

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

LONGI GREEN ENERGY TECHNOLOGY
CO. LTD. and LONGI SOLAR
TECHNOLOGY (U.S.) INC.,

Plaintiffs,

v.

JINKO SOLAR CO., LTD., JINKOSOLAR
HOLDING CO., LTD., JINKO SOLAR
(VIETNAM) INDUSTRIES CO. LTD., and
JINKO SOLAR TECHNOLOGY SDN. BHD,

Defendants.

C.A. No. 2:25-cv-00048-JRG-RSP

DEFENDANTS' P.R. 3-3 and 3-4
INVALIDITY CONTENTIONS AND DISCLOSURES

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Pursuant to the Court’s Docket Control Order (Dkt. No. 48) and Patent Local Rules 3-3 and 3-4, Defendants Jinko Solar Co., Ltd., JinkoSolar Holding Co., Ltd., Jinko Solar Technology Sdn. Bhd., and Jinko Solar (Vietnam) Industries Co. Ltd. (collectively, “Jinko” or “Defendants”) respectfully submit these initial Invalidity Contentions with respect to the asserted claims of U.S. Patent No. 9,515,214 (“the ’214 patent” or “Asserted Patent”), identified by Plaintiffs LONGi Green Energy Technology Co. Ltd. and LONGi Solar Technology (U.S.) Inc. (“LONGi”) in their P.R. 3-1 Infringement Contentions. The currently Asserted Claims of the ’214 patent, as reflected in LONGi’s Infringement Contentions, are claims 1-6, 8, and 11.

I. INTRODUCTION

These invalidity contentions are based on Defendants’ current knowledge, understanding, and belief of the Asserted Patent and prior art, of LONGi’s infringement theories (inasmuch as they can be inferred from their Infringement Contentions), and of the facts and other information available as of the date of these invalidity contentions. Defendants’ investigation, discovery, and analysis of information related to this action is ongoing. Additional discovery, elucidation of LONGi’s impermissibly vague infringement contentions, LONGi’s expert report(s) regarding infringement, and/or orders of the Court may require Defendants to amend or supplement these invalidity contentions, and Defendants expressly reserve the right to do so, subject to the Court’s procedures, as the case proceeds. These contentions represent Defendants’ good-faith effort to provide a comprehensive identification of prior art relevant to this case, but Defendants reserve the right to modify or supplement their prior art list and invalidity contentions at a later time with, or based upon, pertinent information that may be subsequently discovered.

In addition to the prior art that charted in the attached exhibits, additional background references are discussed herein and/or included in the document production accompanying these

invalidity contentions. Defendants reserve the right to rely on these background references for any purpose including, for example, to demonstrate the knowledge of a POSITA at the relevant time.

To the extent LONGi believes anything in these contentions (including the attached claim chart exhibits and accompanying document production) are insufficient, Defendants invite LONGi to bring such issues to its attention as soon as reasonably possible.

A. No Waiver

Nothing in these contentions is intended, nor should be construed, as a waiver of any non-infringement position or argument under 35 U.S.C. § 112. To the contrary, as set forth herein, Defendants contend that all Asserted Claims are invalid pursuant to 35 U.S.C. § 112. Defendants' statements herein (including the accompanying claim charts) reflect Defendants' present understanding of the purported scope of the claims as alleged by LONGi in its Infringement Contentions (as best those contentions can be understood in light of their present deficiencies).

The patent claims have yet to be construed. As a result, Defendants have based these contentions upon its knowledge and understanding of the potential scope of the Asserted Claims at this time, and, in part, upon the apparent interpretations of the Asserted Claims advanced by LONGi in their Infringement Contentions. Defendants may disagree with LONGi's interpretation of the meaning of many terms and phrases in the Asserted Claims. Defendants have provided these contentions based in part on its present understanding of LONGi's apparent constructions and interpretations of the Asserted Claims. These contentions do not represent Defendants' agreement or view as to the proper interpretation of any claim term contained therein. Any similarity between any apparent claim interpretation in any of Defendants' charts of prior art references and LONGi's contentions is not an admission or agreement with LONGi about the meaning of any claim term, but rather a reflection of the fact that the subject matter LONGi believes is claimed is present in the prior art, or that the claims are otherwise invalid. These contentions are made in the alternative,

