Kok's description of reversing the polarity for each shot dependent upon the time delays for the sources meets the recited step of "time aligning recorded signals with respect to a firing time of the second source in each firing sequence." *Id.* (quoting Ex. 1003, 6:41–48). Petitioner further explains that de Kok's polarity decoding "is a form of time-alignment because the polarities are a direct function of the time delays." *Id.* at 22 (citing Ex. 1002 ¶¶ 100–102, 129).

Patent Owner argues de Kok fails to teach any of the three steps recited by claim 31. PO Resp. 19–26. For the reasons discussed below, we agree with Patent Owner that Petitioner has not demonstrated de Kok discloses the step of time aligning the "recorded signals *with respect to a firing time of the second source* in each firing sequence," as recited in independent claim 31.

As mentioned above, Petitioner argues de Kok's polarity decoding "is a form of time-alignment because the polarities are a direct function of the time delays." Pet. 21–22; Pet. Reply 4, n.1. Patent Owner argues Petitioner's "attempts to show anticipation by a purportedly 'analogous' process in de Kok fails." PO Resp. 21. Patent Owner points to the '981 patent's description of the process as applying delays to recorded signals so each recorded signal has the same time delay relative to a reference time, and argues the "time-aligning" step requires time-shifting the recorded traces "such that the firing of the second source takes place at the same time in each of the time-aligned traces." *Id.* at 21–22 (citing Ex. 1001, 8:61–67; Ex. 2001 ¶¶ 69, 72). Patent Owner asserts de Kok fires its sources at chosen times to create matched pairs of firings so that it does not need to align the sources in order to separate them. *Id.* at 22 (citing Ex. 1003, Fig. 5; Ex. 2001 ¶¶ 140, 142, 143).

We agree with Patent Owner that de Kok's polarity encoding and decoding process does not disclose the "time aligning" step. As Patent Owner argues, de Kok describes a polarity encoding and decoding system that does not align the "recorded signals with respect to a firing time of the second source in each firing sequence." Specifically, de Kok explains that it uses activation sequences and polarity to generate signals, from which

"source records may be derived" "using a combination of shot record summations, inversions and filtering." Ex. 1003, 2:51–53; *see also id.* at 4:55–5:4, 5:55–65. To the extent de Kok discusses time delay encoding, any arguable time alignment applies to the firing of the sources, not the recorded signals. *Id.* at 5:66–6:2, 6:41–52. Accordingly, Petitioner has not pointed to persuasive evidence that de Kok's polarity encoding and decoding discloses the "time-aligning" step.

Petitioner also argues a person of ordinary skill would understand that de Kok inherently discloses using "normal move-out correction ('NMO') to time align seismic signals prior to summing them," because NMO correction would be necessary to separate sources in the common mid-point domain. *Id.* at 4. Patent Owner counters that NMO correction is not the same as time-alignment. Surreply 2. Specifically, Patent Owner asserts "NMO correction does not adjust or align firing times; rather, it 'stretches' the time scale of each trace, according to a complex equation, to cancel out the travel time of seismic reflections from the source to the receiver." *Id.* (citing Ex. 2029, 635).

Petitioner has not presented persuasive evidence that NMO correction involves aligning recorded signals with respect to the firing time of the second source. Rather, the evidence submitted indicates that NMO correction "stretches a reflection pulse." Ex. 2029, 635. At oral argument, in response to questions regarding what NMO correction aligns, counsel for Petitioner stated, without citing evidence, that NMO "is aligning to the seismic events." Tr. 70:10; *see id.* at 72:19–21 ("You are aligning the times of the seismic events. There's the time shifting so that the seismic events can all be summed."). After further questions, counsel for Petitioner asserted

NMO correction involved aligning signals with respect to a firing time because "there's a time shift . . . that is reflective of the firing time as well." *Id.* at 71:20–21.

Petitioner has not pointed to any persuasive evidence that NMO correction has any relationship to the firing times of the source, let alone that NMO correction aligns the recorded signal "with respect to the firing time of the second source." Accordingly, Petitioner has failed to demonstrate, by a preponderance of the evidence, that de Kok anticipates claim 31, or claims 32 and 36–38, which depend therefrom.

