

UNITED STATES PATENT AND TRADEMARK OFFICE

---

BEFORE THE PATENT TRIAL AND APPEAL BOARD

---

URT UMWELT UND RECYCLINGTECHNIK GMBH

Petitioner-Appellant,

v.

DUESENFELD GMBH

Patent Owner-Cross-Appellant,

---

Inter Partes Review IPR2024-00887

Patent 11,050,097

---

**PETITION FOR REVIEW / NOTICE OF APPEAL TO THE UNITED  
STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT  
BY DUESENFELD GMBH**

Notice is hereby given that Patent Owner Duesenfeld GMBH (“Patent Owner-Cross-Appellant”, “Duesenfeld”) appeals to the United States Court of Appeals for the Federal Circuit for the instant matter, *inter partes* review IPR2024-00887, *URT Umwelt und Recyclingtechnik GmbH v. Duesenfeld GMBH*. Patent Owner-Cross-Appellant appeals the Decision of the Office which culminated in the Patent Trial and Appeal Board Final Written Decision issued November 12, 2025 (Paper 45, “Final Written Decision”) (attached).

This Notice of Appeal is timely filed because it is filed within 14 days of the Notice of Appeal filed by Petitioner URT Umwelt und Recyclingtechnik GmbH on January 14, 2026. Fed. R. App. P. 4(a)(3); Federal Circuit Rule 4; 37 C.F.R. § 90.3(a)(1).

Patent Owner-Cross-Appellant appeals all determinations of unpatentability and all subsidiary findings, including all prior and interlocutory rulings related thereto or subsumed therein. The issues for appeal are, but are not limited to, the Board’s Final Written Decision determining that Petitioner showed by a preponderance of the evidence that claims 12, 13, and 15–19 of the ’097 patent are unpatentable, and any finding, ruling, or determination supporting or related to the aforementioned issues.

Simultaneously with this submission, Patent Owner-Cross-Appellant is filing a copy of this Notice of Appeal with the Director of the United States Patent

and Trademark Office and a copy of the same, along with the required docketing fee, with the Clerk of the United States Court of Appeals for the Federal Circuit as set forth in the accompanying Certificate of Service.

Respectfully Submitted,

Date: January 26, 2026

/Matthew A. Smith/ USPTO Reg. No. 49,003

Matthew A. Smith  
SMITH BALUCH LLP  
700 Pennsylvania Ave SE, 2nd Floor  
Washington DC, 20003  
Telephone: (202) 669-6207  
email: smith@smithbaluch.com

*Attorney for Patent Owner-Cross-Appellant*

**CERTIFICATE OF SERVICE**

I, Matthew A. Smith, certify that the documents referenced below:

PETITION FOR REVIEW / NOTICE OF APPEAL TO THE UNITED STATES  
COURT OF APPEALS FOR THE FEDERAL CIRCUIT BY DUESENFELD  
GMBH together with attachments were caused to be served upon counsel of  
record, the United States Patent and Trademark Office, and the Court of Appeals  
for the Federal Circuit in this matter on January 26, 2026 by causing them to be  
delivered via electronic mail; via electronically filing the document with the  
USPTO's P-TACTS system; and via CM/ECF with the Clerk's Office of the  
United States Court of Appeals; as follows:

United States Patent & Trademark Office (via P-TACTS)

Director of the United States Patent & Trademark Office  
(via email address efileSO@uspto.gov, in accordance with  
37 C.F.R. § 90.2(a)(1)(i))

United States Court of Appeals for the Federal Circuit (via CM/ECF)  
717 Madison Place NW  
Washington, DC 20005

Counsel for Petitioner-Appellant (via e-mail)  
bkk@nixonvan.com  
jr@nixonvan.com  
Nixon and Vanderhye, PC

/Matthew A. Smith/  
USPTO Reg. No. 49,003  
Matthew A. Smith

UNITED STATES PATENT AND TRADEMARK OFFICE

---

BEFORE THE PATENT TRIAL AND APPEAL BOARD

---

URT UMWELT UND RECYCLINGTECHNIK GMBH,  
Petitioner,

v.

DUESENFELD GMBH,  
Patent Owner.

---

IPR2024-00887  
Patent 11,050,097 B2

---

Before MEREDITH C. PETRAVICK, CHRISTOPHER M. KAISER, and  
KEVIN W. CHERRY, *Administrative Patent Judges*.

KAISER, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision

Determining Some Challenged Claims Unpatentable  
Granting Patent Owner's Motion to Amend in Part  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### A. *Background and Summary*

URT Umwelt und Recyclingtechnik GmbH (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–3, 7–10,<sup>1</sup> 12, 13, and 15–19 (“the challenged claims”) of U.S. Patent No. 11,050,097 B2 (Ex. 1001, “the ’097 patent”). Duesenfeld GmbH (“Patent Owner”) filed a Preliminary Response (Paper 7, “Prelim. Resp.”). With our authorization, Petitioner filed a Reply to Patent Owner’s Preliminary Response (Paper 8, “Prelim. Reply”), and Patent Owner filed a Preliminary Sur-Reply (Paper 9, “Prelim. Sur-Reply”). We determined that the information presented established a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims, so we instituted *inter partes* review of all challenged claims based on all the grounds identified in the Petition. Paper 10 (“Inst. Dec.”).

Following institution of *inter partes* review, Patent Owner filed a Response to the Petition (Paper 17, “PO Resp.”), Petitioner filed a Reply to the Response (Paper 23, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 31, “PO Sur-reply”). In addition, Patent Owner filed a Motion to Amend (Paper 19, “Mot. Amend”), Petitioner filed an Opposition to the Motion to Amend (Paper 25, “Pet. Opp.”), Patent Owner filed a Reply to the Opposition (Paper 33, “PO Reply”), and Petitioner filed a Sur-reply

---

<sup>1</sup> In the Introduction and section headings of the Petition, Petitioner identifies claims 1–3, 7–9, 12, 13, and 15–19 as the challenged claims. Pet. i–ii. In the substantive content of the Petition, however, Petitioner includes claim 10 as a challenged claim as well. *Id.* at 34–35.

(Paper 39, “Pet. Sur-reply”). An oral hearing with was held on August 19, 2025, and a transcript of the hearing is included in the record. Paper 44.

We have authority to determine whether Petitioner has established by a preponderance of the evidence that any of the challenged claims is unpatentable. 35 U.S.C. §§ 6(b), 316(c). For the reasons set forth below, upon considering the briefing and the evidence of record, we determine that Petitioner has shown the unpatentability of some, but not all, challenged claims. In addition, we grant Patent Owner’s motion to amend in part.

*B. Real Parties-in-Interest*

Petitioner identifies URT Umwelt und Recyclingtechnik GmbH as the real party-in-interest. Pet. 2. Patent Owner identifies Duesenfeld GmbH as the real party-in-interest. Paper 4, 1.

*C. Related Matters*

The parties identify the following related court proceeding: *Duesenfeld GmbH v. Ascend Elements, Inc.*, Case No. 2:23-cv-01194 (D. Del.). Pet. 2; Paper 4, 1. In addition, the parties note that the ’097 patent is also being challenged concurrently in IPR2024-00948. Paper 4, 1.

*D. The ’097 Patent*

The ’097 patent is titled “Method for the Treatment of Used Batteries, in Particular Rechargeable Batteries, and Battery Processing Installation” and issued on June 29, 2021. Ex. 1001, codes (45), (54). It is directed to “[a] method . . . for the treatment of used batteries, in particular lithium batteries.” *Id.* at code (57).

The ’097 patent describes several prior-art methods of processing used batteries and discusses the disadvantages of each method. *Id.* at 1:25–

50. “The invention [of the ’097 patent] aims to reduce” these disadvantages.

*Id.* at 1:54–55. To do so, the ’097 patent describes

a method for the treatment of used batteries, in particular used lithium batteries, such as lithium-ion batteries, with the steps (a) comminuting the batteries such that comminuted material is obtained, (b) inactivating of the comminuted material such that an inactive comminuted material is obtained, and (c) filling a transport container with the inactive comminuted material.

*Id.* at 1:8–15. It also describes

a battery processing installation for the treatment of used batteries, in particular for the treatment of used lithium batteries with (a) a comminuting device for comminuting the batteries such that comminuted material is obtained, (b) an inactivation device for inactivating the comminuted material and (c) a filling device for filling a transport container with the inactivated comminuted material.

*Id.* at 1:16–23.

According to the ’097 patent, “the inactivation occurs . . . by way of drying the comminuted material.” *Id.* at 1:57–58. By doing this, “the amount of electrolyte that can be obtained from the comminuted material . . . is such that an electrochemical reaction is no longer possible, or only to a negligibly small extent.” *Id.* at 1:63–66. “In addition, no flammable or explosive gas phase forms above the battery fragments, as the organic carbonates of the electrolyte have been removed.” *Id.* at 1:66–2:2. This renders the comminuted material “largely inert,” so that it “can be transported safely, especially if it is packed under vacuum.” *Id.* at 2:2–4.

*E. Illustrative Claims*

Petitioner challenges claims 1–3, 7–9, 12, 13, and 15–19 of the '097 patent. Claims 1 and 12 are independent and illustrative; they are reproduced below.

1. A method for the treatment of used batteries, comprising the steps:
  - (a) comminuting the batteries such that comminuted material is obtained;
  - (b) inactivating the comminuted material such that an inactivated comminuted material is obtained, wherein the inactivating step is performed during or after the comminuting step; and
  - (c) filling a transport container with the inactivated comminuted material;

wherein the inactivating step is performed by drying the comminuted material, and

wherein the drying occurs at a maximum pressure of 300 hPa.

Ex. 1001, 10:45–59.

12. A battery processing installation for treatment of used batteries, comprising:
  - (a) a comminution unit configured to comminute the batteries such that comminuted material is obtained;
  - (b) an inactivation device comprising a drying device configured to inactivate the comminuted material, wherein the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit;
  - (c) a filling device configured to fill a transport container with the inactivated comminuted material; and
  - (d) a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.

Ex. 1001, 11:48–61.

*F. Asserted Grounds of Unpatentability*

Petitioner asserts the following grounds of unpatentability (Pet. 4–5, 17–57):

| <b>Claim(s)<br/>Challenged</b> | <b>35 U.S.C. §</b> | <b>Reference(s)/Basis</b>                                         |
|--------------------------------|--------------------|-------------------------------------------------------------------|
| 1–3, 7, 8, 10                  | 103                | LithoRec, <sup>2</sup> DIN 28400, <sup>3</sup> Perry <sup>4</sup> |
| 9                              | 103                | LithoRec, DIN 28400, Perry, Hanisch <sup>5</sup>                  |
| 12, 13, 15, 16,<br>18, 19      | 102                | LithoRec                                                          |
| 17                             | 103                | LithoRec, Hanisch                                                 |

In support of its unpatentability arguments, Petitioner relies on the declarations of Volker Spies (Ex. 1003; Ex. 1022; Ex. 1023; Ex. 1030). Patent Owner relies on the declaration of Vani Dantam (Ex. 2025). There is also fact witness testimony from Lydia Grote (Ex. 2040). The parties additionally filed transcripts of the depositions of Mr. Spies (Ex. 2061; Ex. 2062) and Mr. Dantam (Ex. 1039).

