Trials@uspto.gov
571-272-7822

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 IPR2015-00310
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 23–30 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 23–30. 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 23, 24, and 28–30 are unpatentable, but has failed to do so for claims 25–27.

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 IPR2015-00311.

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

> 23. A seismic surveying system, comprising:
> a first seismic energy source;
> a second seismic energy source;
> at least one seismic sensor array;
> a vessel adapted to tow the first seismic source, to tow the at least one seismic sensor array, and to tow the at least one second source at a selected distance from the first source; and
> a controller adapted to actuate the first source and the energy source in a plurality of firing sequences, the sequences having a time delay between firing the first source and the second source which varies between successive firing sequences, the times interval of firing the first and second source indexed so as to enable separate identification of seismic events originating from the first source and seismic events originating from the second source in detected seismic signals.

D. Asserted Grounds of Unpatentability

We instituted review based on Petitioner's allegation that claims 23, 24, and 30 are anticipated 35 U.S.C. § 102 by de Kok[4] and claims 23–29

[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 "indexed," "quasi-randomly," and "randomly." PO Resp. 15–21. 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." With respect to Patent Owner's proposed construction for "indexed," it is important to view the term in the context that it is used in the claim. Accordingly, for purposes of this decision and as discussed further below, we provide an explicit construction for "the times of firing the first and second source *indexed* so as to *enable separate identification of seismic events* originating from the first source and seismic events originating from the second source in detected seismic signals" (the "indexed" limitation).

Petitioner argues "'indexed' simply means that 'you have to save . . . your time delay,' i.e., that the times are recorded." Pet. Reply 5 (citing Ex. 2002, 182:13–15). At oral argument, Petitioner stated it previously argued the "ordinary and customary meaning" of "indexed" is "selecting time delays." Tr. 72:24–73:15 (citing Ex. 1002 ¶ 83). Patent Owner contends "'indexed' means 'recorded with respect to a known time reference,' not merely 'selected,' and that de Kok neither discloses nor

requires indexing the source firing times." Surreply 1 (citing PO Resp. 16–18, 25–29). Patent Owner argues "the claim language makes indexing a feature of separating identification of seismic events." PO Resp. 16–17. Accordingly, Patent Owner argues the term "indexed" requires "recording the firing times for subsequent use in processing," not just selecting firing times. *Id.* at 17. Patent Owner cites to the specification of the '981 patent as support for its position. *Id.* (citing Ex. 1001, 5:62–67, 6:37–7:39, Fig. 4). Specifically, the identified passage from the '981 patent states:

> A recording is made of the signal detected by the sensors that is indexed to a known time reference with respect to time of firing the first source. The second source (or array) is then fired at a known, selected time delay after the firing of the first source, while signal recording continues.

Ex. 1001, 5:62–67.

We agree with Patent Owner that the "indexed" limitation requires more than merely "selecting" times. Petitioner offers no explanation how Dr. Ikelle's testimony that "indexed" should be construed broadly to mean "selected," Ex. 2002, 184:8–11, would be consistent with the rest of the limitation that requires enabling separate identification of events originating from different sources. Patent Owner's proposed construction, however, is unduly narrow to the extent it requires recording.

As explained in the passage cited by Patent Owner, recording the signal and indexing are two separate aspects of the process involved in the '981 patent. Ex. 1001, 5:62–67 ("A *recording* is made of the signal . . . that is *indexed to* a known time reference with respect to time of firing of the first source) (emphases added). The '981 patent demonstrates that the term "indexed" is used in the "indexed" limitation according to one of its ordinary

meanings that one thing is arranged in reference to another. *Id.*; *see also id.* at 6:66–7:1 ("[A] time of firing of each source with respect to a time index" is shown in Figure 4.), 8:33–40 ("[W]hen time is indexed with respect to the firing time of source A," source B events are not coherent between firing sequences.).