C. Asserted Obviousness of Claims 31–37 in View of Beasley and Edington

Petitioner challenges claims 31–37 under 35 U.S.C. § 103(a) as obvious over Beasley and Edington. Pet. 37–45; Pet. Reply 6–20.

1. Beasley (Ex. 1004)

Beasley is a United States patent directed to systems and methods "for acquiring and processing seismic survey data from two or more seismic sources activated simultaneously or nearly simultaneously." Ex. 1004, Abstract. Beasley discusses sorting traces according to CMP gathers and filtering data to obtain useful seismic data from each source independent from each other source. *Id.* Beasley explains that, if each of the seismic sources are fired simultaneously rather than sequentially, the "sources may be arranged to emit encoded wavefields using any desired type of coding." *Id.* at 7:54–58.

2. Edington (Ex. 1006)

Edington is a United States patent describing seismic surveying using a series of shots in which each shot includes activating multiple sources

nearly simultaneously "with a determinable time delay between the activation of each source for each shot." Ex. 1006, Abstract. Edington explains that the time delays allow separation of the recorded signals based on the source even when the sources are activated substantially simultaneously. *Id.*

3. Independent Claim 31

Petitioner contends that Beasley discloses each of the limitations of claim 31 with one exception. In particular, Beasley does not disclose explicitly using the recited time delays to encode the signals from each source even though it "discloses that any desired type of encoding could be used for simultaneous or near simultaneous source activation." Pet. 35–36. Petitioner argues Edington teaches a specific type of encoding, specifically time delay encoding. *Id.* Petitioner argues it would have been obvious to employ Edington's known time delay encoding with Beasley's known system, in order to achieve a predictable result of being able to attribute data recorded from simultaneous or near simultaneous source activations to specific sources. *Id.* at 35–36, 37–38. Petitioner provides claim charts mapping portions of Beasley and Edington to each recited limitation of claim 31. *Id.* at 38–41.

Patent Owner does not argue the combination of Beasley and Edington fails to teach any limitations recited in independent claim 31.[7]

[7] Patent Owner responded to an apparent argument by Petitioner that Beasley itself taught time delay encoding. Surreply 3 (citing Pet. Reply 10). Nevertheless, Petitioner confirmed that the portion of the Reply cited by Patent Owner was merely an argument that the hardware in Beasley was capable of implementing the asynchronous timing taught by Edington. Pet.

Patent Owner, however, argues a person of ordinary skill in the art would not have combined Beasley and Edington. PO Resp. 28–37. Patent Owner also argues "[o]bjective indicia such as long-felt but unmet need, industry praise, and copying form an important component of the obviousness analysis" that "strongly support a conclusion of nonobviousness." *Id.* at 42–48.

As mentioned, Patent Owner does not dispute Petitioner's assertion that the combination of Beasley and Edington describes each element of independent claim 31, but merely asserts that an ordinarily skilled artisan would not have combined Beasley and Edington. *See* Paper 16, 3 ("The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived."). Accordingly, upon reviewing the record developed during trial, we are persuaded by Petitioner's position regarding the relevant teachings of Beasley and Edington and address in detail only the disputed issues relating to the combinability of Beasley and Edington.

Petitioner argues an ordinarily skilled artisan designing seismic surveying systems would look to both land and marine technology and, further, that Beasley's hardware is capable of implementing Edington's time-delay encoding. Pet. Reply 11–12. Patent Owner does not contest

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Reply 10 ("Beasley itself taught POSA that its system *could be used* with such asynchronous sources") (emphasis added); Tr. 21:14–24 ("[T]he argument here . . . is that Beasley is set up for time delays . . . there's no express teaching in Beasley of a varying time delay . . . that's what we use Edington for . . . [Figures] 7 and 8 just show[] that Beasley is set up to handle time delays.").

those assertions.[8] We have reviewed the evidence and Petitioner's arguments, and we are persuaded by Petitioner's uncontested assertions that a person of ordinary skill would have looked to land surveying technology when designing marine surveying systems and that Beasley's hardware is capable of encoding its seismic signals using time delays.

