

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TOPSOE, INC.,
Petitioner

v.

CASALE,
Patent Owner

IPR2025-01454
U.S. Patent No. 11,286,168

**PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE TO
PETITION FOR *INTER PARTES* REVIEW**

TABLE OF CONTENTS

Table of Contents	i
Table of Authorities	iii
Table of Exhibits Submitted With Petitioner’s Reply	vi
I. INTRODUCTION	1
II. 2007 IFA IS A PRINTED PUBLICATION.....	1
A. 2007 IFA Was Presented and Delivered Without Restriction at an Open Industry Conference.....	2
B. 2007 IFA Was Posted on the IFA’s Public Website Before the Critical Date	3
C. An Interested Skilled Artisan Actually Located and Used 2007 IFA Before the Critical Date	5
III. “FURNACE” REQUIRES NO SPECIAL CONSTRUCTION	6
A. The Exacting Lexicography Standard Is Not Met	7
B. PO’s Inconsistent Litigation Position and Extrinsic Evidence Cannot Displace the Intrinsic Record	10
IV. GROUND 1: 2007 IFA ANTICIPATES CLAIMS 1, 5, 6, AND 10; THE GROUND 1A-1E CLAIMS ARE OBVIOUS.....	11
A. Limitation 1[c]: The Fuel Fraction Is Fed as Fuel to at Least One Furnace	11
B. Claim 10	15
C. The Ground 1A Dependent Claims.....	16
V. GROUND 2: RYTTER	19
A. Limitation 1[a].....	19
B. Limitation 1[c].....	19
C. Claim 10	21
VI. GROUNDS 3, 3A, AND 3B: FJELLHAUG.....	21
A. Limitation 1[a].....	21

B. Limitation 1[c] and Claim 1023

VII. THE COMBINATION RATIONALES ARE SUPPORTED.....24

VIII. PO OFFERS NO EVIDENCE OF SECONDARY
CONSIDERATIONS.....26

IX. CONCLUSION.....26

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>3M Innovative Props. Co. v. Avery Dennison Corp.</i> , 350 F.3d 1365 (Fed. Cir. 2003).....	9
<i>Acceleration Bay, LLC v. Activision Blizzard Inc.</i> , 908 F.3d 765 (Fed. Cir. 2018).....	4
<i>Amazon.com, Inc. v. Barnesandnoble.com, Inc.</i> , 239 F.3d 1343 (Fed. Cir. 2001).....	11
<i>Anacor Pharms., Inc. v. Iancu</i> , 889 F.3d 1372 (Fed. Cir. 2018).....	6
<i>Blue Calypso, LLC v. Groupon, Inc.</i> , 815 F.3d 1331 (Fed. Cir. 2016).....	<i>Passim</i>
<i>Celeritas Techs., Ltd. v. Rockwell Int’l Corp.</i> , 150 F.3d 1354 (Fed. Cir. 1998).....	20
<i>GoPro, Inc. v. Contour IP Holding LLC</i> , 908 F.3d 690 (Fed. Cir. 2018).....	2
<i>Hill-Rom Servs., Inc. v. Stryker Corp.</i> , 755 F.3d 1367 (Fed. Cir. 2014).....	7
<i>In re Applied Materials, Inc.</i> , 692 F.3d 1289 (Fed. Cir. 2012).....	16
<i>In re Fulton</i> , 391 F.3d 1195 (Fed. Cir. 2004).....	16, 19, 22
<i>In re Keller</i> , 642 F.2d 413 (CCPA 1981)	18, 25
<i>In re Klopfenstein</i> , 380 F.3d 1345 (Fed. Cir. 2004).....	1, 4

<i>In re Stepan Co.</i> , 868 F.3d 1342 (Fed. Cir. 2017).....	23
<i>Jazz Pharms., Inc. v. Amneal Pharms., LLC</i> , 895 F.3d 1347 (Fed. Cir. 2018).....	4, 5
<i>KSR Int’l Co. v. Teleflex Inc.</i> , 550 U.S. 398 (2007).....	22, 24
<i>Mass. Inst. Tech. v. AB Fortia</i> , 774 F.2d 1104 (Fed. Cir. 1985).....	3
<i>Medichem, S.A. v. Rolabo, S.L.</i> , 437 F.3d 1157 (Fed. Cir. 2006).....	21, 22
<i>Medtronic, Inc. v. Barry</i> , 891 F.3d 1368 (Fed. Cir. 2018).....	2
<i>Merck & Co. v. Teva Pharms. USA, Inc.</i> , 395 F.3d 1364 (Fed. Cir. 2005).....	7
<i>Metalcraft of Mayville, Inc. v. Toro Co.</i> , 848 F.3d 1358 (Fed. Cir. 2017).....	23
<i>Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.</i> , 868 F.3d 1013 (Fed. Cir. 2017).....	6
<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005).....	9, 10
<i>Sinorgchem Co., Shandong v. Int’l Trade Comm’n</i> , 511 F.3d 1132 (Fed. Cir. 2007).....	9
<i>SRI Int’l, Inc. v. Internet Sec. Sys., Inc.</i> , 511 F.3d 1186 (Fed. Cir. 2008).....	5
<i>VidStream LLC v. Twitter, Inc.</i> , 981 F.3d 1060 (Fed. Cir. 2020).....	6
<i>Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.</i> 200 F.3d 795 (Fed. Cir. 1999).....	6