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and should not be interpreted to rely upon, or in any way affect, the non-infringement arguments Defendants may assert in this case. Defendants reserve the right to amend, supplement, or materially modify these contentions as the case proceeds, including to identify additional prior art and/or additional bases for invalidity. Defendants also reserve the right to amend, supplement, or materially modify their contentions based on any infringement and/or additional claim construction positions that LONGi may take in this case or in related patent proceedings.

Defendants also reserve the right to amend, supplement, or materially modify their contentions in response to any claim construction or interpretation positions that LONGi may take or based on any claim construction the Court may further adopt in this case. Defendants also reserve the right to assert that a claim is indefinite, not enabled, or fails to meet the written description requirement of 35 U.S.C. § 112 based on any claim construction or interpretation position LONGi may take in this case or in related patent proceedings, or based on any claim construction the Court may further adopt in this case.

B. No Admission

Nothing disclosed herein is an admission or acknowledgement that any product accused of infringement by LONGi in its Infringement Contentions (the “Accused Products”), or any of Defendants’ other products or services, infringes any of the Asserted Claims.

Defendants further note that LONGi appears to rely upon overly broad interpretations of the Asserted Claims. At the same time, LONGi’s Infringement Contentions are in most places too general and/or vague to discern LONGi’s infringement theories and how exactly LONGi contends each Accused Product meets or practices each element of the Asserted Claims. As a result, Defendants have been prejudiced in their ability to prepare these invalidity contentions. In addition, LONGi’s Infringement Contentions, in many cases, continue to fail to put Defendants on

notice of LONGi's interpretation of the Asserted Claims, further prejudicing Defendants' ability to identify relevant prior art.

To the extent that any of the prior art references discloses the same functionality or feature of any of the Accused Products, Defendants reserve the right to argue that said feature or functionality does not practice any element of any of the Asserted Claims, and to argue, in the alternative, that if said feature or functionality is found to practice any element of any of the Asserted Claims, then the prior art reference demonstrates that the element is not novel, is obvious, and/or is otherwise not patentable.

Attached hereto are representative claim charts that identify examples of where the elements of the Asserted Claims may be found in the prior art and further identifying why those claims are not novel or non-obvious. Defendants' claim charts cite particular teachings and disclosures of the prior art as applied to features of the Asserted Claims. Providing citations to portions of the prior art references should not be construed to mean that other portions of the prior art references are not also relevant to the validity of the claims. Other passages of the identified prior art may additionally disclose, either expressly or inherently, information relevant to the validity of one or more elements of the Asserted Claims. And, persons having ordinary skill in the art generally may view an item of prior art in the context of other publications, literature, products, and understanding. As such, Defendants reserve the right to rely on uncited portions of the prior art references and on other publications and expert testimony to establish the state of the art and to aid in understanding and interpreting the cited portions, as providing context thereto, showing reasons to combine references and as additional evidence that the prior art discloses a claim limitation. Defendants further reserve the right to rely on uncited portions of the prior art references, other publications, and testimony to establish bases for combinations of certain cited

references that render the Asserted Claims obvious. Defendants also reserve the right to rely on uncited portions of the prior art references that describe substantially the same functionality or features that are described in cited portions. Further, for any combination, Defendants reserve the right to rely on information generally known to those skilled in the art and/or common sense.

Where Defendants cite a particular drawing or figure in the accompanying charts, the citation encompasses the description of the drawing or figure, as well as any text associated with the drawing or figure (even if the associated text is not itself expressly cited). Similarly, where Defendants cite particular text concerning a drawing or figure in the accompanying charts, the citation encompasses that drawing or figure (even if the associated drawing or figure is not expressly cited).