The relevance of Patent Owner's argument that "encoding and decoding would be considered together" is unclear. *See* PO Resp. 28–30. Patent Owner asserts the parties agree that encoding and decoding are "inextricably intertwined," that references need to be considered in their entirety, and that Dr. Ikelle's failure to consider Beasley's or Edington's decoding schemes results in inadequate analysis by Dr. Ikelle. *Id.* Patent Owner contends Dr. Ikelle's analysis is incomplete because he did not explicitly consider the decoding schemes used in Beasley or Edington. Patent Owner does not argue Dr. Ikelle is unqualified, and does not explain persuasively why Dr. Ikelle's failure to consider the decoding schemes would render his consideration of Beasley's and Edington's teachings incomplete. Because the parties acknowledge that encoding and decoding schemes are intertwined, it follows that an ordinarily skilled artisan would

[8] Petitioner misinterpreted an argument in Patent Owner's Response regarding the non-combinability of Edington's techniques with Beasley's system as being based on incompatibility of land and marine seismic surveying technology. Pet. Reply 7–9. Patent Owner clarified its position at oral argument that it does not contest Petitioner's assertions that land seismic surveying technology is relevant to marine seismic surveying and that Beasley's hardware is capable of implementing Edington's time delay encoding. Tr. 31:7–10 ("And so this is not a case about whether one would look to the land and the water together. This is not a case about whether there is some ability to do time delay using the equipment of Beasley").

have understood the ramifications of using any known encoding/decoding scheme and the need to use complementary encoding and decoding schemes.

To the extent Patent Owner is arguing Edington's decoding scheme requires taking multiple shots from the same source location, we are unpersuaded. Petitioner's challenge relies on Edington for its teaching that time-delays can be used to encode and decode signals. Based on the arguments and evidence presented during trial, we are persuaded by Petitioner that a person having ordinary skill would have used time-aligning signals, as taught by Edington, as a type of decoding without needing to take multiple shots from the same source. Accordingly, a person having ordinary skill would have been able to decode a signal for a given encoding scheme, and we find Patent Owner's assertion that an ordinarily skilled artisan would "lack[] an effective decoding scheme" unpersuasive.

Patent Owner asserts there would have been no reason for an ordinarily skilled artisan to combine Edington with Beasley because: (1) Beasley's reference to "any type of coding" excludes time-delay encoding; (2) Beasley teaches either alternating or *exactly* concurrent firing of its sources; and (3) Edington is incompatible with Beasley because Edington's timing method would cause smearing. PO Resp. 26–37; Surreply 3–6. Petitioner, on the other hand, argues a person having ordinary skill in the art would have combined Beasley's teaching of simultaneous or near-simultaneous shooting of multiple sources with Edington's teaching of using time-delay encoding because Beasley teaches that any type of coding can be used with Beasley's system, and both Beasley and Edington address encoding and decoding seismic signals and simultaneous shooting of multiple sources. Pet. 38; Pet. Reply 7–17.

Beasley expressly discloses an embodiment where its "leading and trailing sources may be arranged to emit encoded wavefields using any type of coding," and both seismic energy sources are "activated concurrently instead of sequentially." Ex. 1004, 7:54–58. The issue in dispute is what Beasley means by "using any type of coding" and "activated concurrently instead of sequentially."

Patent Owner explains that Beasley discloses two embodiments—a first embodiment in which leading and trailing sources are fired alternately (with no overlap in recording the signals from the separate sources, generating a separate shot record or data set for each source), and a second embodiment in which two sources are fired simultaneously and "dip filtered" to separate the signals of each source from the other. PO Resp. 10–12 (citing Ex. 2001 ¶¶ 122, 124). Patent Owner acknowledges that Beasley's first embodiment "includes a prophetic disclosure that source signature encoding using 'encoded wavefields' could allow the sources 'to be activated concurrently instead of sequentially.'" *Id.* at 11 (quoting Ex. 1004, 7:54–58). Patent Owner also states that U.S. Patent No. 5,717,655 ("the '655 patent"), of which Beasley is a continuation-in-part, "disclosed and claimed the first embodiment." *Id.* at 11 n.1.