Statutes

35 U.S.C. § 316(e) 2
35 U.S.C. § 325(d) 19

Regulations

37 C.F.R. § 42.6(e)..... 29
37 C.F.R. § 42.64(b)(2)..... 5, 2, 7
37 C.F.R. § 42.64(c)..... 11

TABLE OF EXHIBITS SUBMITTED WITH PETITIONER'S REPLY

Exhibit	Description
1045	Declaration of Svend Erik Nielsen, Mar. 11, 2026 (served via email on Petitioner on Mar. 3, 11, 2026, pursuant to 37 C.F.R. § 42.64(b)(2))
1067	Exhibit 4 to Deposition of Dr. Colin Wolden, July 23, 2026 (demonstrative exhibit showing illustration of combined cycle gas turbine)
1068	Reply Declaration of Dr. James A. Ritter, Aug. 3, 2026

I. INTRODUCTION

The Patent Owner Response (“POR”) rests on two pillars, and neither holds. First, Patent Owner (“PO”) reads “furnace” as a closed, four-item list, a lexicography the ’168 Patent’s specification contradicts and PO abandoned when it sued Petitioner for infringement. Second, PO contends 2007 IFA is not a printed publication, though the presentation was delivered without restriction to dozens of skilled artisans at the industry’s flagship technical meeting, given to the International Fertilizer Industry Association (“IFA”) for publication on its public website, archived there by 2010, and cited with its data reproduced in a published 2009 study.

The POR never engages the Petition’s mapping of the limitations onto the prior art. It argues gas turbines are not furnaces while ignoring the fired steam boiler and steam generator disclosures the Petition cited for 2007 IFA (Pet. 17, 19-20), Rytter (Pet. 42, 45), and Fjellhaug (Pet. 57). The Challenged Claims are unpatentable under either party’s reading of “furnace,” on every instituted ground. The skill-level dispute is, as PO concedes, “immaterial.” POR 7; EX1005 ¶¶32-36.

II. 2007 IFA IS A PRINTED PUBLICATION

A reference is publicly accessible if interested, ordinarily skilled persons exercising reasonable diligence could locate it. *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016). The inquiry turns on the totality of the circumstances, *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004), on a

preponderance standard, 35 U.S.C. § 316(e). Three independent bases suffice; the second and third do not depend on EX1045.

A. 2007 IFA Was Presented and Delivered Without Restriction at an Open Industry Conference

Svend Erik Nielsen, 2007 IFA's author and presenter, establishes the circumstances of the March 2007 IFA Technical Committee Meeting under the conference-materials factors: the meeting's size and nature, its openness, and any confidentiality expectation. EX1045; *Medtronic, Inc. v. Barry*, 891 F.3d 1368, 1382-83 (Fed. Cir. 2018).

First, the audience was the interested public. Approximately 67 attendees—process and technical services managers, licensing managers, and plant directors—represented fertilizer producers and licensors including Tata Chemicals, Technip, Snamprogetti, SABIC, Petronas, and Mosaic. EX1045 ¶9. That is what the law requires. *GoPro, Inc. v. Contour IP Holding LLC*, 908 F.3d 690, 694-95 (Fed. Cir. 2018).

Second, the meeting was advertised in trade and IFA publications and open to any fertilizer-industry member. EX1045 ¶¶8, 10.

Third, there was no confidentiality expectation: no NDAs and no restrictions on notes, copying, or photographs. EX1045 ¶¶10-12. Mr. Nielsen presented 2007

IFA on March 13, 2007, to nearly all attendees. EX1045 ¶¶13-15. Dr. Wolden admits he cannot dispute these facts. EX1066, 296:7-20.

Fourth, and dispositive of PO's "transient display" argument (POR 21-23), this is not a display-only case like *Klopfenstein*, 380 F.3d at 1348-50. Mr. Nielsen delivered the complete slide set, a true and correct copy of EX1006, to the IFA for publication without confidentiality conditions. EX1045 ¶¶14, 16-17. In *MIT v. AB Fortia*, oral presentation to skilled artisans plus unrestricted paper delivery made it a printed publication. 774 F.2d 1104, 1108-09 (Fed. Cir. 1985). PO's demand for proof copies were "physically provided to attendees" (POR 21-22) misstates the law: neither hand-distribution nor indexing is required. *Klopfenstein*, 380 F.3d at 1348.

B. 2007 IFA Was Posted on the IFA's Public Website Before the Critical Date

Mr. Nielsen provided his slides to the IFA for publication on www.fertilizer.org, where the IFA posted technical-committee materials for public download, and he verified the posting. EX1045 ¶16. That he is "not an IFA employee" (POR 19) is beside the point: he testifies from personal knowledge, informed by four decades as a repeat IFA presenter. EX1045 ¶¶2, 5-6, 16.

Archival evidence corroborates him. The Wayback Machine captured the IFA's webpage for the 2007 Technical Meeting on March 10, 2010, seven years before the critical date, including a download link for 2007 IFA. EX1019; EX1005

¶88. PO's speculation that the link "might not have functioned" (POR 17) cannot overcome record proof.

PO's "2023 URL" argument (POR 18-19) fails. As PO observes, every pre-2023 IFA document carries the same /wp-content/uploads/2023/ path, the signature of a site migration, not first publication in 2023. The 2010 capture of the prior site with a live download link (EX1019) refutes PO's inference. EX1068 ¶8.