## II. ANALYSIS

*A. Legal Standards*

In an *inter partes* review, “a patent challenger has the burden of producing evidence to support a conclusion of unpatentability under § 102 or

---

<sup>2</sup> Arno Kwade et al., “LithoRec Recycling Lithium-Ion Batteries,” Cuvillier Verlag (2012) (Ex. 1004, English translation submitted as Ex. 1016).

<sup>3</sup> “Vacuum Technology—Terms and Definitions—General Terms.” DIN 28400-1, German Institute for Standards e.V., 1990 (Ex. 1007, English translation submitted as Ex. 1018).

<sup>4</sup> “Perry’s Chemical Engineers’ Handbook 7th Edition.” New York: McGraw-Hill, 1997 (Ex. 1006).

<sup>5</sup> WO 2013/023640 A1, published Feb. 21, 2013 (Ex. 1013, English translation provided as Ex. 1020).

§ 103.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1375–76 (Fed. Cir. 2016) (citing *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1379 (Fed. Cir. 2015)).

*B. Level of Ordinary Skill in the Art*

The level of ordinary skill in the pertinent art at the time of the invention is a factor in how we construe patent claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). It is also one of the factors we consider when determining whether a patent claim is obvious over the prior art. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Factors pertinent to a determination of the level of ordinary skill in the art include “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). “Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case.” *Id.*

Petitioner contends that one of ordinary skill in the art “would have had a B.S. degree in electrical engineering, materials science, chemical engineering, or an equivalent field, as well as at least 2 to 3 years of academic or industry [experience] in the recycling or processing of lithium-ion batteries.” Pet. 14. We adopted this definition of the level of ordinary skill in the art in our Decision on Institution. Paper 10, 7–8; *see also* Prelim.

Resp. 19 (not contesting Petitioner’s proposed level of skill at the institution stage). Subsequently, Patent Owner stated that it “agrees that this level of skill is appropriate.” PO Resp. 7–8. Accordingly, we adopt Petitioner’s assessment of the level of ordinary skill in the art, which is consistent with the ’097 patent and the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

*C. Claim Construction*

We apply the same claim construction standard used in the federal courts—in other words, the claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), which is articulated in *Phillips*. *See* 37 C.F.R. § 42.100(b). Under the *Phillips* standard, the “words of a claim ‘are generally given their ordinary and customary meaning,’” which “is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1312–13.

Petitioner argues that “[n]o claim construction is needed for most of the terms in most of the claims” because “[t]he claims are unpatentable under any reasonable interpretation.” Pet. 15. Patent Owner proposes constructions for “inactivate,” “inactivated,” “drying device configured to inactivate the comminuted material,” and “drying the comminuted material.” PO Resp. 8–14; PO Sur-reply 2–4. Petitioner disagrees with Patent Owner’s proposed constructions. Pet. Reply 1–5.

*1. “Inactivate” and “Inactivated”*

Patent Owner argues that both “inactivate” and “inactivated” should receive their “ordinary meaning.” PO Resp. 9. According to Patent Owner,

the ordinary meaning of “inactivate” is “to render safe for transport,” and the ordinary meaning of “inactivated” is “rendered safe for transport.” *Id.* Petitioner argues instead that these terms should be interpreted to mean “the removal of solvents from a conducting . . . salt.” Pet. Reply 2–3.

To support these proposed constructions, both parties direct us to the same sentence in the specification of the ’097 patent: “The drying of the comminuted material results in inactivated material.” *Id.* at 2 (quoting Ex. 1001, 8:54–55); PO Resp. 9 (quoting Ex. 1001, 8:54–55). According to Petitioner, this sentence equates “inactivating” with “drying,” such that it provides “an explicit definition of ‘inactivated.’” Pet. Reply 2. Patent Owner argues, however, that this sentence “shows that inactivation, rather than being coextensive with drying, is a resulting end point of the drying process.” PO Resp. 9.

The specification states that “drying . . . results in inactivated . . . material,” as well as that “inactivation occurs . . . by way of drying the . . . material.” Ex. 1001, 1:56–58, 8:54–55. By itself, this language is consistent with both parties’ proposed constructions. But the ’097 patent repeatedly suggests that the drying process has an endpoint and that there are multiple points in the drying process that might constitute that endpoint. For example, in some embodiments, the endpoint of the drying process is the point where “[t]he comminuted material is . . . largely inert and can be transported safely.” Ex. 1001, 2:2–4; *see id.* at 2:13–14 (“it is advantageous that a comminuted material is obtained that can be transported safely”). In other embodiments, the endpoint is defined as the point when “an electrolyte content . . . is so low that an electrochemical reaction is [not] possible.” *Id.* at code (57), 4:5–7. The endpoint might be reached when “no flammable or

explosive gas mixture can form above the comminuted material” or when “a flammable or explosive gas mixture can[not] emerge in the transport container or during the subsequent processing.” *Id.* at 3:49–55. It might be reached when “the build-up of heat is so low that a thermal runaway, i.e., a thermally induced chain reaction, is ruled out for at least two months,” or when “any build-up of hydrogen is so low that after two weeks, no excess pressure occurs if a negative pressure of 500 hPa is present to begin with.” *Id.* at 4:19–27. Alternatively, it may not be reached “until the electrolyte content of organic components that are volatile at 80° C. has a maximum value of 3% by weight,” “the accumulated content of organic carbonates from the electrolyte that are volatile at 80° C. falls short of 3% by volume in the atmosphere above the comminuted material,” or “the dimethyl carbonate content is lower than 4% by volume . . . and/or the cyclohexylbenzene content is lower than 1% by volume.” *Id.* at 4:28–40. The challenged claims require both “inactivating the comminuted material” and that “the inactivating step is performed by drying the comminuted material.” *Id.* at 10:45–59; *see also id.* at 11:48–61 (reciting “an inactivation device comprising a drying device”). Given the specification’s repeated focus on the possible endpoints of the drying process and the multiplicity of possible points in the drying process that might constitute an endpoint, and given the claims’ recitation of both inactivating and drying, we are persuaded that inactivated material is not merely material that has been dried, but rather material that has been dried until the endpoint of the drying process has been reached.

Accordingly, we agree with Patent Owner that drying and inactivation are not synonymous or equivalent in scope. We disagree with Patent

Owner’s argument, however, that the endpoint of the drying process is necessarily the point when the comminuted material has been rendered safe for transport. Only some of the endpoints identified in the specification of the ’097 patent relate to the safety of transport; others do not. *See, e.g.*, Ex. 1001, 3:49–56 (“a flammable or explosive gas mixture can[not] emerge . . . during the subsequent processing”), 4:5–7 (“electrolyte content is so low that an electrochemical reaction is impossible”), 4:28–40 (defining drying as complete when the content of certain compounds is below a particular value). Instead, we conclude more generally that the comminuted material is inactivated once it has been dried sufficiently to reach the endpoint of the drying process.

2. *“Drying device configured to inactivate the comminuted material”*

Patent Owner proposes that we construe “drying device configured to inactivate the comminuted material” as “a device configured to produce inactivated comminuted material as a result of drying.” PO Resp. 12–13. Petitioner argues instead that we should construe this phrase as “drying device configured to remove at least one solvent from conducting salt such that DMC and/or EMC is removed from the comminuted material.” Pet. Reply 4. On the record developed at trial, we agree with Patent Owner. Petitioner’s proposed construction suffers from the same over-specificity as Patent Owner’s proposal to construe inactivated as having been rendered safe for transport: the specification of the ’097 patent proposes multiple possible endpoints of the drying process, so the choice of any particular endpoint would be erroneous. Patent Owner’s proposed construction, however, is consistent with our construction of “inactivate” in that it

recognizes the nature of inactivation as the endpoint of the drying process. Accordingly, we adopt Patent Owner’s proposed construction, and we construe “drying device configured to inactivate the comminuted material” as “a device configured to produce inactivated comminuted material as a result of drying.”

3. *“Drying the comminuted material”*

Patent Owner argues that we should construe “drying the comminuted material” as “removing at least one solvent from the comminuted material.” PO Resp. 13–14. Petitioner argues that “the ’097 patent provides an explicit definition for ‘drying,’” with that definition requiring “‘the removal of at least one solvent in the conducting salt’” and, “[i]n particular,” the removal of “‘dimethyl carbonate and/or ethyl methyl carbonate.’” Pet. Reply 4 (quoting Ex. 1001, 2:23–27). The only difference between these proposed constructions is Petitioner’s suggestion that the solvent removed must be either dimethyl carbonate or ethyl methyl carbonate. But, as noted above, the specification of the ’097 patent suggests that drying may be complete when compounds other than these specific carbonates are reduced to specified amounts. Ex. 1001, 4:28–40 (“the electrolyte content of organic components that are volatile at 80° C. has a maximum value of 3% by weight,” “the accumulated content of organic carbonates from the electrolyte that are volatile at 80° C. falls short of 3% by volume in the atmosphere above the comminuted material,” “the cyclohexylbenzene content is lower than 1% by volume”). Accordingly, we do not construe drying as limited to the removal of dimethyl carbonate or ethyl methyl carbonate. Instead, we adopt Patent Owner’s proposed construction, and we construe “drying the

comminuted material” as “removing at least one solvent from the comminuted material.”

*D. Anticipation by LithoRec*

Petitioner argues that claims 12, 13, 15, 16, 18, and 19 were anticipated by LithoRec. Pet. 39–55; Pet. Reply 5–15. Patent Owner disagrees. PO Resp. 14–39; PO Sur-reply 4–12.

*1. Overview of LithoRec*

LithoRec reports the results of a project in which “several processes for recycling traction batteries were evaluated.” Ex. 1016, 1. In particular, LithoRec discloses a “[c]onceptual design of a recycling pilot plant.” *Id.* at 222. Part of this design focuses on “[s]eparation of active materials,” and this separation includes both “[p]re-shredding” and “[d]rying.” *Id.* at 224–226. According to LithoRec, “[t]he electrolytes need to be evaporated for the subsequent dry treatment processes” in order for both to “eliminate[] the potential hazard of flammable solvents” and “convert[] the active mass into the dry powder form required for dry processing.” *Id.* at 226. Because “some of the liquids to be vaporized are highly flammable solvents, the drying temperature should probably be severely restricted. This in turn speaks in favor of drying under vacuum, as the drying temperature can be kept low.” *Id.*

*2. Enablement of LithoRec*

Patent Owner argues that “LithoRec is not enabled to anticipate the challenged claims.” PO Resp. 25–38; PO Sur-Reply 8–11. Petitioner disagrees. Pet. Reply 11–15.

“In order to anticipate a claimed invention, a prior art reference must enable one of ordinary skill in the art to make the invention without undue

experimentation.” *Impax Labs., Inc. v. Aventis Pharms., Inc.*, 545 F.3d 1312, 1314 (Fed. Cir. 2008). In addition, “[a]n anticipatory reference need only enable subject matter that falls within the scope of the claims at issue, nothing more.” *Schering Corp. v. Geneva Pharms.*, 339 F.3d 1373, 1381 (Fed. Cir. 2003).

Patent Owner argues that this standard is not met with respect to the purported anticipation of the challenged claims by LithoRec. Specifically, Patent Owner argues that “Petitioner cannot show that speculative, future work that is in fact non-operational in practice can be enabled.” PO Resp. 25. According to Patent Owner, “LithoRec is not enabled because it represents a future proposal – a concept design for a pilot plant for comminuting batteries for subsequent processing,” and “[a] proposal for implementation does not enable to the extent the proposal does not instruct one of skill in the art how to achieve that which was proposed.” *Id.* at 27 (citing Ex. 1016, 222; Ex. 2025 ¶¶ 68, 168).