Patent Owner points to a portion of Beasley that states coding may be used to activate the respective sources "concurrently instead of sequentially," resulting in an advantage of subsurface incident points having "improved commonality *since there is no time shift* and therefore no spatial reflection point smearing between successive leading and trailing source activations." PO Resp. 32 (quoting Ex. 1004, 7:59–61); Ex. 2001 ¶ 188. Patent Owner also cites a description of Beasley in a later-filed patent stating

Beasley discloses an embodiment where "the several sources can be activated *exactly concurrently*, in which case the sources are then arranged to emit signature-encoded wavefields." PO Resp. 32–33 (quoting Ex. 2015 ("Herkenhoff"), 2:16–18); Ex. 2001 ¶ 191. Patent Owner further asserts the use of time delay encoding would result in a "plain" wavefield, rather than an encoded wavefield, because "the acoustic output of the source is not intrinsically identifiable." PO Resp. 33. Patent Owner contends the submitted evidence supports an understanding that Beasley discloses firing its seismic sources either sequentially or at exactly the same time, which avoids spatial reflection point smearing due to improved commonality.

Patent Owner argues that, even if a skilled artisan would have considered incorporating Edington's time delays into Beasley's marine seismic surveying system, that person would not have made the proposed combination because it would introduce an unacceptable level of spatial reflection point smearing. PO Resp. 34–36 (citing Ex. 2001 ¶¶ 194–195). Patent Owner argues that Beasley teaches away from using Edington's time delays because "Beasley expressly teaches that it would be an 'advantage' to *avoid* this loss of resolution, which it calls 'spatial reflection[-]point smearing.'" PO Resp. 37 (quoting Ex. 1004, 7:59–63; Ex. 2001 ¶ 196).

Petitioner explains Figure 7 of Beasley depicts both timer 26, which is used to introduce delay 29 to source ST relative to SL, and decoders 31 and 33, which Petitioner argues supports its proposed combination. Pet. Reply 12 (citing Ex. 1004, Fig. 7). Petitioner references a portion of Beasley's specification describing Figure 7 that states source SL is activated after a delay relative to ST and, "[i]f the recorded reflected acoustic wavefields were encoded, of course optional decoders 31 and 33 . . . would be inserted."

Id. (quoting Ex. 1004, 7:64–8:27). Petitioner also quotes a portion of Beasley that states the sources may be "fired simultaneously ***or nearly simultaneously***," and asserts Beasley's reference to activating sources "concurrently" would be understood by an ordinarily skilled artisan to include nearly concurrently, much the same as simultaneous would be understood to include nearly simultaneous. *Id.* at 12–13 (citing Ex. 1004, 8:47). Petitioner contends a person having ordinary skill would have combined Beasley and Edington because: (1) both references "address multishooting, encoding, and decoding"; (2) Edington teaches one type of encoding that could have been used with Beasley's system; and (3) it would have been within the level of ordinary skill to use Edington's time delays with Beasley's system to achieve the predicted result of isolating source signals. Pet. Reply 13–14 (citing Ex. 1002 ¶¶ 239–244).

The relevant passages cited by both parties demonstrate that Beasley distinguishes between alternating and concurrent firings. *See, e.g.*, Ex. 1004, 7:52–63. Although Herkenhoff states that the concurrent disclosure in Beasley means "exactly concurrently," Patent Owner has not pointed to any clear disclosure in Beasley itself indicating "concurrently" should be understood as excluding any amount of time delay. Petitioner, however, has pointed to multiple references where Beasley explains that sources may be fired "simultaneously or nearly simultaneously." Pet. Reply 12 (citing Ex. 1004, 8:46–47); Pet. 38 (quoting Ex. 1004, 1:19–25 ("The present invention, in certain aspects, is directed to seismic survey systems and methods in which two or more seismic sources are fired simultaneously, or significantly close together temporally . . . .")); *see also* Ex. 1004, 1:47–51, 8:44–47, 9:5–10, 12:26–29. Moreover, claim 1 of the '655 patent, which