PO's indexing argument (POR 19-21) fails legally and factually. Indexing is not a *per se* requirement where dissemination through a known repository is shown. *Jazz Pharms., Inc. v. Amneal Pharms., LLC*, 895 F.3d 1347, 1359-60 (Fed. Cir. 2018); *Klopfenstein*, 380 F.3d at 1348. Unlike the obscure university listing with insufficient search capabilities in *Acceleration Bay*, the host here is the industry's own trade association, on a searchable resources page, under a conference titled "Energy Efficiency and CO₂ Reduction, Prospects in Ammonia Production." EX1005 ¶¶84-87; *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 772-73 (Fed. Cir. 2018). Dr. Ritter located the slides and the proceedings (EX1017) by searching "ammonia" and "CO₂ reduction." EX1005 ¶85. PO's expert concedes the search he ran returns the proceedings volume containing 2007 IFA. EX2007 ¶64; POR 20 n.18; EX1066, 294:20-295:16. The title recites "CO₂ Reduction Potential," hardly camouflage from artisans focused on CO₂ reduction. EX2008, 176:8-14; EX1068 ¶7; EX1066, 295:17-296:5.

PO's remaining cases sit on the other side of the line: each involved an obscure page or a bare webpage date, with no dissemination, no known repository, and no third-party use. *Blue Calypso*, 815 F.3d at 1349-50; *SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, 511 F.3d 1186, 1197 (Fed. Cir. 2008); *Adaptics Ltd. v. Perfect Co.*, IPR2018-01596, Paper 20, at 23 (PTAB Mar. 6, 2019); *ABS Global, Inc. v. Inguran, LLC*, IPR2016-00927, Paper 33, at 20-21 (PTAB Oct. 2, 2017); *Air Liquide Large Indus. U.S. LP v. Praxair Tech., Inc.*, IPR2015-01074, Paper 11, at 6 (PTAB Oct. 26, 2015). Here there are all three.

C. An Interested Skilled Artisan Actually Located and Used 2007 IFA Before the Critical Date

Actual retrieval is not required, *Jazz*, 895 F.3d at 1360, but it happened here. The Lako study, published by the Energy Research Center of the Netherlands in March 2009 and publicly available before the critical date (EX1020), cites 2007 IFA with a complete bibliographic entry (EX1020 at 44) and reproduces its data with attribution: revamped ammonia plants achieve “at best 7.1 Gcal/t NH₃ ... according to (Nielsen, 2007a),” matching 2007 IFA verbatim. Compare EX1020 at 22 with EX1006 at 2; EX1005 ¶¶89-91.

PO's counterpoints are immaterial. The “6.8 versus 6.89” discrepancy (POR 17 n.13) concerns a range endpoint in Lako's Table 3.5, presenting GJ figures alongside Lako's own Gcal conversions (28.8 GJ/t is 6.89 Gcal/t). EX1020 at 22. A

rounding artifact in one converted endpoint does not undermine the exact 7.1 match or the full citation. PO's suggestion that Lako "may have attended the conference" (POR 17-18) is speculation and self-defeating: an interested artisan obtaining the materials there is public accessibility under *MIT* and *Medtronic*. Lako cites several presentations from the same conference. EX1020 at 22, 25, 44. EX1068 ¶9. That Lako quoted one slide (POR 18) is irrelevant: accessibility attaches to the document, downloadable as a single PDF and within the proceedings PDF (EX1017), not page-by-page. EX1068 ¶¶6-7.

Mr. Nielsen's declaration is properly before the Board, timely served as supplemental evidence under 37 C.F.R. § 42.64(b)(2), which requires service rather than filing, and submitted with this Reply in response to the POR's accessibility arguments. *VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1064-65 (Fed. Cir. 2020); *Anacor Pharms., Inc. v. Iancu*, 889 F.3d 1372, 1380-81 (Fed. Cir. 2018).

III. "FURNACE" REQUIRES NO SPECIAL CONSTRUCTION

The Board need not construe "furnace": the claims are unpatentable under both the plain and ordinary meaning and PO's construction. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); *infra* §§ IV-VI. If construed, "furnace" carries its ordinary meaning: a fired heater, an

apparatus that operates by means of combustion, of which the specification's four listed apparatus are examples. EX1005 ¶¶56, 60; EX2008, 61:7-10.

A. The Exacting Lexicography Standard Is Not Met

Lexicography's standard is "exacting": a patentee must "clearly set forth a definition" and "clearly express an intent to redefine the term." *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014). Apparently definitional language does not suffice unless set forth with "reasonable clarity, deliberateness, and precision" when read against the specification as a whole. *Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1370-72 (Fed. Cir. 2005).

Read in full, the passage PO invokes is descriptive, not a closed definition. The sentence PO truncates continues: "These apparatus, which operate by means of combustion, are identified by the term 'fired heater.'" EX1001, 2:47-52. The paragraph equates "furnace" with a functional class, fired heaters operating by means of combustion, and presents the four apparatus as members. The following sentences use "said furnace" open-endedly: it "in some embodiments forms part of the section for converting the natural gas into synthesis gas," and "[i]n combined ammonia/urea plants said furnace may form part of the urea section." EX1001, 2:52-55; EX1068 ¶11. The patent uses "furnace" generically elsewhere: a "stream production and/or superheating furnace" and "furnaces for pre-heating the charge" in claim 10, "furnaces equipped with dual-fuel burners," and the AUX "charge pre-

heater furnace and auxiliary boiler.” EX1001, 2:47-55, 3:44-52, 7:44-53 & Fig. 1 (AUX block).

PO’s own construction betrays the point. PO quotes both sentences as the “express definition” (POR 8), then proposes a construction deleting the second—the requirement that the apparatus “operate by means of combustion” and the equation to “fired heater”—while accusing Petitioner of “omit[ting] words from the express definition.” POR 9-10. A party cannot invoke lexicography’s exacting standard while rewriting the definition. The deletion is no slip: PO’s merits argument depends on the deleted sentence, excluding the HRSG only because “a heat exchanger does not ‘operate by means of combustion.’” POR 28; EX1066, 234:9-235:13 (PO’s expert adopting the combustion requirement to exclude HRSGs). PO re-imports that limitation when it narrows the art while insisting its lexicography omits it.