In making this argument, Patent Owner analogizes the present case to that in *Apple Inc. v. Int’l Trade Comm’n*, 725 F.3d 1356, 1364 (Fed. Cir. 2013). *Id.* at 27–28. We find *Apple* inapposite here. In *Apple*, an alleged anticipatory reference was non-enabled to anticipate a claim reciting a “transparent capacitive sensing medium” that included “transparent . . . conductive lines” because, although the reference disclosed touch-sensitive electrodes, “[t]he only discussion of transparent electrodes appear[ed] under the ‘Conclusions and Directions for Future Work’ section, in which the authors explain[ed] that they were interested in future ‘research directions.’” 725 F.3d at 1360, 1364. “There [wa]s no disclosure that the authors had achieved a transparent touch screen and the record d[id] not indicate that it

would have been routine to do so.” *Id.* at 1364. Such is not the case here. Patent Owner is correct that LithoRec discloses the “[c]onceptual design of a recycling pilot plant,” but, unlike the record in *Apple*, the record here shows that the construction of LithoRec’s “possible recycling pilot plant” would have been routine. Ex. 1016, 222. Equipment for accomplishing the vacuum drying and shredding that LithoRec discloses was well-known and familiar to those of ordinary skill. Ex. 1024 (vacuum dryer disclosed in 1901); Ex. 1025 (vacuum dryer disclosed in 1996); Ex. 1039, 34:3–37:19 (“ways and means” of shredding and drying batteries were known before 2015). Similarly, the record here does not reflect the failure to state how to obtain a result that led to a finding of non-enablement in *Forest Lab ’ys Inc. v. Ivax Pharms., Inc.*, 501 F.3d 1263, 1268 (Fed. Cir. 2007), or the “speculative and tentative disclosure” that barred a finding of enablement in *Star Sci. Inc. v. R.J. Reynolds Tobacco Co.*, 655 F.3d 1364, 1376 (Fed. Cir. 2011). Instead, LithoRec discloses a result (keeping “the drying temperature . . . severely restricted” because “some of the liquids to be vaporized are highly flammable solvents”) and a non-speculative way of achieving that result (“drying under vacuum”). Ex. 1016, 226. In addition, as noted above, the means for vacuum drying were well-known and familiar to those of ordinary skill.

Patent Owner also argues that “[t]he machines [for comminution and drying] disclosed by LithoRec as part of the conceptualized system do not operate under vacuum pressure.” PO Resp. 30–33. This is because “[t]he drying device recommended by LithoRec is a vibratory fluidized bed dryer, which is not a vacuum dryer,” “the drying system contains a ‘blower,’ which “generate[s] positive pressure,” “[t]he comminution device disclosed

and recommended in LithoRec also does not operate at a vacuum pressure,” and the “[o]ther machines referenced in LithoRec . . . do not provide enabling disclosure.” *Id.* But a reference may be relied upon for all that it would have reasonably suggested to a person of ordinary skill the art, including nonpreferred embodiments, and “even if a piece of prior art does not expressly disclose a limitation, it anticipates if a person of ordinary skill in the art would understand the prior art to disclose the limitation and could combine the prior art description with his own knowledge to make the claimed invention.” *Arthrocare Corp. v. Smith & Nephew, Inc.*, 406 F.3d 1365, 1374 (Fed. Cir. 2005) (citing *Helifix Ltd. v. Blok-Lok, Ltd.*, 208 F.3d 1339, 1347 (Fed. Cir. 2000)); *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 807 (Fed. Cir. 1989). Here, LithoRec discloses the use of vacuum drying and provides a reason for that choice, and as noted above, the means for vacuum drying were well-known and familiar to those of ordinary skill. Ex. 1016, 226.

“Enablement is not precluded by the necessity for some experimentation,” but the “experimentation needed to practice the invention must not be undue experimentation. ‘The key word is “undue,” not “experimentation.””” *In re Wands*, 858 F.2d 731, 736–37 (Fed. Cir. 1988) (quoting *In re Angstadt*, 537 F.2d 498, 504 (CCPA 1976)). In determining whether a reference requires undue experimentation, we consider eight factors:

- (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the

predictability or unpredictability of the art, and (8) the breadth of the claims.

*Id.* at 737. Patent Owner argues that each of these factors except the final one weighs in favor of a conclusion that LithoRec did not enable its disclosure of the subject matter of the challenged claims. PO Resp. 35–38. On the record developed during trial, we disagree.

The first factor is the quantity of experimentation necessary. Patent Owner argues that a person of ordinary skill in the art “would [have] need[ed] to completely reconfigure [LithoRec’s] recommended framework and bill of materials if vacuum drying was the goal, which would require extensive experimentation.” *Id.* at 35–36 (citing Ex. 2025 ¶¶ 167.4, 168). According to Patent Owner, this is so because, “[w]hereas LithoRec mentions the possibility of drying under vacuum, the recommended equipment disclosed by LithoRec is incompatible with vacuum drying.” *Id.* at 36 (citing Ex. 2025 ¶¶ 97–108). Petitioner disagrees, arguing that “little experimentation [would have been] required for a [person of ordinary skill in the art] to make the claimed invention based on the content of LithoRec.” Pet. Reply 14 (citing Ex. 1023 ¶¶ 46–50). Patent Owner is correct that much of LithoRec’s disclosure focuses on non-vacuum shredders and dryers. Ex. 1016, 226 (discussing the use of “a MEWA QZ1200 cross-flow shredder”), 227 (disclosing the use of “a vibratory fluidized bed dryer”), 235 (disclosing the inclusion in the “[d]rying system” of a “blower”); Ex. 2025 ¶¶ 97–108 (testifying that neither vibratory fluidized bed dryers nor cross-flow hoggers operate under a vacuum). But LithoRec is not limited to the use of the particular equipment the pilot plant designers ended up choosing. With respect to the shredding equipment, LithoRec discloses that “it seems

irrelevant which machine is used.” Ex. 1016, 226. With respect to the drying equipment, LithoRec discloses the possible use of “drying under vacuum” and “a discontinuously operating dryer” before settling on the choice of a vibratory fluidized bed dryer. *Id.* Because “the development of . . . operating conditions [was] a standard part of [the] product engineers['] team duties,” “a standard part of making sure a dryer works is to optimize variables like time, temperature, and pressure,” and “there [were] known tradeoffs between batch dryers and continuous dryers,” the experimentation necessary to implement a vacuum dryer in LithoRec’s system would not have been large in quantity or beyond that falling within the scope of a design engineer’s responsibilities. Ex. 1039, 16:2–10, 21:14–23. Thus, this factor weighs in favor of LithoRec being enabled.

The second factor is the amount of direction or guidance presented, and the third factor is the presence or absence of working examples. As Patent Owner notes, LithoRec’s detailed guidance and working examples relate to non-vacuum drying. PO Resp. 35–36; Ex. 1016, 226–27, 235. Thus, these factors weigh against LithoRec being enabled.

The fourth factor is the nature of the invention. The challenged claims recite “[a] battery processing installation for treatment of used batteries” that includes “a comminution unit,” “an inactivation device comprising a drying device,” “a filling device,” and “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.” Ex. 1001, 11:48–61. Each of the recited processes—comminution, inactivation, drying, and vacuum production—was well-known to those of ordinary skill in the art, and the tradeoffs between different methods of carrying out those processes were well-understood.

Ex. 1001, 1:27–50; Ex. 1016, 100, 226–27; Ex. 1023 ¶ 47; Ex. 1034; Ex. 1039, 16:2–10, 20:3–25, 21:14–23, 35:10–17, 36:12–22. Thus, this factor weighs in favor of a conclusion that LithoRec is enabled.

The fifth factor is the state of the prior art. Patent Owner argues that “the prior art did not provide guidance on how to inactivate by drying” because “[t]he prior art focused on adding various chemicals to the batteries, or pre-treating the batteries in some fashion,” such as by “treat[ing] the batteries with fire retardants,” “aqueous solution[s] or a deactivating powder,” “mineral acids,” “brine solutions,” or “pressurized solvents,” as a means of detoxifying batteries before comminution. PO Resp. 38. But the prior art was not limited to such approaches. As the ’097 patent itself recognizes, “DE 10 2011 110 083 A1 describes a method for recovering active material from a galvanic cell, in which the galvanic cells are initially mechanically comminuted, then pre-dried and subsequently sifted” before “the binder is broken down in an oven.” Ex. 1001, 1:43–50; *see also* Ex. 1020, 1 (disclosing a method that includes “crushing the cells, in particular under inert gas”), 5 (disclosing drying “the cell fragments . . . at a drying temperature” “before the cell fragments are heated to the decomposition temperature”). Thus, this factor supports a conclusion that LithoRec was enabled.

The sixth factor is the relative skill of those in the art. Patent Owner argues that “[t]he level of skill in the art . . . is relatively low” and that a person of ordinary skill in the art, who “would have had a bachelor’s degree in a relevant field as well as at least 2-3 years of relevant experience,” “would [have] face[d] greater challenges in experimentation than, say, a Ph.D.” PO Resp. 38 (citing Ex. 2025 ¶ 167). But “the development of . . .

operating conditions [was] a standard part of [the] product engineers['] team duties,” “a standard part of making sure a dryer works is to optimize variables like time, temperature, and pressure,” and “there [were] known tradeoffs between batch dryers and continuous dryers.” Thus, the experimentation necessary to implement a vacuum dryer in LithoRec’s system would not have been beyond that falling within the scope of a design engineer’s responsibilities. Ex. 1039, 16:2–10, 21:14–23. Accordingly, this factor weighs in favor of a conclusion that LithoRec was enabled.

The seventh factor is the predictability or unpredictability of the art. Patent Owner argues that the art was unpredictable, citing LithoRec’s disclosure that there was a “‘high level of uncertainty’ in being able to obtain volumes of EV batteries to work with,” that “batteries ‘cannot be processed as a homogeneous mass due to the different chemical compositions of the battery variants,’” and that there were significant safety hazards involved in transporting and processing used batteries. PO Resp. 37 (quoting Ex. 1016, 8, 33, 96, 220; Ex. 2025 ¶¶ 47, 167.3). Petitioner disagrees, arguing that a person of ordinary skill in the art “could have easily predicted the results of comminuting battery material and drying such comminuted material.” Pet. Reply 14 (citing Ex. 1023 ¶¶ 49–50). As discussed above, we agree with Petitioner that the record supports finding that the technology disclosed in LithoRec and recited in the challenged claims was well-known and familiar to those of ordinary skill, and a person of ordinary skill in the art would have understood how to predict the behavior of used batteries undergoing comminution and drying. Ex. 1039, 16:2–10, 21:14–23. As for LithoRec’s disclosure of a “high level of uncertainty,” that statement relates to “the volume of used lithium-ion

batteries from electric vehicles over time” that would be available to be recycled, not to the art generally or to the behavior of battery material when being subjected to comminution and vacuum drying. Ex. 1016, 8. The situation is similar with respect to LithoRec’s statement that the batteries “cannot be processed as a homogeneous mass due to the different chemical compositions of the battery variants,” which LithoRec identifies as a complicating factor in determining how much battery material could be processed in a particular recycling plant. *Id.* at 8–9. Regarding LithoRec’s discussion of safety considerations, these issues complicate the design of a recycling process and plant, as well as perhaps the mitigation measures that must be taken during routine experimentation, but they do not speak to the unpredictability of the art. *Id.* at 33 (discussing “[t]he danger posed by defective batteries”), 96 (discussing the “difficult and costly handling when opening the cells” stemming from “high reactivity”), 220 (discussing regulatory burdens in “handling battery systems”). Thus, this factor weighs in favor of a conclusion that LithoRec was enabled.