Patent Owner also argues "enabl[ing] separate identification of seismic events originating from the first source and seismic events originating from the second source in detected seismic signals" requires each seismic event to be separately identifiable from each other seismic event. *See* PO Resp. 22–25. Patent Owner asserts the "indexed" limitation requires identification of "the individual seismic events corresponding to one firing of one source." *Id.* at 24 (citing Ex. 2001 ¶¶ 162–163).

Petitioner does not dispute that de Kok fails to teach separate identification of each seismic event from each firing of each source, but asserts Patent Owner's argument "improperly reads the word 'individual' into claim 23." Pet. Reply 3. Petitioner argues the "indexed" limitation requires only discriminating between sources, not separate identification of each seismic event. *Id.*

The '981 patent discloses removal of both random and coherent noise, resulting in traces that "substantially represent seismic signals resulting only from" one particular source. Ex. 1001, 7:53–8:25. As discussed above, Petitioner demonstrates that de Kok generates "source records," that result in data from only one particular source. Ex. 1003, 4:47–55. To the extent the '981 patent contemplates identifying individual traces from each firing of each source, we decline to import that limitation into the claim. Accordingly, Patent Owner's proposed construction is narrower than the

broadest reasonable construction. *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1369 (Fed. Cir. 2003); *see also Superguide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) ("Though understanding the claim language may be aided by the explanations contained in the written description, it is important not to import into a claim limitations that are not a part of the claim. For example, a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment."). In particular, as argued by Petitioner, we note that the relevant portion of claim 23 recites that the indexed firing times "enable separate identification of *seismic events originating from the first source* and *seismic events originating from the second source* in detected seismic signals." We read that phrase to require only that the events originating from one source can be identified (using the indexed firing times) separately from the events originating from a second source, and decline to narrowly construe the phrase to require that individual seismic events resulting from each firing of each source can be separately identified from each other.

For the reasons discussed above, we construe the "indexed" limitation to mean determining the sources' firing times with respect to a known reference time so that a later processing step may distinguish seismic events originating at a particular source from seismic events originating at all other sources.

B. Asserted Anticipation of Claims 23, 24, and 30 by de Kok

Petitioner challenges claims 23, 24, and 30 under 35 U.S.C. § 102 as anticipated by de Kok. Pet. 15–22. Petitioner argues de Kok discloses every

limitation of claims 23, 24, and 30 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 23

Petitioner asserts Figures 2 and 4 of de Kok, and the related description, disclose a seismic survey system with a vessel towing two spaced apart energy sources and a seismic sensor system, as required by claim 23. *Id.* at 19–20 (quoting Ex. 1003, 4:32–35, 5:23–24, Figs. 2, 4). Petitioner argues de Kok’s general description of simultaneous recording of the energy resulting from the activation sequences used to fire its plurality of energy sources and the disclosed exemplary activation sequences meet the claimed requirement of actuating each of the two energy sources in a plurality of firing sequences, and that a controller is necessary to fire the seismic sources using “programmed time delays.” *Id.* at 20 (quoting

Ex. 1003, 2:42–50; Ex. 1002 ¶ 118); Reply 6–7. Petitioner further contends that the exemplary firing sequences demonstrate that de Kok's time delays, between the firing of the first and second sources, vary from shot to shot. *Id.* at 21 (citing Ex. 1003, 6:18–23, Fig. 5A). Finally, Petitioner argues de Kok's disclosure of using activation sequences that enable the recorded seismic energy in the shot recordings to be separated into one record per source constitutes indexing the firing times "so as to enable separate identification of seismic events originating" from each source as claimed. *Id.* (quoting Ex. 1003, 2:47–50); Pet. Reply 4. Petitioner asserts the "indexed" limitation does not require separately identifying each individual seismic event. Pet. Reply 3. Thus, Petitioner asserts de Kok discloses each limitation recited in claim 23.