Patent Owner asserts claims the "first embodiment" of the '981 patent, recites a method including the step of "*substantially simultaneously* launching a first acoustic wavefield," from the leading source, "the first wavefield being characterized by a first unique code and launching a second acoustic wavefield" from the trailing source, "the second acoustic wavefield being characterized by a second unique code." Ex. 2009, 6:46–53. Accordingly, Beasley does not exclude time delay encoding from its disclosed "concurrent" activation embodiments.

Patent Owner's argument that time delay encoding results in a plain wavefield rather than an encoded wavefield and, therefore, using time delay encoding would not fall within Beasley's "any type of coding," is similarly unpersuasive. Patent Owner fails to address that Beasley distinguishes between "a signal with no encoded feature, individual identifier, tag, discriminating feature, or separate signature" and "signals that can be discriminated from each other due to *some identifying characteristic, parameter*, signature or feature." Ex. 1004, 9:67–10:8 (emphasis added). Accordingly, the evidence supports Petitioner's contention that time delay encoding generates signals with an identifying parameter or characteristic (the timing) that would allow the signals to "be discriminated from each other." Pet. Reply 11–12. Furthermore, Dr. Lynn acknowledged that "Edington's time delay source coding is 'a type of source signature encoding.'" *Id.* (quoting Ex. 1022, 148:18–23).

Beasley clearly states that "no time shift" results in "no spatial reflection-point smearing." Ex. 1004, 7:61–62. Both parties agree that some amount of spatial reflection point smearing would result from using Edington's time delay encoding with Beasley's seismic surveying system.

See Tr. 28:3–8, 38:14–15 (counsel for Patent Owner stating that "frankly, any time you have a time delay at all, there is spatial reflection point smearing"). However, neither party pointed us to evidence explaining the relationship between the amount of delay and the amount of smearing, or how much smearing would be tolerated in marine seismic surveying.

One consequence of the lack of evidence on this point is that it is unclear whether Beasley is stating that simultaneous activation versus *sequential* activation avoids smearing or if simultaneous activation versus *near-simultaneous* activation avoids smearing. Beasley's disclosure regarding the benefit of eliminating smearing immediately follows the discussion that distinguishes between sequential and concurrent source activation. Based on the record before us, we find Beasley indicates that simultaneous (or near-simultaneous) activation of sources avoids the smearing that otherwise results when activating the sources sequentially. Ex. 1004, 7:52–63.

Furthermore, Patent Owner has not argued, and we do not find, that claim 31 should be construed to exclude any amount of spatial reflection point smearing.[9] The parties have pointed to no evidence or argument explaining sufficiently why the level of smearing resulting from Petitioner's proposed combination of Beasley and Edington would be unacceptable, but the level of smearing resulting from the time delay encoding recited in the '981 patent would be acceptable. Therefore, to the extent that incorporating

[9] When asked whether the subject matter of the '981 patent suffered from spatial reflection point smearing because of its use of time delays, counsel for Patent Owner stated "I do think it suffers it to some degree." Tr. 41:14–15.

Edington's time delay encoding into Beasley's system generates reflection point smearing, the evidence does not support a finding that claim 31 excludes any amount of smearing. Based on the record before us, we are not persuaded the smearing allegedly introduced by combining Edington's time delay encoding with Beasley's system would have led an ordinarily skilled artisan away from that combination.

Patent Owner also argues objective indicia support a finding of nonobviousness. PO Resp. 55–60. The factual inquiries for obviousness include secondary considerations based on evaluation and crediting of objective evidence. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). However, to accord substantial weight to objective evidence requires the finding of a nexus between the evidence and the merits of the claimed invention. *In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). "Nexus" is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988). The burden of showing that a nexus exists lies with the patent owner. *Id.*; *see In re Paulsen*, 30 F.3d 1475, 1482 (Fed. Cir. 1994).