The final factor is the breadth of the claims. Here, claim 12 is moderately broad, not limiting its “[a] battery processing installation for treatment of used batteries” to the use of any particular types of “comminution unit[s],” “drying device[s],” “filling device[s],” or “vacuum installation[s].” Ex. 1001, 11:48–61. Accordingly, we agree with Patent Owner that “this factor is neutral” with respect to whether LithoRec is enabled.

Considering all the factors discussed above, as well as the case law cited by Patent Owner and the arguments and evidence made of record during trial, we conclude that LithoRec’s disclosure of the subject matter of

the challenged claims was sufficiently enabled to support Petitioner's anticipation arguments. In short, the field of the '097 patent was predictable, and those of ordinary skill in the art were sufficiently familiar with the operating principles and prior art disclosures of the processes recited in the challenged claims and disclosed in LithoRec, that the disclosure of LithoRec would have enabled a person of ordinary skill in the art to have been able to make the claimed invention without undue experimentation.

3. *Analysis of Claim 12*

a) *“A battery processing installation for treatment of used batteries”*

The preamble of claim 12 recites “[a] battery processing installation for treatment of used batteries.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this subject matter. Pet. 39–41. Patent Owner does not dispute this argument. PO Resp. 14–40. LithoRec discloses the design of a “recycling pilot plant” for the processing of batteries, including “Li-ion accumulators in the form of traction batteries, hybrid batteries and plug-in batteries.” Ex. 1016, 222. Accordingly, LithoRec discloses the preamble of claim 12.

b) *“A comminution unit configured to comminute the batteries such that comminuted material is obtained”*

Claim 12 recites “a comminution unit configured to comminute the batteries such that comminuted material is obtained.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this limitation. Pet. 41–43. Patent Owner does not dispute this argument. PO Resp. 14–40. LithoRec discloses “mechanical comminution and separation of the cell and preparation of the active material,” which “cause[s] the cell housings . . . to break open and . . .

lead to an extensive separation of the active mass from the arrester foils.” Ex. 1016, 223, 226. Accordingly, LithoRec discloses this limitation of claim 12.

c) *“An inactivation device comprising a drying device configured to inactivate the comminuted material”*

Claim 12 recites “an inactivation device comprising a drying device configured to inactivate the comminuted material.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this limitation. Pet. 43–46; Pet. Reply 8–10. Patent Owner disagrees. PO Resp. 21–25; PO Sur-reply 6–8.

As discussed more completely above, we construe “drying device configured to inactivate the comminuted material” as “a device configured to produce inactivated comminuted material as a result of drying,” and we determine that the comminuted material is inactivated once it has been dried sufficiently to reach the endpoint of the drying process. In addition, the ’097 patent describes “drying” as meaning “the removal of at least one solvent in the conducting salt.” Ex. 1001, 2:23–27. Petitioner argues that LithoRec discloses this limitation of claim 12 because

LithoRec discloses “The electrolytes need to be evaporated for the subsequent dry treatment process, which are primarily aimed at extracting the active mass. On the one hand, this step eliminates the potential hazard of flammable solvents and, on the other hand, converts the active mass into the dry powder form required for dry processing.”

Pet. 44 (quoting Ex. 1016, 226). We agree that the evidence supports Petitioner’s argument. As Petitioner points out, LithoRec discloses “evaporat[ing]” “electrolytes.” Ex. 1016, 226. Among the electrolytes that LithoRec identifies as being evaporated is dimethyl carbonate, the same electrolyte that is removed in the drying process of the ’097 patent.

Ex. 1001, 2:25–27, 3:4–12, 4:37–40, 4:61–63; Ex. 1016, 100. Because LithoRec discloses that the result of its drying process is to “eliminate[] the potential hazard of flammable solvents,” not merely to reduce that hazard, it discloses reaching the endpoint of the drying process. Ex. 1016, 226.

Against this evidence, Patent Owner raises several arguments. First, Patent Owner argues that LithoRec is not “configured to inactivate the comminuted material” because “[t]here is no disclosure that the LithoRec authors ever configured a vacuum drying apparatus.” PO Resp. 22 (citing Ex. 2025 ¶¶ 148, 159–163.6). Although another limitation of claim 12 recites “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device,” Ex. 1001, 11:48–61, the present limitation does not recite vacuum drying, so the assertion that LithoRec fails to disclose an apparatus configured to carry out vacuum drying is immaterial to the present limitation. As discussed above, LithoRec discloses that its drying operation “eliminates the potential hazard of flammable solvents,” which constitutes reaching an endpoint of the drying process.

Patent Owner next argues that LithoRec’s disclosure of this limitation is non-enabled. PO Resp. 22 (citing PO Resp. 25–38). We have already considered Patent Owner’s non-enablement argument with respect to LithoRec, and, for the reasons discussed above, we do not find it persuasive.

Patent Owner argues that “[t]he only evidence that Petitioner points to in support of its position is the disclosure of the ’097 patent.” *Id.* at 23 (citing Pet. 44–45; Ex. 1003 ¶ 142). This is untrue. Although Petitioner cites the ’097 patent as evidence that, within the scope of the ’097 patent, drying includes the removal of dimethyl carbonate, Petitioner also cites the disclosure of LithoRec, as well as the testimony of Mr. Spies. *See* Pet.

43–46 (citing Ex. 1001, 2:23–27, 3:4–12, 4:37–40, 4:61–63, 8:14–15, 8:54–55; Ex. 1003 ¶¶ 140–144; Ex. 1016, 100, 226).

Next, Patent Owner argues that LithoRec does not disclose “configured to inactivate the comminuted material” inherently because “the structures disclosed are inconsistent with vacuum drying.” PO Resp. 23–24. Once again, the present limitation of claim 12 does not require vacuum drying, only inactivation of the comminuted material, which LithoRec does disclose. Moreover, that disclosure is express, so any failure of LithoRec to disclose this limitation inherently is immaterial.

Patent Owner argues that LithoRec’s “use of [a] continuous process with a vibratory fluidized bed dryer . . . could hinder the effective inactivation of the comminuted material.” PO Resp. 24 (citing Ex. 2025 ¶¶ 119–120, 160–163). But LithoRec discloses both continuous drying and batch drying. Ex. 1016, 226 (“There is also the question of whether drying should also take place in a batch or continuously.”). It suggests that continuous drying is preferred because “the necessary process steps (inerting, filling, drying, emptying) of a discontinuously operating dryer require a longer work cycle in total than the pre-shredder.” *Id.* A reference may be relied upon for all that it would have reasonably suggested to a person of ordinary skill the art, including nonpreferred embodiments. *Merck*, 874 F.2d at 807. Thus, because LithoRec discloses both batch drying and continuous drying within the same process arrangement, the fact that it discloses that continuous drying is preferred is immaterial to whether it discloses the present limitation of claim 12.

Finally, Patent Owner argues that LithoRec could “output comminuted battery product that had been subject to drying, but which did

not reach a point of being inactivated,” because LithoRec’s “continuous process” involves “a steady supply of new comminuted material containing various solvents, and some will preferentially evaporate before others.” PO Resp. 24–25 (citing Ex. 1016, 227; Ex. 2025 ¶¶ 119–120, 145.1–145.2, 160–161, 169.1). As discussed above, however, LithoRec discloses both batch drying and continuous drying within the same process arrangement, and it discloses that the drying process reaches the endpoint at which “the potential hazard of flammable solvents” has been “eliminate[d].” Ex. 1016, 226. Thus, the fact that one version of the drying process LithoRec discloses might not achieve inactivation is immaterial to whether LithoRec discloses the present limitation of claim 12.

For these reasons, we find that LithoRec discloses “an inactivation device comprising a drying device configured to inactivate the comminuted material.”

*d) “Wherein the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit”*

Claim 12 recites that “the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this limitation. Pet. 45. Patent Owner does not dispute this argument. PO Resp. 14–40. In the process of LithoRec, the comminution step occurs before the drying step. Ex. 1016, 230. Accordingly, we find that LithoRec discloses that “the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit.”

- e) *“A filling device configured to fill a transport container with the inactivated comminuted material”*

Claim 12 recites “a filling device configured to fill a transport container with the inactivated comminuted material.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this limitation. Pet. 46–47. Patent Owner does not dispute this argument. PO Resp. 14–40. LithoRec discloses that the “active mass,” the battery material that has been comminuted and dried to a “powder form, is fed by means of a suitable screw conveyer (3.19) to a drum filler with palletizing device (3.20) and packaged.” Ex. 1016, 227, 228, 230. Thus, we find that LithoRec discloses “a filling device configured to fill a transport container with the inactivated comminuted material.”

- f) *“A vacuum installation connected to the drying device and configured to generate a vacuum in the drying device”*

Claim 12 recites “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.” Ex. 1001, 11:48–61. Petitioner argues that LithoRec discloses this limitation. Pet. 47–49; Pet. Reply 6–8. Patent Owner disagrees. PO Resp. 16–21; PO Sur-reply 4–6.

LithoRec discloses that “some of the liquids to be vaporized are highly flammable solvents,” so “the drying temperature should probably be severely restricted,” which “speaks in favor of drying under vacuum, as the drying temperature can [thus] be kept low.” Ex. 1016, 226. Thus, it discloses operating its drying process at vacuum pressure and suggests that doing so is preferable to operating at higher pressures, such as atmospheric pressure.

Against this evidence, Patent Owner makes several arguments. First, Patent Owner argues that “Petitioner does not identify any structure corresponding to the claimed ‘vacuum installation’” and that “LithoRec’s speculative suggestion that drying could occur under a vacuum” does not “constitute[] sufficient express disclosure” of such structure. PO Resp. 16–17. We are not persuaded by this argument. First, LithoRec does not merely, as Patent Owner argues, “speculative[ly] suggest[] that drying could occur under a vacuum.” *Id.* at 16. Instead, it discloses that vacuum drying is preferred in order to “severely restrict[]” the temperature reached during the drying process. Ex. 1016, 226. According to LithoRec, this is a safety measure necessitated by the fact that “some of the liquids to be vaporized are highly flammable solvents.” *Id.* Second, Petitioner does identify structure that a person of ordinary skill in the art immediately would have envisaged as necessary to produce the vacuum that LithoRec discloses using in its drying process. Pet. 47–48; Pet. Reply 6. Supporting Petitioner’s identification of this structure is Mr. Spies’s testimony that “a dryer cannot operate under vacuum,” as LithoRec discloses is preferable, “without a vacuum installation that generates the vacuum in the dryer.” Ex. 1023 ¶¶ 19–20 (citing Ex. 1016, 98; Ex. 1024; Ex. 1025; Ex. 1026). To the extent that LithoRec’s disclosure could be considered limited to continuous dryers, which, as discussed above, we find that it is not, Mr. Spies testifies that continuous vacuum dryers were known in the art. Ex. 1023 ¶ 36 (citing Ex. 1029, 1–2).