Patent Owner argues de Kok fails to teach the "indexed" limitation, as recited in claim 23.[7] PO Resp. 22–29. Specifically, Patent Owner contends de Kok does not use firing times to enable separate identification of each of the sources from the recorded signal. PO Resp. 26–27. Rather, Patent Owner asserts, two of every four of de Kok's shots in a sequence occur at a reference time and the other two occur at a fixed alternate time, and that the interval between the firing times does not matter as long as it is constant. *Id.* at 27. Patent Owner further argues de Kok's system only needs to record the reference time on which the firing times of each shot are based, not the specific timing of each shot, to generate its resulting signals. *Id.* at 28–29.

[7] We do not address the parties' contentions regarding whether de Kok records firing times because we do not construe the "indexed" limitation to require recording, for the reasons discussed above. *See* PO Resp. 26–28; Pet. Reply 4–5; Surreply 1–3.

Patent Owner argues de Kok does not disclose "enabl[ing] separate identification of seismic events originating from the first source," because de Kok generates new traces, called "source recordings," that do not retain the data relating to individual traces for each shot of each source. *Id.* at 24 (citing Ex. 2001 ¶ 162). As discussed above with respect to claim construction, Patent Owner asserts the "indexed" limitation requires separately identifying each individual trace from each shot of each source. *Id.*

Petitioner points to de Kok's disclosure that the seismic sources are fired using an activation sequence and the "recordings responsive to individual seismic sources" may be separated out from the records of all shots. Pet. 21 (quoting Ex. 1003, 2:47–50); Pet. Reply 3–4. Petitioner also argues de Kok's separation of its shot records into source records "requires that the firing times be indexed," because de Kok has to control firing times in the field in order for the later summations and source separations to work. Pet. Reply 5 (citing Ex. 1022, 135:17–137:2).

We note Patent Owner recognizes that de Kok's system needs to use the reference time (on which the firing times of each shot in each activation sequence are based) to later separate the signals into de Kok's source recordings. PO Resp. 28–29. De Kok explains that each source is activated with a fixed time delay relative to a reference time (t_r). Ex. 1003, 6:21–30. Patent Owner acknowledges that de Kok enables separately identifying seismic signals attributed to a particular source. PO Resp. 24. Patent Owner's understanding in this regard demonstrates that its arguments rely on a narrow interpretation of the "indexed" limitation, which we have not adopted. Thus, given our construction of the "indexed" limitation, Patent

Owner's distinctions between what de Kok discloses and what claim 23 recites are inapposite. We are persuaded by Petitioner's arguments, which Patent Owner does not contest, that de Kok's firing times for each source are indexed (as we have construed the "indexed" limitation) to the reference time in a way that allows the shot records to be separated into source records. Because de Kok discloses both indexing and enabling separate identification of seismic events *originating from* each source, de Kok discloses the "indexed" limitation as we have construed it.

Patent Owner also argues de Kok fails to teach a vessel adapted to tow a second source *at a selected distance* from the first source (the "selected distance" limitation), as recited in claim 23. PO Resp. 29–32. Patent Owner asserts that, because de Kok never explicitly mentions a distance between its first and second sources or any criteria for selecting a distance, it does not meet the "selected distance" limitation. *Id.* Patent Owner further argues that, because de Kok's method could be performed "without ever selecting a distance," de Kok does anticipate claim 23. *Id.* at 31. Patent Owner contends that de Kok's disclosure of the sources being "relatively close to each other," fails to teach that the distance between sources "is 'selected,' much less an enabling disclosure of performing that selection." *Id.* (quoting Ex. 1003, 5:36–39).

Petitioner counters that, in addition to stating the sources are relatively close to each other, de Kok describes some sources placed at the front of the sensor streamers and some trailing the sensor streamers. Pet. Reply 5–6 (citing Ex. 1003, 5:36–40). Regarding Patent Owner's argument that de Kok does not provide a specific dimension, Petitioner asserts that the '981 patent neither recites nor teaches a specific dimension. *Id.* at 6.