The claims confirm this. Claim 10 recites furnace species—“a steam production and/or superheating furnace; or one or more furnaces for pre-heating the charge of the autothermal reformer or natural-gas desulphurization section.” By reciting “one or more of the following apparatuses” and labeling each a “furnace,” claim 10 presupposes a general furnace concept of which these are examples. If claim 1’s “furnace” were confined to PO’s list, claim 10’s enumeration would do little work and would collapse a dependent-claim apparatus list into the independent-claim term. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1314-15 (Fed. Cir. 2005).

Most fundamentally, the specification's use of the fuel fraction defeats the heat-versus-electricity dichotomy underlying PO's construction. PO and Dr. Wolden posit that a "furnace" transfers thermal energy while a turbine makes electricity. POR 12-13; EX2007 ¶26. But the '168 Patent teaches producing "the electricity necessary for the synthesis of ammonia ... using as fuel CO₂-depleted synthesis gas," via "a flow of steam produced in a steam generator or steam superheater" driving a turbo generator, and via "combustion in a gas turbine or in a gas engine." EX1001, 7:44-53. A "steam generator," one of PO's four listed apparatus, is used precisely to make electricity. The specification draws no line between heat and power equipment; it describes an integrated class of combustion equipment fired by the fuel fraction. EX1005 ¶60; EX1068 ¶12.

PO's cases are not to the contrary. In *Sinorgchem* the quotation-marked definition was applied consistently throughout the patent, *Sinorgchem Co., Shandong v. Int'l Trade Comm'n*, 511 F.3d 1132, 1136-38 (Fed. Cir. 2007); in *3M* the specification used the express formula "'embossed' means," *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1374 (Fed. Cir. 2003). Here the purported definition is generalized to "fired heater," and the broader intrinsic usage (2:52-55; 7:44-53) is inconsistent with a closed list.

PO's deposition soundbites cannot change the intrinsic record. Dr. Ritter's "gas grill" answers addressed counsel's hypotheticals about the outer bounds of

“fired heater” and were qualified in the moment. EX2008, 67:17-68:11. His operative testimony: a POSA reads “furnace” as “a fired heater where combustion takes place,” and a gas turbine in cogeneration generates electricity “with the off-gas being used to generate steam—hence, a steam generator, which is one of the examples in Column 2.” EX2008, 61:7-10, 82:6-13; EX1068 ¶14.

B. PO’s Inconsistent Litigation Position and Extrinsic Evidence Cannot Displace the Intrinsic Record

PO’s infringement allegations abandon the construction it advances here. In district court, PO maps the claim onto “a fired heater (i.e., a furnace),” not the four listed apparatus. EX1044 at 39 (¶66). Claims must mean the same thing for validity and infringement. *Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1351 (Fed. Cir. 2001). PO’s shifting usage confirms that “furnace = fired heater” is the operative meaning.

The EPO opposition decision (EX2009), which Petitioner has objected to and may move to exclude (Paper 36; 37 C.F.R. § 42.64(c)), is not probative even if admitted. It applied a different framework to a different claim set, without the *Phillips* hierarchy. The EPO asked whether a “steam turbine” is “an enclosed high-temperature apparatus used to generate heat for warming buildings or industrial processes,” EX2009 at 10, a definition found nowhere in the ’168 Patent. The EPO thus was not applying PO’s lexicography and did not address the fired-boiler and

steam-generator disclosures at issue. Extrinsic evidence cannot override the intrinsic record. *Phillips*, 415 F.3d at 1317-19.

Petitioner's later-filed application (EX2011) says nothing about what the '168 Patent conveys, and supports Petitioner: it equates "fired heater/process furnaces," EX2011 [0094], the same class the '168 Patent identifies at 2:50-52; EX1066, 234:14-22 (PO's expert equating "fired heaters" with "furnaces"). The reexamination amendment removing "primary steam reformer burners" from claim 10 narrowed the claimed configuration, not the meaning of "furnace"; a primary steam reformer remains a furnace even if the amended claims no longer recite processes using one.

IV. GROUND 1: 2007 IFA ANTICIPATES CLAIMS 1, 5, 6, AND 10; THE GROUND 1A-1E CLAIMS ARE OBVIOUS

A. Limitation 1[c]: The Fuel Fraction Is Fed as Fuel to at Least One Furnace

The Petition's mapping rests on the "Integrated reforming and power cycle" flowsheet, a single embodiment on one slide. EX1006 at 9; Pet. 16-17. Desulfurized natural gas and steam pass through a pre-reformer and an oxygen-fed ATR (no primary reformer), then shift and CO₂ removal; immediately downstream, the CO₂-depleted syngas splits into a stream labeled "H₂ Fuel" and a stream sent to the methanator to become "Ammonia Syngas." *Id.*; EX1005 ¶92. Because every element

appears in this one flowsheet, PO's and the EPO's "no link between slides" argument (POR 25 n.19, 27-28) does not disturb anticipation. EX1068 ¶¶16, 23.

PO's lead merits argument—that "Fuel" in 2007 IFA means hydrocarbon (POR 24-26, 30-31)—attacks a strawman. For claim 1, the Petition maps the fuel fraction to the stream labeled "H₂ Fuel," split from the CO₂-depleted syngas. Pet. 16-17. Pages 7-8 were cited for the steam-and-power train into which that fuel is fired, Pet. 17; EX1005 ¶¶93, not the fuel's identity. Regardless, slide 16's title ("*Integration of gas turbine driver in the ammonia process*") confirms that "Fuel" includes H₂ Fuel; otherwise the slide would show no integration with the ammonia process. EX1068 ¶25.