Second, Patent Owner argues that LithoRec fails to “expressly disclose[] any dryer in sufficient detail” other than “a ‘vibratory fluidized bed dryer,’” which cannot operate under a vacuum. PO Resp. 17–18 (citing

Ex. 1016, 222, 226, 227, 235; Ex. 2025 ¶¶ 68, 71–72, 74, 92–99.3, 150–158, 165–167.2, 168; Ex. 2026). As discussed above, however, in addition to a detailed disclosure of a vibratory fluidized bed dryer system, LithoRec discloses drying under vacuum, and Mr. Spies testifies that a person of ordinary skill in the art would have understood that “the mere existence of a vacuum dryer (such as the one disclosed in LithoRec . . . ) means that a vacuum installation to the extent recited in claim 12 [would] be present with that vacuum dryer.” Ex. 1003 ¶¶ 151–153 (citing Ex. 1016, 226); *see* Ex. 1023 ¶¶ 19–20.

Patent Owner’s next argument, that LithoRec’s disclosure of a non-vacuum “cross-flow hogger” for comminution, “installed on a shared nitrogen line with the vibratory fluidized bed dryer,” demonstrates that, in LithoRec, “a vacuum is not used,” is similar. PO Resp. 18 (citing Ex. 1016, 227, 230, 235; Ex. 2025 ¶¶ 100–108.1, 112, 154, 167.1). LithoRec discloses the use of a dryer in its process. Ex. 1016, 226, 230. It discloses that the dryer may operate in either batch mode or continuously. *Id.* at 226. And it discloses that the dryer should operate under a vacuum. *Id.* Thus, the evidence of record shows that LithoRec discloses drying under a vacuum, not merely doing so at a higher pressure using a vibratory fluidized bed dryer.

Finally, Patent Owner argues that, “[a]t most, LithoRec contemplates the possibility of using vacuum” and that “[a] mere suggestion to use vacuum is not a disclosure of a vacuum installation.” PO Resp. 18–19. Patent Owner is incorrect regarding LithoRec’s disclosure of drying under vacuum. Far from a mere contemplation of the possibility, as Patent Owner argues, the disclosure in LithoRec is that vacuum drying is preferred in order

to “severely restrict[]” the temperature reached during the drying process. Ex. 1016, 226. According to LithoRec, this is a safety measure necessitated by the fact that “some of the liquids to be vaporized are highly flammable solvents.” *Id.*

Patent Owner is correct that we are not permitted “to fill in missing limitations simply because a skilled artisan would immediately envision them.” PO Resp. 19 (quoting *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co., Ltd.*, 851 F.3d 1270, 1274–75 (Fed. Cir. 2017)). But “even if a piece of prior art does not expressly disclose a limitation, it anticipates if a person of ordinary skill in the art would understand the prior art to disclose the limitation and could combine the prior art description with his own knowledge to make the claimed invention.” *Arthrocare*, 406 F.3d at 1374 (citing *Helifix*, 208 F.3d at 1347). Here, the preponderance of the evidence of record shows that LithoRec discloses drying under a vacuum, lacking only disclosure of the specific equipment needed to produce that vacuum, and Mr. Spies testifies that a person of ordinary skill in the art would have known what equipment was needed and could have immediately envisioned that equipment. Ex. 1003 ¶¶ 151–153; Ex. 1016, 226; Ex. 1023 ¶¶ 19–20. With respect to claim 12, which requires only “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device,” LithoRec discloses only two options: drying using a vibratory fluidized bed dryer or drying under vacuum, with the machinery associated with the latter option not being described in detail. Ex. 1016, 226–227. All that is being filled in is the identity of the specific equipment used to generate the vacuum whose use LithoRec encourages, and this equipment was well-known to a person of ordinary skill in the art

seeking to follow LithoRec’s disclosed recommendation to dry under a vacuum. Ex. 1003 ¶¶ 151–153; Ex. 1023 ¶¶ 19–20.

For these reasons, we find that LithoRec discloses “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.”

*g) Conclusion Regarding Claim 12*

Based on the record developed at trial, we find that Petitioner has shown by a preponderance of the evidence that claim 12 is unpatentable as anticipated by LithoRec.

*4. Claim 13*

Claim 13 depends from claim 12 and recites that “the drying device is configured to dry the comminuted material until an electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Ex. 1001, 11:62–12:3. Petitioner argues that LithoRec discloses this limitation. Pet. 49–50; Pet. Reply 15. Patent Owner disagrees. PO Resp. 39; PO Sur-reply 11–12.

LithoRec discloses that the drying process “eliminates the potential hazard of flammable solvents,” as well as that, once “all volatile, highly flammable solvents have been removed during the drying process, no explosion protection is required” in later processing steps. Ex. 1016, 226, 229. Mr. Spies testifies that, when the hazard of flammable solvents is eliminated, “the electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Ex. 1003 ¶ 156; *see also* Ex. 1023 ¶ 43 (Spies testifying that “the flammable solvents (electrolytes) being evaporated are the elements needed for electrochemical reactions,” so their absence “would make electrochemical reactions impossible”). Thus,

there is sufficient evidence to find that LithoRec discloses that “the drying device is configured to dry the comminuted material until an electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.”

Against this evidence, Patent Owner argues that “[t]he most that LithoRec discloses are certain goals of removing solvents to render the battery material safe,” which “fall short of a disclosure that the device is configured to dry the battery material to a point that an electrochemical reaction is impossible.” PO Resp. 39 (citing Ex. 1016, 226, 229; Ex. 2025 ¶ 169.1). We disagree with Patent Owner’s interpretation of LithoRec’s disclosure. The statement in LithoRec that the drying “step eliminates the potential hazard of flammable solvents” is not merely the disclosure of a “goal[] of removing solvents to render the battery material safe,” as Patent Owner argues. *Id.*; Ex. 1016, 226. Instead, it is a disclosure of the result of the drying operation: not simply a reduction of risk, but a complete elimination of any hazard due to the presence of flammable solvents. Moreover, LithoRec also discloses that, once “all volatile, highly flammable solvents have been removed during the drying process, no explosion protection is required” in later processing steps. Ex. 1016, 229. This is not merely a description of a goal, but a disclosure of the result of the drying process. However the drying process of LithoRec is configured, the clear disclosure of LithoRec is that the process must be configured in such a way as to produce material in which “the potential hazard of flammable solvents” has been “eliminate[d],” and, if it is configured so as to remove “all volatile, highly flammable solvents,” then “no explosion protection is required” in later processing steps. *Id.* at 226, 229. The testimony of Mr. Spies

additionally informs us that the absence of the evaporated solvents “would make electrochemical reactions impossible” and that, once the hazard of flammable solvents is eliminated, “the electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Ex. 1003 ¶ 156; Ex. 1023 ¶ 43.

For these reasons, we find that Petitioner has shown by a preponderance of the evidence that claim 13 is unpatentable as anticipated by LithoRec.

*5. Claim 15*

Claim 15 depends from claim 12 and recites

a hard metal detachment device and/or a light fraction detachment device;

a separation device configured to separate active material from a carrier such that an active material fraction and a carrier fraction occur; and

a second filling device configured to separately fill the active material fraction and the carrier fraction in respective containers.

Ex. 1001, 12:7–17. Petitioner argues that LithoRec discloses this claim. Pet. 50–54. Patent Owner does not dispute Petitioner’s argument. PO Resp. 14–40. LithoRec discloses a “second sorting step” that “is intended for the rough separation of heavy parts (housing parts, bridges, nuts, bolts and the like)” from a “light fraction” that “largely consists of foils (copper, aluminum, plastic) and the active mass to be recovered as powder.” Ex. 1016, 227, 228. It also discloses “sieving at e.g. 1 mm sieve mesh width” to separate “the active mass from the granulator’s comminution product” and that, “with this screen mesh size, the pulverized active mass can be separated very reliably from the films.” *Id.* at 228. In addition,

LithoRec discloses that the “active mass in powder form” is sent “to a drum filler with palletizing device” and that “[t]he metal foils” are sent to “buffer containers” that “can hold at least one day’s production” before being sent to a “briquette press.” *Id.* at 228, 229. For these reasons, we find that Petitioner has shown by a preponderance of the evidence that claim 15 is unpatentable as anticipated by LithoRec.

*6. Claim 16*

Claim 16 depends from claim 15 and recites that “the carrier fraction are aluminum and copper foils.” Ex. 1001, 12:18–19. Petitioner argues that LithoRec discloses this claim. Pet. 54. Patent Owner does not dispute Petitioner’s argument. PO Resp. 14–40. LithoRec discloses that “[t]he light fraction largely consists of foil (copper, aluminum, plastic).” Ex. 1016, 228. For these reasons, we find that Petitioner has shown by a preponderance of the evidence that claim 16 is unpatentable as anticipated by LithoRec.

*7. Claim 18*

Claim 18 depends from claim 15 and recites that “the separation device is a second comminution device.” Ex. 1001, 12:22–24. Petitioner argues that LithoRec discloses this claim. Pet. 54–55. Patent Owner does not dispute Petitioner’s argument. PO Resp. 14–40. LithoRec discloses that its “light classifier” separation device includes a “granulator” to carry out “disintegration comminution.” Ex. 1016, 228. According to LithoRec, this “disintegration shredding process should remove the active mass as completely as possible from the metal foils without shredding these foils too finely.” *Id.* For these reasons, we find that Petitioner has shown by a preponderance of the evidence that claim 18 is unpatentable as anticipated by LithoRec.

8. *Claim 19*

Claim 19 depends from claim 12 and recites that “the batteries are lithium batteries.” Ex. 1001, 12:25–26. Petitioner argues that LithoRec discloses this claim. Pet. 55. Patent Owner does not dispute Petitioner’s argument. PO Resp. 14–40. LithoRec refers to the “‘LithoRec – Recycling of lithium-ion batteries’ project,” and it discloses that “[b]attery types to be processed are Li-ion accumulators in the form of traction batteries, hybrid batteries and plug-in batteries.” Ex. 1016, 1, 222. For these reasons, we find that Petitioner has shown by a preponderance of the evidence that claim 19 is unpatentable as anticipated by LithoRec.

*E. Asserted Obviousness over LithoRec and Hanisch*

Petitioner argues that claim 17 would have been obvious over the combination of LithoRec and Hanisch. Pet. 56–57. Patent Owner disagrees. PO Resp. 39–40, 53–61.

1. *Overview of Hanisch*

Hanisch is a published patent application titled “Method for reclaiming active material from a galvanic cell and active material separation installation, in particular active metal separation installation.” Ex. 1020, 1. It relates to “a method for reclaiming active material, in particular lithium or lithium compounds, from a galvanic cell.” *Id.* The method includes

the steps of (a) crushing the cells, in particular under inert gas, in such a way that solid cell fragments are at least additionally formed, (b) heating the solid cell fragments to a decomposition temperature selected high enough that the binder decomposes and/or evaporates, in such a way that heat-treated cell fragments are formed, and (c) classifying the heat-treated cell fragments.

*Id.* “The heating of cell fragments [up] to the decomposition temperature is preferably carried out under inert gas or in a vacuum.” *Id.* at 5.

The method of Hanisch additionally “preferably comprises the step whereby, before the cell fragments are heated to the decomposition temperature, the cell fragments are dried at a drying temperature, in such a way that dry cell fragments and drying vapours arise, at least part of the drying vapours being condensed.” *Id.* Hanisch teaches that “[t]his has the advantage that the electrolyte solvent can be reclaimed. In this context, it is advantageous for the drying temperature to be below 100 °C, in particular below 80 °C.” *Id.*

Hanisch also teaches that “[a]n air jet sieve 50 is arranged downstream from the oven 44 in terms of the material flow direction.” Ex. 1020, 8. In addition, Hanisch teaches that the use of its air jet sieve device achieves a “high level of separation.” *Id.* at 6.