Petitioner also quotes a statement from Patent Owner's declarant, Dr. Lynn, that the '981 patent does not provide specific locations for its sources and merely requires that the sources be within a reasonable range that produces useful information. *Id.* (quoting Ex. 1022, 112:4–16). Petitioner asserts there is no distinction between what is disclosed by the '981 patent and what is disclosed by de Kok with respect to the "selected distance" limitation. *Id.*

To the extent Patent Owner argues de Kok does not provide "an enabling disclosure of performing that selection [of a distance between sources]," such an argument is not commensurate with the scope of the claim. Specifically, the "selected distance" limitation merely requires the vessel be adapted to tow the second source a selected distance from the first source. Claim 23 is directed to an apparatus and, accordingly, no step of selecting a distance is recited. Regarding the argument that no specific dimension is provided in de Kok, we agree with Petitioner that de Kok discloses as much as the '981 patent does regarding the "selected distance" between sources. Particularly in light of Dr. Lynn's testimony that the two sources need only be within a reasonable range such that useful data may be obtained during simultaneous recording of the different sources, we find an ordinarily skilled artisan would have been aware of how to choose a reasonable and useful "selected distance." Moreover, de Kok is directed to a similar goal of simultaneously recording "useful" data from multiple sources and, accordingly, we find an ordinarily skilled artisan would have understood de Kok to disclose that the sources are towed a "selected distance" apart, as required by the "selected distance" limitation recited in claim 23. Furthermore, because the "selected distance" limitation merely

recites "a vessel adapted to tow" the second source a selected distance from the first source, Petitioner has demonstrated de Kok discloses such a vessel.

Finally, Patent Owner argues de Kok does not disclose "a controller adapted to actuate the" sources. PO Resp. 32–33. Patent Owner asserts the Petition relies solely on inherent anticipation and offers no evidence de Kok discloses a controller "adapted to actuate two sources." *Id.* at 32. Patent Owner also contends that, even accepting Petitioner's assertion that de Kok must have a controller to fire its seismic sources, Dr. Ikelle testified de Kok could have one controller for each source and, accordingly, it "would be possible to practice the de Kok method using multiple controllers that are each adapted to fire *one* of the sources in a coordinated fashion." *Id.* Patent Owner concludes that, because de Kok does not require a single controller, de Kok does not inherently anticipate claim 23.

Petitioner counters that any argument that separate controllers could be used to coordinate the firing of the sources according to the programmed time delays "simply ignores the reality of how such systems work." Reply 6. Petitioner further argues that the recitation of "a controller" covers one or more controllers, and "a controller adapted to actuate" the sources in a firing sequence, therefore, encompasses multiple controllers being adapted to actuate the sources. *Id.* at 6–7. Finally, Petitioner contends that "a controller is simply a 'synchronization system' and, if there were multiple controllers, the controllers would be programmed in a coordinated fashion." *Id.* at 7 (citing Ex. 2002, 295:15–296:5, 298:18–25); *see* Ex. 2002, 293:4–298:25 (Dr. Ikelle explaining that a controller, as recited in claim 23, would be understood by an ordinarily skilled artisan to be a system for synchronizing firing times in the field, and that seismic systems necessarily

have a system that synchronizes firing times). Patent Owner was given the opportunity to respond to any portion of Petitioner's Reply that Patent Owner believed was not properly responsive to the Patent Owner Response. Paper 34, 2. In its Sur-Reply, Patent Owner did not address Petitioner's position on whether de Kok described the claimed controller. Accordingly, based on Dr. Ikelle's unrebutted testimony that de Kok necessarily has a system for controlling its firing sequences, that an ordinarily skilled artisan would have understood to be a controller, Ex. 2002, 297:12–14, we find that de Kok inherently discloses "a controller adapted to actuate" the sources, as recited in claim 23.

Accordingly, upon reviewing the arguments and evidence presented by both parties during trial, Petitioner persuades us by a preponderance of evidence that de Kok anticipates claim 23 of the '981 patent.