Defendants also reserve the right to rely on deposition testimony of an inventor, deposition testimony of prosecution counsel, expert testimony, and any additional prior art located or developed during the course of discovery. Defendants may rely on additional documents or materials relating to system prior art addressed in these invalidity contentions.

The references cited in the attached claim charts may disclose the limitations of the Asserted Claims expressly and/or inherently. Defendants may rely on inherency to demonstrate the invalidity of the Asserted Claims. Moreover, certain prior art references and solutions may inherently anticipate certain features of the Asserted Claims as construed by LONGi. Defendants may rely on cited or uncited portions of the prior art, other documents, and expert testimony to establish the inherency of certain features of the prior art to invalidate the Asserted Claims. Defendants also may rely on any reference identified in these invalidity contentions or any other reference to prove that the references are enabling, to provide a reason to combine the references, as an indication of the state of the art, or to explain the meaning of a term used in any reference.

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The suggested obviousness combinations may be presented in conjunction with or in the alternative to Defendants' contentions regarding anticipation. These obviousness combinations should not be construed to suggest that any reference included in any combination is not anticipatory in its own right. Further, to the extent that LONGi contends that any of the references identified does not constitute prior art under 35 U.S.C. § 102, Defendants reserve the right to rely upon other prior art references in the same patent family with substantially identical disclosures as evidence of invalidity based on the same theories as those disclosed below.

Throughout the charts, Defendants provide exemplary citations indicating where the cited references disclose subject matter recited in the preambles of the claims, without regard to whether the preambles are limitations of the claims. Defendants do not take any position at this time regarding whether or not the preambles of the Asserted Claims are limitations, and will address this topic, if necessary, during the scheduled claim construction process.

With regard to the prior art that Defendants identify as rendering the Asserted Claims obvious, non-limiting examples of the reasons why the prior art renders the Asserted Claims obvious, including exemplary identification of combinations of prior art showing obviousness, are provided below. Generally, for all prior art combinations addressed herein, a reason or motivation to combine the prior art includes that each prior art reference is relevant to solar battery module systems, and one of ordinary skill in the art tasked with implementing such a system would have been motivated to investigate the various existing systems, patents, and other publications, including those identified herein, to address his or her particular needs. The combinations and modifications of the prior art to invalidate the Asserted Claims would have arisen from ordinary innovation, ordinary skill, or common sense and/or would have been obvious to try or otherwise predictable in the field of data communications and/or power distribution between devices.

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A person having ordinary skill in the art would have had a reason to combine the prior art based on the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons having ordinary skill in the art. For example, each of the prior art references is relevant to solar battery module systems, including addressing problems such as resistive losses in solar modules caused by higher current levels. In addressing these problems, one of ordinary skill in the art would have been motivated to combine the teachings of research in the field.

Additionally, some prior art references cite or discuss other prior art references, illustrating the close technical relationship among the prior art. To the extent that any prior art reference refers to or discusses another prior art reference, either expressly or inherently, it would have been obvious to combine those references for at least that reason.

As shown in the accompanying claim charts, numerous books and research papers show that methods were being used to improve solar module efficiency. Design incentives and other market forces would have prompted combinations and modifications of the prior art. Design needs and market pressures provide ample reason to combine prior art elements in the manner combined. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007). Defendants reserve the right to supplement these disclosures if such evidence of design needs and/or market pressures become apparent through discovery in this case.

Moreover, the Asserted Claims are also obvious because they merely arrange old elements, with each performing the same function that had been known, to perform and yield no more than what one having ordinary skill in the art would expect from such an arrangement.

Because there were a finite number of predictable solutions in the art of solar battery modules with regard to any claimed feature, it would have been obvious to a person of ordinary skill in the art to pursue the known options. A person skilled in this art would have been familiar

with all the claim elements that the patentees used to distinguish the prior art during prosecution. The identified prior art references merely use those familiar elements for their primary or well-known purposes and in a manner well within the ordinary level of skill in the art. Accordingly, common sense and the knowledge of one having ordinary skill in the art render the Asserted Claims invalid.