Patent Owner points to various prior attempts (including Edington, Beasley, and de Kok) to conduct simultaneous shootings in a marine environment and the failings of each of them. *Id.* at 43–44. Patent Owner also points to various published papers allegedly "investigat[ing] data processing techniques for use with data sets modeled on [the '981 patent]'s varied time delays" and field trials and studies allegedly using the '981 patent's "time-delay acquisition and indexing methods." *Id.* at 44–48.

Petitioner argues Patent Owner has shown no nexus between Patent Owner's proffered secondary considerations and the invention of the '981 patent. Pet. Reply 20–22. Petitioner contends Patent Owner's focus on the varied time delays of claim 31 is insufficient because time delayed encoding "existed long before the '981 patent." *Id.* We agree with Petitioner that Patent Owner has not demonstrated sufficiently a nexus between the secondary considerations and the alleged novelty of claim 31. First, as Petitioner points out, and as borne out by the evidence in this case, time delay encoding for seismic surveying existed prior to the '981 patent. *E.g.*, Exs. 1006, 1021. Second, the majority of the evidence cited by Patent Owner focuses on the randomness of the time delays, not just the use of time delays generally. Consequently, Patent Owner has not presented persuasive evidence or analysis linking the claims at issue with the alleged "long-felt but unmet need, industry praise, and copying." *See* PO Resp. 55.

Based on the record before us, we conclude Petitioner has demonstrated by a preponderance of the evidence that independent claim 31 would have been obvious in view of the teachings of Beasley and Edington.

4. Dependent Claims 32–37

Petitioner argues the combination of Beasley and Edington teaches each recited limitation of claims 32–37. Pet. 31–35. Patent Owner argues claims 32–37 are patentable for the same reasons asserted with respect to independent claim 31 and further argues Petitioner failed to show that the combination of Beasley and Edington teaches the additional limitations recited in dependent claims 33, 34, 36, and 37.

a) Claims 33 and 34

Claims 33 and 34 depend from claim 31 and further recite that "the delay between firing the first source and firing the second source is varied" quasi-randomly (claim 33) or randomly (claim 34) "between each firing sequence." Petitioner asserts:

> [o]nce one of ordinary skill selects the known source signal encoding option of time interval variation, selecting the time intervals at random, pseudo-randomly, or based on a predetermined correlation were all obvious variants, the selection of which was well within the skill of one having ordinary skill in the art prior to the earliest filing date claimed by the '981 patent.

Pet. 43 (citing Ex. 1002 ¶¶ 259, 319). Petitioner further argues "Edington specifically contemplates ways to utilize random aspects of time delays that are unavoidable." *Id.* at 44 (quoting Ex. 1006, 4:46–50). Petitioner argues Dr. Lynn "agreed that systematic, random, and quasi-random variations were all known design choices within the skill of POSA." Pet. Reply 18.

Patent Owner argues Beasley does not disclose time delay variation at all and Edington discloses varying delays according to a formulaic pattern. PO Resp. 38. Patent Owner contends Petitioner never articulates a reason an ordinarily skilled artisan would incorporate Edington's time delays into Beasley's system, "then immediately discard Edington's recommendation to use a non-random sequence of time delays." *Id.* at 39. Patent Owner asserts Edington's preferred variation of delays by a constant amount was to simplify the decoding scheme. *Id.* at 40 (citing 2001 ¶ 201).

Petitioner never asserts that the proposed combination teaches random or quasi-random variations in the time delays. Instead, as pointed out by Patent Owner, Petitioner merely argues that such delays would have been

options available to a designer of the proposed system, and selecting random or quasi-random variations would have been a design choice. PO Resp. 39 (citing Ex. 2002, 109:12–16, 158:2–11); *see* Pet. 43–44; Pet. Reply 18. Petitioner's challenge lacks any meaningful discussion of whether there were only a limited number of options or *why* an ordinarily skilled artisan would have selected random or quasi-random variations.