PO's "furnace" argument attacks a position the Petition never took. The POR labors to prove a gas turbine "is not a 'furnace'" (POR 27-29), but the Petition argued that a gas turbine "operates by means of combustion and therefore *includes* a 'furnace,'" its combustor. Pet. 17-18; EX1005 ¶¶56, 60. Dr. Ritter's opening declaration describes the H₂ fuel as used "in an auxiliary furnace of a gas turbine (GT) and heat recovery steam generator (HRSG)." EX1005 ¶92. Limitation 1[c] requires only that the fuel fraction be "fed as fuel to at least one furnace," not that it be free-standing or that the machine housing it be labeled one. Feeding the H₂ fuel to the GT/HRSG combustor feeds it to a furnace: a "steam generator" under PO's definition or a furnace under the ordinary meaning. EX1068 ¶¶15-22; EX1066,

181:20-182:2 (PO's expert agreeing with the ordinary meaning), 227:10-22 (combustion inside the turbine combustor).

Independently, the Petition identified a second furnace, one squarely on PO's own list, asserting that 2007 IFA "specifically shows using CO₂-depleted syngas as fuel for both a gas turbine (GT) and steam generator (HRSG—Heat Recovery Steam Generator)." Pet. 17; EX1006 at 8-9; EX1005 ¶¶92-93. A "steam generator" is one of the four apparatus in PO's construction. EX1001, 2:47-52. PO's observation that "[t]he Petition does not assert that the gas turbine ... is any one of" the four (POR 27) is empty: the Petition asserted the steam-generator prong in the very sentence PO quotes around, as PO concedes when it pivots, "[t]o the extent the Petition is instead, or additionally, pointing to 'HRSG.'" POR 28. It is, three ways:

- **Slide 18 (the mapped flowsheet).** The H₂ fuel split from the CO₂-depleted syngas feeds the GT/HRSG power train, Dr. Ritter's "auxiliary furnace." EX1005 ¶92; EX1006 at 9. That the HRSG recovers heat to raise steam does not make the train less combustion-fired: the H₂ fuel is combusted in it, and steam is generated from that combustion. EX1005 ¶¶92-93; EX1068 ¶¶17-22 (GT/HRSG unit designed to combust fuel for cogeneration of steam and power, functionally and structurally identical to a fired steam boiler).

- **Slide 16** details the same integration “in the ammonia process”: a “Package HP Steam Boiler” receiving Fuel and boiler feedwater and exhausting to a Stack, a fired steam generator producing superheated high-pressure steam. EX1006 at 8; EX1005 ¶93 (“fuel also is combusted to generate steam from boiler feedwater”). Dr. Ritter reaffirmed: “you can tell it’s combusted because that line goes to the stack.... So emphatically, those are furnaces.” EX2008, 115:1-17.
- **Slide 17** bridges slides 16 and 18, enumerating the “Steam and Power Production” unit’s configurations, including “(c) Gas Turbine + MP Steam Boiler” and “(d) Gas Turbine + HP Steam Boiler.” EX1006 at 9. Reading the reference as a whole, a POSA reads the flowsheet’s GT/HRSG train as that same combustion-fired steam-raising unit. *Blue Calypso*, 815 F.3d at 1341-42; EX1005 ¶¶92-93; EX1068 ¶23.

PO’s response—that an HRSG is a mere heat exchanger “fed with an exhaust gas ... *not* with a ‘CO₂-depleted synthesis gas’” (POR 28-29; EX2007 ¶73)—misreads both the claim and the reference. Under PO’s construction as proposed, a bare list without a combustion requirement, the HRSG is a listed “steam generator” by name and function, so limitation 1[c] is met on PO’s own words. And Dr. Ritter’s opening opinion is that the slide-18 unit fed by the H₂ fuel is an “auxiliary furnace” of the GT/HRSG. EX1005 ¶92. PO describes an exhaust-only HRSG, citing an

unauthenticated vendor webpage; 2007 IFA discloses a fired train in which the H₂ fuel is combusted, raising steam, satisfying even the combustion requirement PO imports. POR 28; EX1005 ¶¶92-93; EX2008, 115:1-17. The EPO passage PO reproduces (POR 27-28) confirms the mismatch: it asked whether a POSA would “replace the turbine with a furnace,” a modification inquiry foreign to anticipation. *Blue Calypso*, 815 F.3d at 1341-42. The disclosed process feeds the fuel fraction to two furnaces: the gas turbine combustor and the fired steam generator. EX1068 ¶¶14, 20, 22-23; EX1066, 204:19-206:8 (PO’s expert admitting a duct-fired HRSG is a “steam generator”), 236:18-237:14; EX1067.

PO does not dispute limitations 1[a], 1[b], 1[d], or the same-composition requirement.

B. Claim 10

Claim 10 is disjunctive: “one or more of” a steam production/superheating furnace or charge-preheating furnaces suffices. The Petition showed the first alternative: the fuel fraction feeds a steam production furnace, the fired HP steam boiler of slide 16 and the steam-raising train of the integrated flowsheet. Pet. 19-20; EX1005 ¶205; EX1006 at 8-9. PO’s emphasis on Dr. Ritter’s acknowledgment that 2007 IFA does not show an ATR charge-preheating furnace (POR 31-32) is immaterial, and its “hydrocarbon fuel” argument fails for the reasons above. EX1068 ¶24-26.