C. Reservation of Rights

Prior art not currently included in this disclosure may become relevant. Defendants are currently unaware of the extent, if any, to which LONGi will contend that limitations of the Asserted Claims are not disclosed in the prior art identified by Defendants or contend that prior art identified by Defendants does not qualify as prior art. Defendants reserve the right to identify other references that would have made the addition of the allegedly missing limitation to the disclosed device or method obvious or show that the allegedly missing limitation would have been known or readily apparent to one of ordinary skill in the art at the time of the invention in light of the disclosure of the prior art at issue or other prior art. Defendants further reserve the right to rely on any of the references produced concurrently with these contentions in order to demonstrate the state of art at the alleged times of invention and as evidence of the knowledge of one of ordinary skill in the art¹ in support of any motivations to modify or combine the charted prior art references with other references or knowledge.

To the extent that Defendants charted a published patent application that later issued as a patent that includes substantially the same disclosure, Defendants contend that the issued patent discloses the claims for at least the same reasons explained in connection with the published

¹ For purposes of these invalidity contentions, the term “general knowledge” includes the common knowledge and common sense of a POSITA as well as the general knowledge of POSITAs in the field.

application and Defendants reserve their rights to rely on the issued patent to establish invalidity. Similarly, to the extent that Defendants charted an issued patent the application for which was previously published (and which contains substantially the same disclosure), Defendants contend that the published application discloses the claims for at least the same reasons explained in connection with the issued patent and Defendants reserve the right to rely on the published application to establish invalidity (including to establish an earlier prior art date).

Defendants reserve the right to supplement or otherwise amend these invalidity contentions. This is particularly true for all claims for which LONGi has not provided adequate infringement contentions. LONGi may also be aware of additional prior art that is not known to Defendants. To the extent LONGi produces additional prior art responsive to Defendants' discovery requests after these contentions are served, Defendants may supplement their invalidity contentions with prior art contained in such production once they have had a fair opportunity to review, analyze, and chart such prior art. Defendants reserve the right to amend their invalidity contentions with any additional potential prior art known by LONGi but not yet disclosed to Defendants.

Defendants provide these invalidity contentions only for the claims that are asserted by LONGi but reserve the right to seek invalidation of all claims of the '214 patent.

In addition to the prior art that is set forth in the charts, additional prior art references are being produced concurrently with these contentions. This additional art may be relevant to the validity of the Asserted Claims depending on the positions taken by LONGi, and in any event may be referenced to show the state and evolution of technology in these fields. Accordingly, for the foregoing reasons, Defendants reserve the right to supplement these invalidity contentions with specific claim charts and obviousness combinations with the additional references based on the

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allegations and contentions asserted by LONGi as these allegations and corresponding constructions of the claims become clear.

D. Ongoing Investigation

Defendants' investigation is ongoing, and Defendants expressly reserve the right to amend their disclosures and document production to account for evidence uncovered as their investigation continues. Such amendments include identifying and relying on additional references that may result from Defendants' further search and analysis. Defendants reserve the right to supplement these contentions in light of any additional prior art of which LONGi is aware and has not disclosed to Defendants in discovery, or that might be subsequently disclosed by LONGi in response to Defendants' discovery requests. An example of such prior art may include products sold and offered for sale by Mitsubishi. Such products may have been offered for sale or publicly shown in a manner that renders them prior art under 35 U.S.C. §§ 102 and 103. Defendants reserve the right to supplement these contentions to rely on those and products from LONGi. Defendants' investigation into prior art systems and products is ongoing, and Defendants reserve the right to amend these contentions to reflect the identification of and information about such systems and products learned through discovery.

Defendants anticipate issuing subpoenas to third parties believed to have knowledge, documentation and/or corroborating evidence concerning some of the prior art listed herein and/or additional prior art. These third parties include, but are not limited to, the authors, employers of authors, inventors, assignees, or former or current employees of assignees or previous assignees, of the references identified in these invalidity contentions. For example, Defendants have already issued subpoenas to potential prior artists including but not limited to individuals and entities responsible for the development of prior art systems identified in these invalidity contentions.