3. Dependent Claims 24 and 30

Patent Owner argues that claims 24 and 30 are not anticipated by de Kok for the same reasons asserted with respect to claim 23. Patent Owner does not contest Petitioner's assertions that de Kok discloses the additional limitations recited in claims 24 (systematic variation of delay times) and 30 (towing at least a third source a selected distance from the other two sources with the controller adapted to also fire the at least third source with another delay). *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 24 and 30, and find them persuasive. *See* Pet. 21–22. Accordingly, we find de Kok anticipates claims 24 and 30 for the same

reasons discussed above with respect to claim 23 and for the respective reasons asserted by Petitioner for claims 24 and 30.

4. Summary

Based on Petitioner's arguments and evidence, we are persuaded Petitioner has demonstrated, by a preponderance of the evidence, that claims 23, 24, and 30 are anticipated by de Kok.

C. Asserted Obviousness of Claims 23–29 in View of Beasley and Edington

Petitioner challenges claims 23–29 under 35 U.S.C. § 103(a) as obvious over Beasley and Edington. Pet. 32–42; Pet. Reply 7–23.

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 23

Petitioner contends that Beasley discloses each of the limitations of claim 23 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. 33. 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 33, 35. Petitioner provides claim charts mapping portions of Beasley and Edington to each recited limitation of claim 23. *Id.* at 35–38.

Patent Owner does not argue the combination of Beasley and Edington fails to teach any limitations recited in independent claim 23.[8]

[8] Patent Owner responded to an apparent argument by Petitioner that Beasley itself taught time delay encoding. Surreply 3–5 (citing Pet. Reply 11–12). 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. Reply 11 ("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.").

Patent Owner, however, argues a person of ordinary skill in the art would not have combined Beasley and Edington. PO Resp. 35–44. 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 49–55.

As mentioned, Patent Owner does not dispute Petitioner's assertion that the combination of Beasley and Edington describes each element of independent claim 23, 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 9–10. Patent Owner does not contest those assertions.[9] We have reviewed the evidence and Petitioner's arguments, and

[9] 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 9–12. Patent Owner clarified its position at oral argument that it does not contest Petitioner's assertions that land

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. 35–38. 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. *Id.* at 36. 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 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

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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").

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. 33–44; Surreply 5–6. 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. 35; Pet. Reply 9–18.

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. 11–13 (citing Ex. 2001 ¶¶ 122–126). 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 12 (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. 39 (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. 39–40 (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. 40. 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. 41–44 (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. 44 (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 14 (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. Pet. Reply 14–15 (citing Ex. 1004, 8:46–47). 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. 15–16 (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 15 (citing Ex. 1004, 8:46–47); Pet. 47 (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 13. 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 23 should be construed to exclude any amount of spatial reflection point smearing.[10] 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 Edington's time delay encoding into Beasley's system generates reflection point smearing, the evidence does not support a finding that claim 23 excludes any amount of smearing. Based on the record before us, we are not

[10] 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.

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. 49–55. 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 50–51. 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 52–55. Petitioner argues Patent Owner has shown no nexus between Patent Owner's proffered secondary considerations and the invention of the '981 patent. Pet. Reply 21–23. Petitioner contends Patent Owner's focus on the varied time

delays of claim 23 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 23. 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 23 would have been obvious in view of the combination of Beasley and Edington.

4. Dependent Claims 24–29

Petitioner argues the combination of Beasley and Edington teaches each recited limitation of claims 24–29. Pet. 39–42. Patent Owner argues claims 24–29 are patentable for the same reasons asserted with respect to independent claim 23, and further argues Petitioner failed to show that the combination of Beasley and Edington teaches the additional limitations recited in dependent claims 25–27.

a) Claims 25 and 26

Claims 25 and 26 depend from claim 23 and further recite in relevant part that "the time interval is varied" quasi-randomly (claim 25) or randomly (claim 26). Petitioner asserts:

> Once 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. 40 (citing Ex. 1002 ¶¶ 259, 304). Petitioner further argues "Edington specifically contemplates ways to utilize random aspects of time delays that are unavoidable." *Id.* (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 20.