C. The Ground 1A Dependent Claims

Claims 3-4. PO's cited passage confirms Petitioner's point: the fuel fraction's size is a result-driven allocation, since more syngas to fuel means less CO₂ emitted and more make-up syngas required. EX1001, 2:64-3:4. That is a result-effective variable subject to routine optimization, and the specification recites nested ranges without attributing criticality to any. EX1005 ¶¶170-77; *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295-97 (Fed. Cir. 2012). PO's "counterintuitive economics" theme is a commercial preference, not a teaching away, and spending H₂ as fuel to cut CO₂ is 2007 IFA's premise. EX1006 at 8-10; *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). Rytter's allocation guidance (at least 5% to synthesis, remainder to fuel and other H₂ uses, EX1008, 4:10-14) supplies the ranges under Ground 1B. Pet. 21-22, 31-33; EX1005 ¶¶240-45. PO's methanol/ammonia distinction ignores that the ranges concern allocating CO₂-depleted syngas between fuel and synthesis, a decision common to both processes, in references that each contemplate ammonia. EX1008, 3:12-16, 4:41-57, 7:26; EX1068 ¶27.

Claim 7. PO's own argument that "no more than 1000 ppm" CO₂ "is required to meet the plant emissions targets" (POR 36) concedes the variable is result-effective: residual CO₂ in the fuel sets stack emissions, so optimizing removal depth toward 2007 IFA's objective of "reduc[ing] the CO₂ emission to zero" (EX1006 at 10) is routine. EX1005 ¶¶190-96. The flowsheet's methanator independently signals

deep CO₂ removal, since residual CO/CO₂ poisons ammonia catalyst. EX1005 ¶¶51-55; EX1068 ¶28, EX1066, 290:7-291:4 (PO's expert admitting CO₂ removal to ppm levels).

Claims 8-9. The flowsheet expressly feeds the ATR with "Oxygen." EX1006 at 9; EX1005 ¶46. The specification's recited advantages of enrichment (EX1001, 3:36-43) are art-recognized, expected benefits, confirming a known result-effective variable, not criticality. Pet. 24-25; EX1005 ¶¶197-203; EX1031 ¶¶16-17; EX1041 at 1. Rytter's "substantially pure O₂" supplies the claimed concentrations under Ground 1B. EX1008, 4:26-29; EX1066, 291:16-292:10 (PO's expert admitting enriched-O₂ advantages were known before 2017); *see* EX1068 ¶¶29, 37.

Claim 11. 2007 IFA lists a "Cryogenic purge gas recovery unit" returning "recovered hydrogen at high pressure" among its energy-reducing features, and its flowsheets show the ammonia-loop purge. EX1006 at 2-3. A POSA understood purge-gas "recovery" to encompass separating an H₂-rich stream from a methane-rich tail gas and recycling the tail gas to the front end, a practice so old the '168 Patent admits it. EX1001, 1:63-66; EX1016 at 3-4; EX1005 ¶¶210-14. PO's annotation showing purge gas "leaving the system" (POR 37) ignores the recovery-unit disclosure. PO's "coal-to-methanol" framing of Ji (POR 57-59) is incomplete: Ji's separation-and-recycle process expressly applies to chemical production including ammonia, EX1012, Abstract, 1:17-24, and Ji is cited for the narrow, well-

known step of splitting purge gas into H₂-rich and CH₄-rich fractions with recycle. Obviousness does not require bodily incorporation of Ji's gasifier. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981); Pet. 25-27, 37-39; EX1005 ¶¶210-19, 252-55; EX1068 ¶30; EX1066, 131:11-134:18 (PO's expert admitting H₂-rich purge streams were recycled as furnace fuel).

Claim 17. PO's "neither 'gas turbine (GT)' nor 'HRSG' is a furnace" refrain (POR 39) fails for the reasons given for limitation 1[c]. The '168 Patent frames trim fuel as an operational-control preference, EX1001, 3:44-52, and the allocation between generated H₂ fuel and natural-gas trim is a design choice; Licht discloses the claimed endpoint, hydrogen and by-product gas firing the reformer with "[n]o natural gas trim fuel." EX1009, 5:37-42, 10:4-9; Pet. 27-28, 39-41; EX1005 ¶¶220-24, 256-59. Licht is cited for the fuel-allocation principle, not its reformer configuration, so its primary reformer is beside the point. *Keller*, 642 F.2d at 425. Dr. Wolden's observation that natural gas and nitrogen can join the H₂ fuel line (EX2007 ¶91) is consistent with the claim, which permits natural-gas trim up to 15%. EX1068 ¶31; EX1066, 252:19-254:13 (PO's expert admitting N₂ moderation consistent with H₂ firing in 2007). Licht's consideration during reexamination is no bar; PO develops no § 325(d) argument.

Claims 2, 5, 6, 18, and 19 are not separately disputed.

V. GROUND 2: RYTTER

A. Limitation 1[a]

Rytter discloses the ATR “fed ... a prereformed natural gas.” EX1008, 4:30-33. A POSA reads that as pre-reformer followed by ATR: the gas delivered to the ATR is characterized only as prereformed, and where Rytter intends a steam (primary) reformer, it says so—its “particularly preferred” plant “consists of an autothermic reformer combined with a steam reformer and a prereformer.” EX1008, 4:17-20; EX1005 ¶95. Rytter thus discloses configurations with and without a primary reformer, and anticipation may rest on a disclosed alternative; because Ground 2 is a § 102/§ 103 ground, a preference cannot teach away. *In re Fulton*, 391 F.3d at 1201. PO’s reading, that “prereformed” gas “could have been” treated by an unmentioned primary reformer (POR 41-42), inserts an apparatus Rytter never places between the pre-reformer and the ATR, and concedes obviousness, since on PO’s account the POSA knew both configurations. EX1005 ¶¶45-49; EX1068 ¶32; EX1066, 307:20-308:21 (PO’s expert agreeing Rytter’s figure shows no primary reformer before the ATR).