Defendants reserve the right to supplement these contentions in light of any newly discovered information produced by these or other companies from which Defendants may seek discovery.

II. LEGAL STANDARDS

A. Law of Anticipation

A patent claim is anticipated if each and every element of the claim was disclosed in a single prior art reference. *See SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, 511 F.3d 1186, 1192 (Fed. Cir. 2008) (“A [patent] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.”).

To be anticipated, each element of a patent claim may be disclosed by a prior art reference either expressly or inherently. *SRI*, 511 F.3d at 1192. An element of a patent claim is inherent in a prior art reference if the element must necessarily be present. *See Schering Corp. v. Geneva Pharms.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003) (“[A] prior art reference may anticipate without disclosing a feature of the claimed invention if that missing characteristic is necessarily present, or inherent, in the single anticipating reference.... [A] court may consult artisans of ordinary skill to ascertain their understanding about subject matter disclosed by the prior art, including features inherent in the prior art.”). “Inherency, however, may not be established by probabilities or possibilities.” *Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1332 (Fed. Cir. 2010).

B. Law of Obviousness

A patent may not issue where “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103. That is, the claimed invention must be nonobvious. The legal test to determine the question of obviousness is expansive and flexible, and there is “need for caution in granting a patent based on the combination of elements found in the prior art.” *KSR Int'l*

Co. v. Teleflex Inc., 550 U.S. 398, 415 (2007). The Supreme Court’s *KSR* decision established the proper analysis for obviousness. *Id.* The Court loosened the standard for showing the obviousness of combining prior art references by overturning the Federal Circuit’s teaching-suggestion-motivation test as too rigid and narrow and reaffirming the Graham factors. *Id.* at 415, 419–21.

In place of the teaching-suggestion-motivation test, the Court held that a more expansive and flexible approach should be applied. *Id.* at 415. “Obviousness is a question of law based on underlying findings of fact.” *In re Kubin*, 561 F.3d 1351, 1355 (Fed. Cir. 2009). The underlying factual inquiries are: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations of non-obviousness. *See KSR*, 550 U.S. at 399 (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)).

In defining the obviousness standard, the Supreme Court stressed that “the results of ordinary innovation are not the subject of exclusive rights under the patent laws. Were it otherwise patents might stifle, rather than promote, the progress of useful arts.” *KSR*, 550 U.S. at 427; *see also id.* at 402 (“Granting patent protection to advances that would occur in the ordinary course without real innovation retards progress and may, for patents combining previously known elements, deprive prior inventions of their value or utility.”). The Court also emphasized that its long-standing precedents confirm that “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *Id.* at 416–417 (citing *Anderson’s-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 62 (1969); *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 282 (1976); *United States v. Adams*, 383 U.S. 39, 50–51 (1966)). Thus, the operative question when assessing whether a claimed invention would have been obvious is “whether the improvement is more than the predictable use of prior art elements

according to their established functions.” *KSR*, 550 U.S. at 417. Notably, “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *Id.* at 421. Indeed, beyond simple cases that merely require the combination of two prior art references, “a person of ordinary skill [often] will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* at 420.

It is sufficient that a combination of limitations was “obvious to try” holding that, “[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* at 421. “In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.” *Id.* All the following rationales recognized in *KSR* support a finding of obviousness with respect to each of the obviousness combinations disclosed herein:

- (1) Combining prior art limitations according to known methods to yield predictable results;
- (2) Simple substitution of one known limitation for another to obtain predictable results;
- (3) Use of known technique to improve similar devices (methods, or products) in the same way;
- (4) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- (5) “Obvious to try”—choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

(6) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and

(7) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

Certain of these rationales are discussed with greater specificity below, but all apply, and the lack of a more specific discussion of some should not be taken to imply or admit that others do not also apply as the discussion below is intended to provide further explanation regarding certain of the specific rationales.