Finally, Petitioner's argument that Edington uses unavoidable random time delays is also unavailing. The relevant portion of Edington states "for sources which exhibit considerable random variation in operation from the selected activation time, the true time of activation should be measured and recorded to improve the accuracy of the separation process." Ex. 1006, 4:46–50. As Patent Owner contends, that disclosure of Edington merely teaches it is possible to compensate for undesired random variations and does not teach varying a time delay randomly or quasi-randomly, as recited in claims 33 and 34. Moreover, the evidence of secondary considerations submitted by Patent Owner (Exs. 2007, 2017, 2019–2021, 2023–2025) discussing the import of using random or incoherent variations supports a finding of nonobviousness. Accordingly, we find Petitioner has not demonstrated, by a preponderance of the evidence, that claims 33 and 34 would have been obvious in view of the teachings of Beasley and Edington.

b) Claims 36 and 37

Patent Owner argues the combination of Beasley and Edington fails to teach the limitations in claims 36 and 37 relating to using CMP gathers to determine shot to shot coherence. PO Resp. 41–42. Specifically, Patent Owner argues neither Beasley nor Edington teaches that determining shot to shot coherence includes using a CMP gather as part of that process and, an

ordinarily skilled artisan would not use CMP gathers as part of determining shot to shot coherence, even if that person combined the teachings of Beasley and Edington. *Id.* Patent Owner contends that a CMP gather in Beasley would result in both sources being coherent, and a CMP gather in Edington would attenuate, but not render incoherent, a second source's signal. *Id.* at 42 (citing Ex. 2001 ¶¶ 213–214).

Petitioner asserts Patent Owner's arguments "ignore[] the basic teachings of Beasley, and the prior art in general." Pet. Reply 19. Petitioner argues Beasley teaches using CMP gathers. *Id.* (citing Ex. 1004, 4:22–23; Ex. 1022, 103:16–104:7). Petitioner further contends it is a "basic principle" of seismic surveying that variable time delays would render a second source incoherent. *Id.* (citing Ex. 1022, 57:13–19).

We are persuaded by Petitioner's arguments and evidence that Beasley teaches determining shot to shot coherence includes using CMP gathers. Ex. 1004, 4:16–23 (explaining that, to separate the sources' data, Beasley updates the system with one source's geometry and the data is "sorted to order" in the CMP domain); Ex. 1022, 58:8–13 (Dr. Lynn stating, in 1987, that they found "when we sorted the data into" CMP geometry, "that second source was no longer coherent").

Based on the record, Petitioner has demonstrated, by a preponderance of the evidence, that claims 36 and 37 would have been obvious in view of the teachings of Beasley and Edington.

5. Dependent Claims 32 and 35

Petitioner argues the combination of Beasley and Edington teaches each recited limitation in dependent claims 32 and 35. Pet. 43, 44. Patent Owner argues only that dependent claims 32 and 35 are patentable for the

same reasons asserted with respect to independent claim 31. *See* Paper 16, 3 ("The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived."). We have reviewed Petitioner's arguments and evidence with respect to claims 32 and 35, and find them persuasive. Accordingly, we find claims 32 and 35 would have been obvious in view of the combined teachings of Beasley and Edington for the same reasons discussed above with respect to claim 31 and for the respective reasons asserted by Petitioner for claims 32 and 35.

6. Summary

Based on the record developed during trial, we are persuaded Petitioner has demonstrated, by a preponderance of the evidence, that claims 31, 32, and 35–37 would have been obvious in view of the combination of Beasley and Edington. Petitioner, however, has failed to demonstrate, by a preponderance of the evidence, that claims 33 and 34 would have been obvious in view of the teachings of Beasley and Edington.

III. CONCLUSION

Petitioner has demonstrated, by a preponderance of the evidence, the unpatentability of claims 31, 32, and 35–37 as obvious in view of Beasley and Edington. Petitioner has not demonstrated, by a preponderance of the evidence, the unpatentability of: (1) claims 31, 32, and 36–38 of the '981 patent as anticipated by de Kok; and (2) claims 33 and 34 as obvious in view of Beasley and Edington.

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 31, 32, and 35–37 of the ’981 patent are held *unpatentable*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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