B. Limitation 1[c]

Under PO’s construction as proposed, Rytter feeds the H₂ stream as fuel to listed apparatus, as the Petition cited (Pet. 42):

- **A steam reformer:** “part of the H₂-containing stream from the separator for the H₂ and CO₂ reformer is supplied as fuel,” EX1008, 4:55-57, and claim 11 (“part of the H₂-containing stream ... is fed to the reforming plant as a fuel”).
- **A steam generator:** hydrogen power station 7 is “supplied with air for the combustion of the hydrogen gas to steam producing electrical power.” EX1008, 6:8-13. Combusting fuel to raise steam is a steam generator operating by means of combustion; that the steam then generates electricity is what the ’168 Patent contemplates for its own fuel fraction. EX1001, 7:44-53; EX1068 ¶33; EX1066, 333:1-334:17 (PO’s expert agreeing steam-first cogeneration is a feasible alternative).

The POR addresses only “gas turbines,” leaning on Rytter’s observation that “hydrogen rich gas cannot simply be used in a gas turbine being constructed for the combustion of methane.” POR 42-44 (quoting EX1008, 9:6-26). That argument fails three ways. First, teaching away is irrelevant to anticipation. *Celeritas Techs., Ltd. v. Rockwell Int’l Corp.*, 150 F.3d 1354, 1361 (Fed. Cir. 1998). Second, for obviousness, the passage recites design parameters for adapting methane-designed turbines to the hydrogen firing Rytter teaches: its power station combusts the H₂ stream for power, and its reforming plant burns that stream as fuel. EX1008, 4:55-57, 6:8-13, 9:6-26, cl. 11. Nothing suggests hydrogen firing is “unlikely to be

productive of the result sought,” and advantages and disadvantages do not necessarily obviate motivation. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). Third, the passage says nothing about the fired reformer or steam-raising equipment the Petition relies on. EX1068 ¶34; EX1066, 224:12-14 (PO’s expert admitting burners that could burn hydrogen existed before 2017).

C. Claim 10

Claim 10’s disjunctive first alternative is met by station 7’s combustion of hydrogen “to steam,” EX1008, 6:8-13, and by the reformer-fuel disclosures above. Pet. 45; EX1005 ¶206. Rytter’s ammonia disclosures (EX1008, 3:12-16, 4:41-57, 7:26; EX1005 ¶¶95, 154) answer PO’s field-of-use points, and the preamble and “intended for” phrases carry no patentable weight. Pet. 13 n.2.

VI. GROUNDS 3, 3A, AND 3B: FJELLHAUG

A. Limitation 1[a]

Fjellhaug supplements the ATR’s air with turbine exhaust “as an oxygen source.” EX1010, 3:28-29. In testimony PO filed, Dr. Ritter explained that a POSA understands the recycle’s purpose “is to get more moles [of oxygen] fed to the reactor.” EX2008, 150:12-19; EX1005 ¶¶46, 127; Pet. 54; EX1068 ¶¶35-36.

Ground 3B independently resolves limitation 1[a]: Rytter supplies “substantially pure O₂” to the conversion section. EX1008, 4:26-29; Pet. 60-61. Fjellhaug frames its air-driven operation as a departure from the known oxygen-

driven ATR of the prior art it discusses, and selecting between two known options with predictable results is obvious under *KSR*. EX1010, 1:43-52, 2:13-28; EX1005 ¶¶127, 278-84; *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416-21 (2007); EX1066, 291:16-292:10 (PO’s expert admitting enriched-O₂ advantages were known).

PO’s teaching-away argument (POR 46-49, 54-55) overreads Fjellhaug. The statement that “the ATR should be an air driven reactor” expresses a preference serving Fjellhaug’s objective of producing a lean gas suited to its combined-cycle turbine. EX1010, 2:16-28. It neither criticizes nor discredits oxygen operation; its cost commentary targets a particular prior-art compression scheme, not oxygen generally. EX1010, 1:45-52. A preferred alternative is not a teaching away. *Fulton*, 391 F.3d at 1201. PO’s *Wenzhou* analogy fails on its own terms: institution was denied there because the petitioner never described its modification with particularity and offered no objective evidence of benefit. *Wenzhou Xin Xin Sanitary Ware Co. v. Delta Faucet Co.*, IPR2023-01332, Paper 13, at 23-25, 32-33 (PTAB Feb. 7, 2024). Here the substitution is precise and documented in Rytter and the ’168 Patent. EX1001, 3:36-43; EX1005 ¶¶127, 278-84. Benefits lost and gained are weighed against one another, *Medichem*, 437 F.3d at 1165, and this record supplies both. EX1068 ¶37; EX1066, 291:16-292:10.

B. Limitation 1[c] and Claim 10

Under the plain and ordinary meaning, combined-cycle gas turbine 24, fed the CO₂-depleted, hydrogen-rich stream 17 as fuel, includes a furnace. EX1010, 4:32-36; Pet. 55; EX1005 ¶110; EX2008, 150:23-25. And Fjellhaug's train raises and superheats steam from that fuel's combustion heat. EX1010, 4:38-50.