## 2. *Analysis*

Claim 17 depends from claim 15 and recites that “the separation device is an air jet sieving device.” Ex. 1001, 12:20–21. Petitioner argues that “Hanisch teaches using an air jet sieve to separate active material from foil” and that a person of ordinary skill in the art would have had reason to combine the teachings of Hanisch with those of LithoRec. Pet. 56–57.

Patent Owner does not challenge the merits of Petitioner’s arguments that Hanisch teaches using an air jet sieve device or that a person of ordinary skill in the art would have had a reason to combine the teachings of Hanisch with those of LithoRec. PO Resp. 39–40. Patent Owner does, however, argue that objective indicia of nonobviousness demonstrate that claim 17 would not have been obvious over the combination of LithoRec and

Hanisch. *Id.* at 53–61. In particular, Patent Owner argues that “long-felt need, unexpected results, commercial success, and licensing . . . confirm patentability.” *Id.* We consider the parties’ arguments below.

*a) Hanisch teaches that the separation device is an air jet sieving device*

Hanisch teaches that “[a]n air jet sieve 50 is arranged downstream from the oven 44 in terms of the material flow direction.” Ex. 1020, 8. This device separates “[t]he active material particles” from “[t]he foil fraction.” *Id.* at 8–9. Accordingly, Hanisch teaches that the separation device is an air jet sieving device.

*b) Petitioner has shown a reason to combine the teachings of Hanisch and LithoRec*

Hanisch teaches that the use of its air jet sieve device achieves a “high level of separation.” *Id.* at 6. This benefit provides a reason for a person of ordinary skill in the art to have combined Hanisch’s teaching of using an air jet sieve device with LithoRec’s teachings regarding the claims discussed above. *Id.* at 6.

*c) Patent Owner has not established that objective indicia confirm the patentability of claim 17*

“[F]or objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33, 32 (PTAB Jan. 24, 2020) (precedential) (citing *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016)). A patentee is entitled to a presumption of nexus “when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘embodies the claimed features, and is coextensive with them.’” *Fox*

*Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018) (quoting *Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000))). “A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations.” *Fox Factory*, 944 F.3d at 1373. “To the contrary, the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* at 1373–74 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)). “Where the offered secondary consideration actually results from something other than what is both claimed and *novel* in the claim, there is no nexus to the merits of the claimed invention,” meaning that “there must be a nexus to some aspect of the claim not already in the prior art.” *In re Kao*, 639 F.3d 1057, 1068–69 (Fed. Cir. 2011) (emphasis in original). On the other hand, there is no requirement that “objective evidence must be tied exclusively to claim elements that are not disclosed in a particular prior art reference in order for that evidence to carry substantial weight.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1331 (Fed. Cir. 2016). A patent owner may show, for example, “that it is the claimed combination as a whole that serves as a nexus for the objective evidence; proof of nexus is not limited to only when objective evidence is tied to the supposedly ‘new’ feature(s).” *Id.* Ultimately, the fact finder must weigh the secondary considerations evidence presented in the context of whether the claimed invention as a whole would have been obvious to a skilled artisan. *Id.* at 1331–32.

Here, Patent Owner argues that it “is entitled to the rebuttable presumption of a nexus between the objective evidence of nonobviousness and the Challenged Claims because the evidence is tied to a specific process, Duesenfeld’s battery recycling process at its Wendeburg Plant, and that process is the invention disclosed and claimed in the Challenged Claims.” PO Resp. 59 (citing Ex. 2025 ¶¶ 176–177; Ex. 2036, Appx. D; Ex. 2040). The evidence to which Patent Owner directs us includes the testimony of Mr. Dantam that “the Wendeburg Plant . . . practices the ’097 claimed invention.” Ex. 2025 ¶ 176 (citing Ex. 2036, Appx. D; Ex. 2037; Ex. 2040 ¶¶ 1–9; Ex. 2041; Ex. 2053). Both Patent Owner and Mr. Dantam cite the claim chart included in Exhibit 2036,<sup>6</sup> with Mr. Dantam testifying that the “chart illustrat[es], on a per-limitation basis, how Duesenfeld’s Wendeburg Plant practices Independent Claims 1 and 12 and various dependent claims.” *Id.* Exhibit 2036 contains evidence that the plant in question practices claims 1, 3, 8, 9, 10, 12, and 19 of the ’097 patent. Ex. 2036, 1–23. It contains no evidence with respect to whether the plant practices claim 17. *Id.* Accordingly, Patent Owner directs us to no evidence that there is a presumption of nexus between the asserted objective indicia of nonobviousness and claim 17, the only claim challenged as obvious over the combination of LithoRec and Hanisch. Petitioner challenges claims 12, 13, 15, 16, 18, and 19 as anticipated, and evidence of objective indicia of

---

<sup>6</sup> Both Patent Owner and Mr. Dantam refer to an “Appendix D” to Exhibit 2036, but the exhibit does not contain any appendices. PO Resp. 58; Ex. 2025 ¶ 177; *see* Ex. 2036. We treat the citations to Exhibit 2036 as referring to the claim chart that forms the entire content of the exhibit.

nonobviousness “simply is not relevant or material” to the anticipation inquiry. *In re Wiggins*, 488 F.2d 538, 543 (CCPA 1973).

Patent Owner also argues “that the ‘unique characteristics of the claimed invention’ of the ’097 patent are driving the commercial success of Duesenfeld’s battery recycling processes.” PO Resp. 60 (quoting *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023)). In particular, Patent Owner cites evidence that “[a]dvertisements for Duesenfeld’s battery recycling process tout the benefits of the patented ’097 ‘vacuum drying’ technology.” *Id.* (citing Ex. 2012; Ex. 2053, 3, 5). The cited evidence refers to “processes that do not require melting down or high-temperature treatment of batteries,” to “[d]rying below 80 degrees Celsius,” to “the drying process tak[ing] place below 80°C and at a low vacuum,” to “no exhaust gas scrubbing [being] necessary,” to “the solvents of the electrolyte, the graphite and the lithium be[ing] recovered in a purity so that they can be reused,” to “[a] low process temperature prevent[ing] the formation of toxic gases,” and to “[t]he separated solvent ha[ving] a very high purity level because the production of hydrogen fluoride from reaction products is avoided.” Ex. 2012; Ex. 2053, 3, 5. None of this evidence mentions or relates to the air jet sieving device of claim 17, nor does Patent Owner argue that it does. PO Resp. 60; Ex. 2012; Ex. 2053, 3, 5. Accordingly, Patent Owner has not shown a nexus between the asserted objective indicia of nonobviousness and claim 17.

### *3. Conclusion*

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 17 is unpatentable because it would have been obvious over the combination of LithoRec and Hanisch.

*F. Asserted Obviousness over LithoRec, DIN 28400, and Perry*

Petitioner argues that claims 1–3, 7, 8, and 10 would have been obvious over the combination of LithoRec, DIN 28400, and Perry. Pet. 17–35; Pet. Reply 16–27. Petitioner also argues that claim 9 would have been obvious over the combination of LithoRec, DIN 28400, Perry, and Hanisch. *Id.* at 35–38; Reply 23–27. Patent Owner disagrees with both of these arguments. PO Resp. 40–61; PO Sur-reply 12–25.

*1. Overview of DIN 28400*

DIN 28400 is a glossary that provides “Terms and Definitions” of “General terms” related to “Vacuum technology.” Ex. 1018, 1. The definitions are provided “[i]n conjunction with International standard ISO 3529-1:1981 published by the International Organization for Standardization (ISO).” *Id.* DIN 28400 provides a definition for “Vacuum,” disclosing that “Vacuum refers to the state of a gas when the pressure of the gas, and thus the number density of molecules, in a container is lower than outside.” *Id.* ¶ 1.1. Alternatively, DIN 28400 defines vacuum as “refer[ring] to the state of a gas . . . when the pressure of the gas is lower than 300 mbar, i.e. lower than the lowest atmospheric pressure on the Earth’s surface.” *Id.* In addition, DIN 28400 provides pressure ranges corresponding to “Rough (low) vacuum,” “Medium vacuum,” “High vacuum HV,” and “Ultra-high vacuum UHV.” *Id.* at Table 1. For “Rough (low) vacuum,” the applicable pressure range is disclosed to be “ $1 \cdot 10^5$  to  $1 \cdot 10^2$ ” Pascals, which we note is a range of 1 to 1000 hPa. *Id.*

*2. Overview of Perry*

Perry is a copy of the Seventh Edition of Perry’s Chemical Engineers’ Handbook, an engineering reference book. Ex. 1006. A portion of Perry

discloses information about “Batch Through-Circulation Dryers,” including “Vacuum-Shelf Dryers,” which Perry describes as “indirect-heated batch dryers consisting of a vacuum[-]tight chamber usually constructed of cast iron or steel plate, heated supporting shelves within the chamber, a vacuum source, and usually a condenser.” *Id.* at 12-44. According to Perry, these dryers “are used extensively for drying pharmaceuticals, temperature-sensitive or easily oxidizable materials, and materials so valuable that labor cost is insignificant,” and they “operate in the range of 1 to 25 mmHg pressure.” *Id.* at 12-44–12-45.

3. *Analysis of Claim 1*

a) *“Wherein the drying occurs at a maximum pressure of 300 hPa”*

Claim 1 recites “wherein the drying occurs at a maximum pressure of 300 hPa.” Ex. 1001, 10:58–59. Petitioner contends that DIN 28400 and Perry each teach or suggest this limitation and that a person of ordinary skill in the art would have had a reason to combine the teachings of these references with those of LithoRec. Pet. 24–28.

(1) *Combination of LithoRec and DIN 28400*

Petitioner argues that “LithoRec discloses general conditions at which drying should occur, including keeping pressures low in order accommodate the evaporation of highly flammable solvents” but that “LithoRec does not explicitly teach a specific vacuum pressure to be used.” *Id.* at 25. Instead, Petitioner argues first that “DIN 28400 teaches the conditions that define a vacuum according to the international standard ISO 3529-1: 1981 that was issued by the International Organization for Standardization (ISO)” and that “[o]ne of the conditions that meets the international standard ISO 3529-1:

1981 for a vacuum is that the pressure is between 0 and 300 millibars (i.e., between 0 and 300 hPa).” *Id.* at 25–26 (citing Ex. 1018 ¶ 1.1). For this reason, Petitioner argues that a pressure of 300 hPa or less “was well known for producing a vacuum,” “was part of the international standard and thus certainly would have been used by a [person of ordinary skill in the art] who already knew to implement a dryer with a vacuum from LithoRec.” *Id.* at 26.

We do not find Petitioner’s argument persuasive. First, although DIN 28400 states that one definition of a vacuum is “the state of a gas . . . when the pressure of the gas is lower than 300 mbar,” it also defines a vacuum as “the state of a gas when the pressure of the gas, and thus the number density of molecules, in a container is lower than outside,” and it includes pressures as high as 1000 hPa in its definition of “Rough (low) vacuum.” Ex. 1018 ¶ 1.1, Table 1. Petitioner does not explain why a person of ordinary skill in the art would have chosen the 300-mbar definition over either of the other definitions, neither of which is limited to the “maximum pressure of 300 hPa” of claim 1. Pet. 25–26. Moreover, Petitioner does not cite any evidence to support its contention that, because a pressure of 300 hPa or less “was part of the international standard,” it “certainly would have been used by a [person of ordinary skill in the art] who already knew to implement a dryer with a vacuum from LithoRec.” *Id.* at 26.