The rationale to combine prior-art references can come from a variety of sources and is not limited to the prior art itself or the specific problem the patentee was trying to solve. *Id.* at 420. Furthermore, the Supreme Court’s expansive approach in *KSR* encourages, rather than restricts, the use of common sense when addressing obviousness. *Id.* at 421. The references themselves need not provide a specific hint or suggestion of the alteration needed to arrive at the claimed invention; the analysis “may include recourse to logic, judgment, and common sense available to the person of ordinary skill that do not necessarily require explication in any reference or expert opinion.” *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1329 (Fed. Cir. 2009). And the “reason, suggestion, or motivation to combine may be found explicitly or implicitly: 1) in the prior art references themselves; 2) in the knowledge of those of ordinary skill in the art that certain references, or disclosures in those references, are of special interest or importance in the field; or 3) from the nature of the problem to be solved....” *Ruiz v. A.B. Chance Co.*, 234 F.3d 654, 665 (Fed. Cir. 2000).

C. 35 U.S.C. § 112

1. Written Description and Enablement

To satisfy the written description requirement, the patent “must ‘clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.’” *Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (*en banc*) (quoting *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562–63 (Fed. Cir. 1991)); see *Kao Corp. v. Unilever U.S., Inc.*, 441 F.3d 963 967–68 (Fed. Cir. 2006). “[E]nough [of the invention] must be included to convince a person of skill in the art that the inventor possessed the invention” *LizardTech, Inc. v. Earth Res. Mapping, Inc.*, 424 F.3d 1336, 1345 (Fed. Cir. 2005). Section 112, ¶ 1, also requires a patent to describe “the manner and process of making and using [the claimed invention], in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same.” 35 U.S.C. § 112, ¶ 1 (pre-AIA). A patent must disclose enough to permit a person of skill in the art, after reading the specification, to practice the claimed invention without undue experimentation.” *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008).

“The full scope of the claimed invention must be enabled.” *Sitrick*, 516 F.3d at 999–1000 (“Because the asserted claims are broad enough to cover both movies and video games, the patents must enable both embodiments.”). “Enabling the full scope of each claim is ‘part of the quid pro quo of the patent bargain.’” *Id.*

2. Indefiniteness

Section 112, ¶ 2, requires that “one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.” 35 U.S.C. § 112 ¶ 2 (pre-AIA). “[A] patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those

skilled in the art about the scope of the invention.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). “Indefiniteness must be proven by clear and convincing evidence.” *Sonix Tech. Co. v. Publ’ns Int’l, Ltd.*, 844 F.3d 1370, 1377 (Fed. Cir. 2017).

Section 112, ¶ 4, states that “a claim in dependent form shall contain a reference to a claim previously set forth and then specify *a further limitation* of the subject matter claimed. A claim in dependent form shall be construed to incorporate by reference *all the limitations of the claim to which it refers*.” 35 U.S.C. § 112 ¶ 4 (pre-AIA) (emphasis added). “A dependent claim that contradicts, rather than narrows, the claim from which it depends is invalid.” *Multilayer Stretch Cling Film Holdings, Inc. v. Berry Plastics Corp.*, 831 F.3d 1350, 1362 (Fed. Cir. 2016); *see also*, e.g., *Pfizer, Inc. v. Ranbaxy Lab’ys Ltd.*, 457 F.3d 1284, 1291 (Fed. Cir. 2006) (where independent claim and dependent claim “deal with non-overlapping subject matter,” the dependent claim is invalid).

III. THE ASSERTED CLAIMS OF THE ’214 PATENT ARE INVALID

A. Priority Date

LONGi asserted a “priority date no later than the filing date of International Application No. PCT/JP2010/061334 on July 2, [2]010” for the Asserted Claims in its Infringement Contentions.