Patent Owner argues Beasley does not disclose time delay variation at all and Edington discloses varying delays according to a formulaic pattern. PO Resp. 45. 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 46. Patent Owner asserts Edington's preferred variation of delays by a constant amount was to simplify the decoding scheme. *Id.* at 47 (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. 46 (citing Ex. 2002, 109:12–16, 158:2–11); *see* Pet. 40; Pet. Reply 19–20. 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 25 and 26. 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 25 and 26 would have been obvious in view of the teachings of Beasley and Edington.

b) Claim 27

Petitioner argues given "the use of time delay encoding, it would have been obvious to a person of ordinary skill in the art to use time intervals that vary in steps of about 100 milliseconds." Pet. 41. Patent Owner argues claim 27's recitation of varying the time delays "in steps of about 100 milliseconds" is not taught by Beasley or Edington. PO Resp. 48. Patent Owner asserts that, even though Dr. Ikelle testifies that "100 milliseconds is just longer than the duration of the source signature for most marine seismic sources," Petitioner does not explain why a person having ordinary skill would *vary* the time delays *in steps* of about 100 milliseconds, as opposed to

some other delay that is greater than 100 milliseconds. *Id.* at 49; s*ee, e.g.*, *In re Chaganti*, 554 Fed. App'x 917, 922 (Fed. Cir. 2014) ("It is not enough to say that . . . to do so would 'have been obvious to one of ordinary skill.' Such circular reasoning is not sufficient—more is needed to sustain an obviousness rejection."). In its Reply, Petitioner merely repeated its argument from the Petition. Pet. Reply 20–21.

On the record before us, Petitioner has not articulated sufficiently *why* an ordinarily skilled artisan would *vary* delay times *in steps* of about 100 milliseconds. Accordingly, Petitioner has failed to demonstrate, by a preponderance of the evidence, that claim 27 would have been obvious in view of the teachings of Beasley and Edington.

5. Dependent Claims 24, 28, and 29

Petitioner argues the combination of Beasley and Edington teaches each recited limitation in dependent claims 24, 28, and 29. Pet. 39, 41–42. Patent Owner argues only that dependent claims 24, 28, and 29 are patentable for the same reasons asserted with respect to independent claim 23. *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 24, 28, and 29, and find them persuasive. Accordingly, we find claims 24, 28, and 29 would have been obvious in view of the combined teachings of Beasley and Edington for the same reasons discussed above with respect to claim 23 and for the respective reasons asserted by Petitioner for claims 24, 28, and 29.

6. Summary

Based on Petitioner's arguments and evidence, we are persuaded Petitioner has demonstrated, by a preponderance of the evidence, that claims 23, 24, 28, and 29 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 25–27 would have been obvious in view of the combination of Beasley and Edington.

III. CONCLUSION

Petitioner has demonstrated, by a preponderance of the evidence, the unpatentability of: (1) claims 23, 24, and 30 of the '981 patent as anticipated by de Kok; and (2) claims 23, 24, 28, and 29 as obvious in view of Beasley and Edington. Petitioner has not demonstrated, by a preponderance of the evidence, the unpatentability of claims 25–27 as obvious in view of Beasley and Edington.

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 23, 24, and 28–30 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.

PETITIONER:
Michael L. Kiklis
Scott McKeown
Kevin Laurence
Christopher Ricciuti
Katherine Cappaert
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
CPDocketKiklis@oblon.com
CPDocketMcKeown@oblon.com
CPDocketLaurence@oblon.com
CPDocketRicciuti@oblon.com
CPDocketCappaert@oblon.com

PATENT OWNER:

David I. Berl
Jessamyn Berniker
David M. Krinsky
Thomas S. Fletcher
Christopher A. Suarez
WILLIAMS & CONNOLLY, LLP
dberl@wc.com
jberniker@wc.com
dkrinsky@wc.com
tfletcher@wc.com
csuarez@wc.com