In its Reply, Petitioner argues that “[t]he claimed ‘300 hPa or less’ pressure range would have been obvious over LithoRec because a POSITA—at a minimum—would have easily achieved the claimed pressure range through routine optimization of known result-effective variables.” Pet. Reply 16 (citing Ex. 1023 ¶ 39). This argument is supported by the

testimony of Mr. Spies and Mr. Dantam that optimizing the operating pressure and temperature was a standard part of the design of drying systems. Ex. 1023 ¶ 39; Ex. 1039, 15:15–20:2. But this argument is not the same argument that Petitioner proposed in the Petition. *Compare* Pet. Reply 16–19, *with* Pet. 24–28. Although “the introduction of new evidence in the course of the trial is to be expected in *inter partes* review trial proceedings,” *Genzyme Therapeutic Prods. LP v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1366 (Fed. Cir. 2016), the shifting of arguments is not, *Wasica Fin. GmbH v. Cont’l Auto. Sys., Inc.*, 853 F.3d 1272, 1286 (Fed. Cir. 2017). Accordingly, we consider this argument untimely and do not rely on it in our analysis.

*(2) Combination of LithoRec and Perry*

As noted above, Petitioner argues that “LithoRec discloses general conditions at which drying should occur, including keeping pressures low in order accommodate the evaporation of highly flammable solvents” but that “LithoRec does not explicitly teach a specific vacuum pressure to be used.” *Id.* at 25. Petitioner argues next that “Perry includes a section devoted to vacuum dryers and teaches an operating pressure range for an exemplary type of vacuum dryer,” specifically a “[s]helf vacuum dryer[,]” which “‘operate[s] in the range of 1 to 25 mmHg pressure’ (1.33 to 33.33 hPa).” *Id.* at 26 (quoting Ex. 1006, 12-45). According to Petitioner, because “Perry provides a concrete example of a vacuum dryer operating within the claimed range, . . . a [person of ordinary skill in the art] would have been motivated to select a vacuum pressure for the dryer of LithoRec within the claimed range.” *Id.*

We do not find Petitioner’s argument persuasive. Petitioner does not explain why a person of ordinary skill in the art would have considered Perry’s teachings regarding a shelf vacuum dryer to define the operating pressure for the vacuum dryer of LithoRec. *Id.* This lack of explanation is particularly troublesome given the teachings of LithoRec that “batch drying is not used” and of Perry that “[v]acuum-shelf dryers are indirect-heated batch dryers.” Ex. 1006, 12-44; Ex. 1016, 226.

For the same reasons discussed above with respect to the combination of LithoRec and DIN 28400, we determine that Petitioner’s argument in its Reply that “[t]he claimed ‘300 hPa or less’ pressure range would have been obvious over LithoRec because a POSITA—at a minimum—would have easily achieved the claimed pressure range through routine optimization of known result-effective variables,” Pet. Reply 16, is untimely.

*b) Conclusion Regarding Claim 1*

Petitioner has not shown sufficiently that a person of ordinary skill in the art would have combined the teachings of DIN 28400 or Perry with those of LithoRec to arrive at the maximum drying pressure of 300 hPa recited in claim 1. Accordingly, Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over the combination of LithoRec, DIN 28400, and Perry.

*4. Claims 2, 3, and 7–10*

As discussed above, Petitioner does not show by a preponderance of the evidence that claim 1 would have been obvious over the combination of LithoRec, DIN 28400, and Perry. Petitioner relies on its arguments with respect to claim 1 in arguing for the obviousness of claims 2, 3, and 7–10, all of which depend from claim 1. Pet. 28–35, 37–38; *see* Ex. 1001, 10:60–65,

11:16–31. Accordingly, Petitioner does not show by a preponderance of the evidence that claims 2, 3, 7, 8, and 10 would have been obvious over LithoRec, DIN 28400, and Perry, or that claim 9 would have been obvious over LithoRec, DIN 28400, Perry, and Hanisch.

### III. MOTION TO AMEND

Patent Owner moves to amend the Challenged Claims, “contingent upon the Board’s determinations of patentability for originally-issued claims.” Mot. Amend 7. In particular, Patent Owner requests replacement “of issued claims 1, 2, 3, 8, 12, 13, 16, and/or 19” with proposed claims 22–29, respectively, but Patent Owner requests that we “not consider this motion for any of issued claims 1, 2, 3, 8, 12, 13, 16, and/or 19 that the Board finds to be patentable.” *Id.* at 7, 20–26. As discussed above, we determine that Petitioner has not shown the unpatentability of any of claims 1–3 or 8, so we do not consider Patent Owner’s motion to amend with respect to the replacement of those claims with proposed claims 22–25. We determine that Petitioner has shown, however, the unpatentability of claims 12, 13, 16, and 19, so we proceed to consider Patent Owner’s motion to amend with respect to the replacement of those claims with proposed claims 26–29.

#### *A. Legal Standards*

“During an inter partes review . . . , the patent owner may file 1 motion to amend the [challenged] patent” by “[c]ancel[ing] any challenged patent claim” or, “[f]or each challenged claim, propos[ing] a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1). “An amendment . . . may not enlarge the scope of the claims of the patent or introduce new matter.” *Id.* § 316(d)(3). “Any motion to amend may be denied where . . .

[t]he amendment does not respond to a ground of unpatentability involved in the trial; or . . . [t]he amendment seeks to enlarge the scope of the claims of the patent or introduce new subject matter.” 37 C.F.R. § 42.121(a)(2). The motion “may cancel a challenged claim or propose a reasonable number of substitute claims. The presumption is that only one substitute claim will be needed to replace each challenged claim, and it may be rebutted by a demonstration of need.” *Id.* § 42.121(a)(3).

Patent Owner bears the ultimate burden to show that its motion to amend complies with the requirements of 35 U.S.C. § 316(d)(1), (3) and 37 C.F.R. § 42.121(a)(2), (a)(3), (b)(1), and (b)(2). 37 C.F.R. § 42.121(d)(1). Petitioner bears the ultimate burden to show that any proposed substitute claims are unpatentable. 37 C.F.R. § 42.121(d)(2).

*B. Statutory and Regulatory Requirements*

*1. Reasonable Number of Substitute Claims*

A motion to amend must propose a reasonable number of substitute claims, and there is a presumption that only one substitute claim will be needed to replace each challenged claim. 35 U.S.C. § 316(d)(1)(B); 37 C.F.R. § 42.121(a)(3). Petitioner does not raise any argument on this issue. Pet. Opp. 1–24; Pet. Sur-reply 1–12. Patent Owner proposes eight substitute claims to replace eight challenged claims, and Patent Owner proposes four substitute claims to replace the four challenged claims that we determine Petitioner has shown are unpatentable. Mot. Amend 8–10. Accordingly, Patent Owner has shown it proposes a reasonable number of substitute claims.

*2. Respond to Ground of Unpatentability*

A motion to amend must respond to a ground of unpatentability involved in the proceeding. 37 C.F.R. § 42.121(a)(2)(i). Petitioner does not raise any argument on this issue. Pet. Opp. 1–24; Pet. Sur-reply 1–12. Patent Owner notes that “each of claims 22-29 now contains a limitation requiring a dryer, or drying, operating in a batch mode.” Mot. Amend 17; *see also* Mot. Amend at 20–26 (Claim Listing). Patent Owner contends that “LithoRec’s drying device, however, is not a batch drying device, and LithoRec in fact teaches away from the use of batch drying devices.” *Id.* at 17. Patent Owner quotes LithoRec’s teaching that, “[f]or this reason, batch drying is not used.” *Id.* (quoting Ex. 1016, 226). Patent Owner further contends that “each of the claims excludes LithoRec, and the combination of LithoRec with another reference to reach the new claims would not have the necessary motivation, especially given LithoRec’s express teaching away.” *Id.* Accordingly, Patent Owner has shown that the motion to amend responds to a ground of unpatentability involved in this proceeding.

*3. Scope of Amended Claims*

A motion to amend may not enlarge the scope of the claims of the patent. 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). Petitioner does not raise any argument on this issue. Pet. Opp. 1–24; Pet. Sur-reply 1–12. Patent Owner argues that “each Proposed Substitute Claim begins with the language of either independent claim 1 or independent claim 12, and provides only narrowing amendments thereto.” Mot. Amend 12. Our review of proposed claims 26–29 shows that Petitioner is correct in its assertion that each of these claims narrows claim 12. *Id.* at 23–26.

Accordingly, Patent Owner's Motion has not enlarged the scope of the claims of the patent.

*4. New Matter*

A motion to amend may not introduce new subject matter. 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). Petitioner does not raise any argument on this issue. Pet. Opp. 1–24; Pet. Sur-reply 1–12. Patent Owner identifies support in the application that matured into the challenged patent (the '484 application) for each limitation of each proposed substitute claim. Mot. Amend 14–17. Accordingly, Patent Owner's Motion has not introduced new subject matter.

*C. Asserted Unpatentability of Claims 26–29*

Petitioner argues that claims 26–29 are unpatentable because they would have been obvious over various combinations of prior art. Pet. Opp. 1–23; Pet. Sur-reply 1–11. In particular, Petitioner argues that claims 26–28 would have been obvious over the combination of LithoRec and Perry; claims 26–29 would have been obvious over the combination of LithoRec and Uchida;<sup>7</sup> and claims 26–29 would have been obvious over the combination of LithoRec, Mitsubishi,<sup>8</sup> and Perry. *Id.* Patent Owner disagrees with each of Petitioner's arguments. PO Reply 2–12.

*1. Asserted Obviousness over LithoRec and Perry*

Petitioner argues that proposed substitute claims 26–28 would have been obvious over the combination of LithoRec and Perry. Pet. Opp. 1–13. Each of these claims recites “that the drying device operates with a pressure

---

<sup>7</sup> US 2008/0050295 A1, published Feb. 28, 2008 (Ex. 1026).

<sup>8</sup> JP 2013-4299 A, published Jan. 7, 2013 (Ex. 1031, English translation provided as Ex. 1032).

of 300 hPa or less.” Mot. Amend 23–25. Patent Owner argues that Petitioner has not shown sufficiently that the prior art teaches or suggests this limitation. PO Reply 2–7.

Petitioner argues that Perry teaches “vacuum dryers (which includes batch vacuum rotary dryers) typically operate at levels above . . . 6.7 hPa,” that Perry further teaches that “vacuum-shelf (batch) dryers operate in the range of . . . 1.3 to 33.3 hPa,” and that a person of ordinary skill in the art “would have been motivated to combine the teaching of Perry with the teaching of LithoRec since both references teach batch drying and drying under vacuum conditions in order to lower the drying temperature.” Pet. Opp. 11–12 (citing Ex. 1006, 12-45, 12-66; Ex. 1016, 226; Ex. 1030 ¶¶ 18–22). This is not a sufficient reason to combine the teachings of LithoRec and Perry. Although the argument that both references relate to batch vacuum drying may be enough to show that the two references are analogous art, *see Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238 (Fed. Cir. 2010), simply demonstrating that a set of references are all directed to the same problem is not, by itself, a sufficient rationale to combine the references. *See id.* (upon finding that two references were directed to the same problem, the Court proceeded to analyze whether a person of ordinary skill in the art would have been motivated to combine the references); *see also In re Kahn*, 441 F.3d 977, 987–88 (Fed. Cir. 2006) (noting that the inquiry as to whether a person of ordinary skill in the art would have sought to combine the references “picks up where the analogous art test leaves off”).