LONGi has failed in its obligation to disclose “the priority date to which each asserted claim allegedly is entitled” (P.R. 3-1(e)), at least because it discloses an ambiguous “priority date” qualified with the phrase “no later than.” To the extent LONGi attempts to rely on a different date from the specifically enumerated date listed above (i.e., under the “no later than” language), Defendants reserve the right to supplement these contentions. Moreover, because discovery has not yet been completed, Defendants have relied on LONGi’s assertions for the purposes of identifying relevant prior art in these invalidity contentions. Defendants reserve the right to

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supplement these invalidity contentions should discovery reveal that LONGi is not entitled to the asserted priority date. In addition, Defendants also reserve the right to supplement these contentions should LONGi subsequently attempt to amend its infringement contentions in any way, or to otherwise modify its infringement allegations or seek to establish an earlier date of invention.

B. Invalidity Grounds Under 35 U.S.C. §§ 102 and 103

Defendants attach as Exhibits to its invalidity contentions claim charts showing examples of how the cited references anticipate and/or render obvious the Asserted Claims of the '214 patent under at least pre-AIA 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and 103 either expressly or inherently as understood by a person having ordinary skill in the art or based on LONGi's apparent interpretation of the claims.

Ex.	Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
1	J. E. Boretz et al., Study To Establish Criteria For A Solar Cell Array For Use As A Primary Power Source For A Lunar-Based Water Electrolysis System (1971) (Boretz)	September 15, 1971 (Published)	
2	Datasheet for BP Solar's BP 3280T (BP 3280T)	June 9, 2010 (Offered for sale, sold, and/or used)	
3	D. W. Cunningham et al., Reaching Grid Parity Using BP Solar Crystalline Silicon Technology (Cunningham)	June 20-25, 2010 (Published)	
4	U.S. Patent Application Publication No. 2007/0295381A1 (Fujii)	December 27, 2007 (Published)	March 29, 2005
5	PCT Patent Application Publication WO2010/070573 (Guy)	June 24, 2010 (Published)	December 14, 2009
6	U.S. Patent Application Publication No. 2008/0000523 (Hilgarth)	January 3, 2008 (Published)	September 7, 2005
7	Japan Patent No. JP07106619A (Maehane)	April 21, 1995 (Published)	October 7, 1993
8	Japan Patent Application No. JP2000164901A (Matsubara)	June 16, 2000 (Published)	November 27, 1998

Ex.	Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
9	Indian Patent Application No. 1260/KOL/2008 (Ravi260)	January 29, 2010 (Published)	July 23, 2008
10	Indian Patent Application No. 1328/KOL/2007 (Ravi328)	October 4, 2009 (Published)	September 26, 2007
11	U.S. Patent No. 4,089,705A (Rubin)	May 16, 1978 (Published)	July 28, 1976
12	Japan Patent Application No. JP 2005-276896A (Tomiyuki)	October 6, 2005 (Published)	March 23, 2003
13	U.S. Patent No. 8,067,295 (Yagiura)	April 5, 2007 (Published)	September 27, 2006
14	U.S. Application Publication No. 2007/0175509 (Yagiura509)	August 2, 2007 (Published)	January 31, 2007
15	China Patent Application No. CN 201171051 Y (Zhang)	December 24, 2008 (Published)	January 31, 2008
16	A. P. Woosley, MSFC Skylab Electrical Power Systems Mission Evaluation (1974) (“Skylab Eval”); W. D. West, Skylab Operations Handbook: Orbital Workshop (OWS), Airlock Module (AM), Multiple Docking Adapter (MDA): Systems Descriptions - Volume 1 (1970) (“Skylab V1”); NASA, MSFC Skylab Orbital Workshop, Volume 2 (1974) (“Skylab V2”) (collectively, “Skylab”)	June 1974 (Published) July 20, 1970 (Published) May 1974 (Published)	

Defendants additionally identify and rely on any system, product, or public knowledge or use that embodies or otherwise incorporates any of the prior art patents and publications listed above. Defendants reserve the right to identify and rely on systems that represent different versions or are otherwise related variations of the identified systems. Defendants also incorporate by reference any and all other prior art systems identified in any other case brought by LONGi and/or involving the Asserted Patent.