For claim 10, the Petition presented the obviousness path (Ground 3A): implementing the fuel fraction in a conventional fired steam production/superheating furnace was well known and predictable. Pet. 57-58; EX1005 ¶¶56, 60, 208. The modification substitutes one conventional steam-raising means for another in a process that already combusts the fuel fraction and generates and superheats steam. Dr. Ritter supplied the evidence: hydrogen-rich fuel was known for use "in many applications, such as boilers, furnaces, gas turbines." EX1005 ¶56 (quoting EX1015 at 121). That is a *KSR* substitution with predictable results, not the unexplained leap condemned in *Metalcraft* or the "routine optimization" rejected in *Stepan. Metalcraft of Mayville, Inc. v. Toro Co.*, 848 F.3d 1358, 1367-68 (Fed. Cir. 2017); *In re Stepan Co.*, 868 F.3d 1342, 1346-47 (Fed. Cir. 2017). Should the Board adopt PO's construction, Ground 3B incorporates Rytter's limitation-1[c] disclosures. Pet. 59.

VII. THE COMBINATION RATIONALES ARE SUPPORTED

PO's recurring theme, that an ammonia POSA would not consult methanol, hydrogen, or power-generation references and that "coupled" processes resist modification (POR 53-64), fails for five reasons.

First, every reference concerns essentially the same front end: natural-gas reforming to syngas, shift, CO₂ removal, and allocation of the hydrogen-rich product, the '168 Patent's own field. It is common across ammonia, methanol, and hydrogen service, as Ritter confirms by benchmarking against "standard technology today in the production of hydrogen for the synthesis of ammonia" and directing its H₂ stream to ammonia among "other uses." EX1008, 3:12-16, 4:41-57, 7:26; EX1005 ¶¶40-49, 95.

Second, under *KSR* the motivation need not mirror the patentee's problem, and the design pressure here, cutting CO₂ across syngas processes, was decades old, as Dr. Ritter confirmed and PO quotes. EX2008, 176:8-14; *KSR*, 550 U.S. at 419-20.

Third, the "cascade of effects" argument proves too much: it would forbid any combination in chemical engineering. The cited testimony says only that changes have downstream consequences engineers routinely manage. EX2008, 160:8-161:12. The transplanted features—a percentage allocation, an oxygen concentration, a membrane purge-gas split, a trim-fuel fraction—are conventional

parameters, each supported by Dr. Ritter's declaration. EX1005 ¶¶169-77, 197-203, 210-19, 220-24, 240-90; EX1068 ¶40; EX1066, 43:2-50:1 (PO's expert agreeing a POSA would evaluate how best to optimize toward the desired goal).

Fourth, PO's attempt to cast Petitioner's expert as conceding that methanol art lies outside the POSA's field fails. PO relies on Dr. Ritter's remark that his research group "didn't have interest in methanol" (POR 58, 62), but that described his academic laboratory's focus, not the art a POSA is charged with knowing. EX2008, 45:14-46:24. Dr. Ritter testified that these syngas processes share a common front end: "all these patents ... all make a mixture of CO, CO₂, and hydrogen for a variety of uses. Ammonia happens to be one of them. Methanol happens to be one of them." EX2008, 176:17-24; EX1068 ¶¶38-39.

Fifth, PO's attack on Price as a Fischer-Tropsch rather than an ammonia reference (POR 53-56) misapprehends what Price is cited for: not its synthetic-fuels end product, but its disclosure of conventional gas purification, residual CO₂ levels, and steam-to-carbon ratios in an ATR-based, ammonia-directed syngas process. EX1011 ¶¶5, 39-45, 53-59; EX1005 ¶¶159-68, 229-32, 246-51, 262-66. Price's Fischer-Tropsch context concerns an unclaimed downstream step, and obviousness does not require bodily incorporation. *Keller*, 642 F.2d at 425.

VIII. PO OFFERS NO EVIDENCE OF SECONDARY CONSIDERATIONS

PO's two paragraphs of attorney argument (POR 64) cite no evidence, not even its expert. Long-felt need requires objective evidence of an art-recognized, persistent need not earlier satisfied, and all objective indicia require a nexus. *DISH Network Corp. v. Customedia Techs, L.L.C.*, IPR2017-00724, Paper 47, at 37-39 (PTAB July 25, 2018); *Varian Med. Sys., Inc. v. William Beaumont Hosp.*, IPR2016-00166, Paper 69, at 39-46 (PTAB May 4, 2017). A generalized industry interest in CO₂ reduction shows a goal, not an unmet need, and 2007 IFA shows the industry pursuing this solution a decade before the critical date. EX1006 at 8-10. PO's soundbite about the label "secondary considerations" ignores that Dr. Ritter addressed the substance: he is aware of no commercial success, praise, licensing, or copying tied to the claims. EX1005 ¶337; EX1068 ¶41; EX1066, 69:12-70:15 (PO's expert offering no secondary-considerations opinions).

IX. CONCLUSION

For these reasons and those in the Petition, claims 1-11 and 17-19 are unpatentable. Petitioner respectfully requests that the Board cancel the Challenged Claims. Petitioner does not concede any point in the POR not expressly addressed herein.

Date: August 3, 2026

Respectfully submitted,

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CERTIFICATION OF WORD COUNT COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), I hereby certify that this Reply to Patent Owner's Response complies with the type-volume limits of 37 C.F.R. § 42.24(c)(1). As calculated by the word count feature of the word-processing system used to prepare this Reply, it contains 5,596 words, excluding parts of the Reply that are exempted by 37 C.F.R. § 42.24(a)(1) (including a table of contents, a table of authorities, and a certificate of service or word count).

Date: August 3, 2026

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that on August 3, 2026 a true and correct copy of the foregoing Petitioner's Reply to Patent Owner's Response was served by electronic mail on Patent Owner's lead and backup counsel at the following email addresses:

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