Petitioner also argues that “it would have been obvious to arrive at the claimed pressure range through routine optimization, because pressure and temperature were recognized as being outcome-effective variables” and

because “[a] process engineer would perform this kind of routine optimization at the time of the invention as a standard part of plant setup.” Pet. Opp. 12 (citing Ex. 1030 ¶ 22; Ex. 1039, 15:15–16:13). To show that a person of ordinary skill in the art would have arrived at the claimed invention through routine optimization, Petitioner must provide “an explanation as to *why* it would have been routine optimization.” *In re Stepan Co.*, 868 F.3d 1342, 1346 (Fed. Cir. 2017) (emphasis in original). Part of that explanation must be an identification of the variable to be optimized, the result that the prior art recognized would be affected by the variable, and “the relationship between the variable and the result.” *E.I. Dupont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1009 (Fed. Cir. 2018). Here, there is evidence in the record that “humidity levels” and “temperatures” were routinely adjusted to properly dry the appropriate mass of material. Ex. 1039, 15:15–16:1. There is also evidence in the record that pressure was a variable that would have been optimized to “mak[e] sure a dryer works” and that, in some unspecified contexts, pressure was one of “the most important variables to optimize.” *Id.* at 16:7–20. For these reasons, Mr. Spies testifies that “pressure and temperature were recognized as being outcome-effective variables.” Ex. 1030 ¶ 22. Mr. Spies and Petitioner do not explain, however, what result would have been known to be affected by the adjustment of pressure or what the known relationship between that result and pressure was. *Id.*; Pet. Opp. 11–12. In fact, there is evidence that Mr. Spies’s reference to “outcome-effective variables” was an unsupported conclusory statement that even Mr. Spies himself did not understand the basis of. Ex. 2062, 138:25–139:4 (testifying that “I don’t know what you mean by” the term “outcome-effective variable”).

Accordingly, Petitioner has not shown sufficiently that a person of ordinary skill in the art would have engaged in routine optimization of pressure to arrive at the recited pressure of 300 hPa or less.

For these reasons, Petitioner has not shown that proposed claims 26–28 would have been obvious over the combination of LithoRec and Perry.

*2. Asserted Obviousness over LithoRec and Uchida*

Petitioner argues that proposed substitute claims 26–29 would have been obvious over the combination of LithoRec and Uchida. Pet. Opp. 13–19. Each of these claims recites “that the drying device operates with a pressure of 300 hPa or less.” Mot. Amend 23–25. Patent Owner argues that Petitioner has not shown sufficiently that the prior art teaches or suggests this limitation. PO Reply 10–12.

Petitioner argues first that Uchida teaches a range of operating pressures, “1 to 500 hPa,” that overlaps with the claimed range of less than 300 hPa, and second that a person of ordinary skill in the art “would have known to optimize the pressure, temperature, and duration of the drying process.” Pet. Opp. 15–17. According to Petitioner, the pressure range recited in claims 26–29 “is merely a workable setting for evaporating dimethyl carbonate . . . at 80 °C.” *Id.* at 17.

It is true that Uchida discloses a pressure range of “0.1 to 100 kPa,” or 1 to 1000 hPa, which overlaps the recited range of 0 to 300 hPa. Ex. 1026 ¶ 74. But Patent Owner argues that the recited pressure range is critical to achieving the purpose of the invention, “fully inactivat[ing] comminuted Lithium-ion battery material . . . in a manner that would not produce HF.” PO Reply 6. We agree with Patent Owner that this is a purpose of the

claimed invention. The '097 patent describes the purpose behind “drying . . . at a maximum pressure of 300 hPa” as enabling “considerable parts of most electrolytes [to] vaporise . . . at temperatures of less than 80° C.” Ex. 1001, 3:8–12. This low drying temperature is described as having “[t]he advantage . . . that the formation of hydrogen fluoride is hindered.” *Id.* at 3:12–14. Although partial drying might occur at temperatures low enough to hinder the production of hydrogen fluoride, the proposed amended claims recite “an inactivation device . . . configured to inactivate the comminuted material,” and we construe “inactivate” as drying sufficiently to reach the endpoint of the drying process. Thus, claims 26–29 require full inactivation, and the '097 patent’s purpose is a process for accomplishing this inactivation while minimizing hydrogen fluoride production. This makes the recited range of operating pressures critical to achieving the invention’s purpose.

Uchida, on the other hand, teaches a drying process in which temperature is not restricted and in which hydrogen fluoride production is not minimized. Uchida’s drying process begins with exposing the battery material to “a temperature of about 85° C.” Ex. 1026 ¶ 76. After 30 minutes, “the temperature . . . is raised further and maintained at 102° C. for 30 minutes.” *Id.* Finally, the temperature is increased yet again and “is maintained in a temperature range equal to or greater than the thermal decomposition temperature . . . of LiPF<sub>6</sub>.” *Id.* ¶ 79. Thus, although Uchida’s disclosed range of operating pressures overlaps the claimed range, the evidence of record demonstrates the criticality of the claimed range to achieving the invention’s purpose.

We find Petitioner’s argument that a person of ordinary skill in the art “would have known to optimize the pressure, temperature, and duration of the drying process,” Pet. Opp. 15–17, unpersuasive for the same reasons as the similar argument Petitioner makes with respect to the combination of LithoRec and Perry.

For these reasons, Petitioner has not shown that proposed claims 26–29 would have been obvious over the combination of LithoRec and Uchida.

*3. Asserted Obviousness over LithoRec, Mitsubishi, and Perry*

Petitioner argues that proposed substitute claims 26–29 would have been obvious over the combination of LithoRec, Mitsubishi, and Perry. Pet. Opp. 19–23. Each of these claims recites “that the drying device operates with a pressure of 300 hPa or less.” Mot. Amend 23–25. Petitioner argues that Mitsubishi teaches this limitation and that a person of ordinary skill in the art would have had a reason to combine the teachings of Mitsubishi with those of LithoRec and Perry. Pet. Opp. 20–21. Patent Owner argues that Petitioner has not shown sufficiently that a person of ordinary skill in the art would have modified the teachings of LithoRec and Perry with those of Mitsubishi. PO Reply 12.

On the record developed during trial, we agree with Patent Owner. Petitioner’s argument that a person of ordinary skill in the art would have combined the teachings of Mitsubishi with those of LithoRec and Perry is that, because LithoRec “teaches drying electrolyte solutions under vacuum in a lithium ion battery recycling system,” and because “Mitsubishi discloses a particular pressure range for drying electrolytes under vacuum in a lithium ion battery recycling system,” a person of ordinary skill in the art “would

have applied the teaching of Mitsubishi to the system of LithoRec.” Pet. Opp. 20 (citing Ex. 1030 ¶ 45). The cited testimony of Mr. Spies repeats this argument word for word. Ex. 1030 ¶ 45.

As Patent Owner points out, there is a significant difference between Mitsubishi’s system and LithoRec’s system, even though both are designed for recycling lithium-ion batteries. In particular, Mitsubishi’s drying process is performed on whole batteries, not on the comminuted battery material of LithoRec. Ex. 1032 ¶ 18, Fig. 1; Ex. 2061, 91:21–93:10; Ex. 2062, 160:5–9. At the time of the ’097 patent, processes involving drying of comminuted battery material differed from processes involving drying whole batteries. Ex. 1001, 1:27–50. Thus, Petitioner’s argument, that, merely because both LithoRec and Mitsubishi broadly teach vacuum drying as part of a process of recycling lithium-ion batteries, a person of ordinary skill in the art would have used Mitsubishi’s pressure in LithoRec’s process, is insufficient to show a reason to combine these teachings.

For these reasons, Petitioner has not shown that proposed claims 26–29 would have been obvious over the combination of LithoRec, Mitsubishi, and Perry. Because Petitioner does not show that proposed claims 26–29 are unpatentable on any of the grounds it asserts, we grant Patent Owner’s motion to amend as to these claims.

#### IV. CONCLUSION

For the reasons set forth above, we determine that (1) Petitioner has established by a preponderance of the evidence that claims 12, 13, and 15–19 of the ’097 patent are unpatentable; (2) Petitioner has not shown the unpatentability of claims 1–3 and 7–10 of the ’097 patent; and (3) the record

supports granting Patent Owner’s Motion to Amend with respect to proposed claims 26–29.

In summary, with respect to the challenged claims of the ’097 patent:

| <b>Claim(s)</b>              | <b>35<br/>U.S.C. §</b> | <b>Reference(s)/Basis</b>                 | <b>Claim(s)<br/>Shown<br/>Unpatentable</b> | <b>Claim(s)<br/>Not Shown<br/>Unpatentable</b> |
|------------------------------|------------------------|-------------------------------------------|--------------------------------------------|------------------------------------------------|
| 1–3, 7, 8,<br>10             | 103                    | LithoRec, DIN<br>28400, Perry             |                                            | 1–3, 7, 8, 10                                  |
| 9                            | 103                    | LithoRec, DIN<br>28400, Perry,<br>Hanisch |                                            | 9                                              |
| 12, 13,<br>15, 16,<br>18, 19 | 102                    | LithoRec                                  | 12, 13, 15, 16,<br>18, 19                  |                                                |
| 17                           | 103                    | LithoRec, Hanisch                         | 17                                         |                                                |
| <b>Overall<br/>Outcome</b>   |                        |                                           | 12, 13, 15–19                              | 1–3, 7–10                                      |

In summary, with respect to Patent Owner’s Motion to Amend:

| <b>Motion to Amend Outcome</b>              | <b>Claim(s)</b> |
|---------------------------------------------|-----------------|
| Original Claims Cancelled by Amendment      | 12, 13, 16, 19  |
| Substitute Claims Proposed in the Amendment | 22–29           |
| Substitute Claims: Motion to Amend Granted  | 26–29           |
| Substitute Claims: Motion to Amend Denied   |                 |
| Substitute Claims: Not Reached              | 22–25           |

## V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown that claims 12, 13, and 15–19 of the ’097 patent are unpatentable;

FURTHER ORDERED that Petitioner has not shown that claims 1–3 and 7–10 of the ’097 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Amend is granted to the extent that claims 12, 13, 16, and 19 shall be replaced with claims 26–29, respectively;

FURTHER ORDERED that Patent Owner's Motion to Amend is moot in all other respects; 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.

**NON-PUBLIC VERSION — PROTECTIVE ORDER MATERIAL**

IPR2024-00887

Patent 11,050,097 B2

**FOR PETITIONER:**

Brian Kauffman  
Jonathan Roberts  
NIXON AND VANDERHYE, P.C.  
bkk@nixonvan.com  
jr@nixonvan.com

**FOR PATENT OWNER:**

Steven Carlson  
Samuel LaRoque  
ROBINS KAPLAN LLP  
scarlson@robinskaplan.com  
slaroque@robinskaplan.com

Mathew Smith  
Elizabeth Laughton  
SMITH BALUCH LLP  
smith@smithbaluch.com  
laughton@smithbaluch.com