To the extent any item of prior art cited above is deemed not to disclose, explicitly or inherently, any limitation of an asserted claim of the '214 patent, Defendants contend that any difference between that prior art and the corresponding patent claim would have been either

inherent in the art or obvious to a person of ordinary skill in the art, even if Defendants have not specifically denoted that the art is to be combined with the knowledge of a person of ordinary skill in the art.

On information and belief, the systems identified below were in public use, on sale, or otherwise available to the public before the priority date of the '214 Patent. Defendants' further investigation and/or subsequent discovery from LONGi or third parties with knowledge regarding prior art systems may reveal additional relevant prior art systems and/or further information regarding the systems identified below, or other relevant prior art systems. Defendants reserve the right to supplement these invalidity contentions based on subsequent investigation and discovery, including from third parties.

- BP Solar's BP 3280T and other solar panels and solar cells
- Spectrolab solar panels and solar cells
- REC Solar solar panels and solar cells
- Solarex solar panels and solar cells
- Sanyo Energy solar panels and solar cells
- Skylab

The attached claim charts identify specific examples of disclosures that teach or suggest a given claim limitation. These identifications should be understood to be exemplary; the charts do not necessarily indicate every location within a particular prior art reference where a claim limitation may be disclosed or suggested. Defendants and their expert witness(es) may rely on other portions of the prior art.

The chart below identifies references that invalidate the Asserted Claims and specifies which claims each reference anticipates (denoted by an asterisk) or renders obvious, either alone

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or as part of a specified combination. The discussion below sets forth rationale and motivation for combining the respective references with respect to the claimed features they disclose.

	<u>Asserted Claims of the '214 Patent</u>							
<u>Prior Art</u>	1	2	3	4	5	6	8	11
Boretz (Ex. 1) & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Boretz (Ex. 1) & BP 3280T (Ex. 2)	X	X	X	X	X	X	X	X
Boretz (Ex. 1) & Fujii (Ex. 4)	X	X	X	X	X	X	X	X
Boretz (Ex. 1), Fujii (Ex. 4), & Ravi328 (Ex. 10)	X	X	X	X	X	X	X	X
Boretz (Ex. 1) & Matsubara (Ex. 8)	X	X	X		X	X	X	X
BP 3280T (Ex. 2)	X*	X*	X*	X*	X*	X*	X*	X*
BP 3280T (Ex. 2) & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
BP 3280T (Ex. 2) & Ravi260 (Ex. 9)	X	X	X	X	X	X	X	X
BP 3280T (Ex. 2) & Ravi328 (Ex. 10)	X	X	X	X	X	X	X	X
BP 3280T (Ex. 2) & Matsubara (Ex. 8)	X	X	X	X	X	X	X	X
Ravi260 (Ex. 9) & Boretz (Ex. 1)	X	X	X	X		X	X	X
Ravi260 (Ex. 9), Boretz (Ex. 1), & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Ravi260 (Ex. 9), Boretz (Ex. 1), & Yagiura (Ex. 13)	X	X	X	X	X	X	X	X
Ravi260 (Ex. 9), Boretz (Ex. 1), & Tomiyuki (Ex. 12)	X	X	X	X	X	X	X	X
Ravi260 (Ex. 9), Boretz (Ex. 1), & Guy (Ex. 5)	X	X	X	X	X	X	X	X

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	<u>Asserted Claims of the '214 Patent</u>							
<u>Prior Art</u>	1	2	3	4	5	6	8	11
Ravi260 (Ex. 9), Matsubara (Ex. 8), & Yagiura (Ex. 13)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10) & Boretz (Ex. 1)	X	X	X	X		X	X	X
Ravi328 (Ex. 10), Boretz (Ex. 1), & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Boretz (Ex. 1), & Yagiura (Ex. 13)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Boretz (Ex. 1), & Tomiyuki (Ex. 12)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Boretz (Ex. 1), & Guy (Ex. 5)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Maehane (Ex. 7), & Yagiura (Ex. 13)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Maehane (Ex. 7), & Tomiyuki (Ex. 12)	X	X	X	X	X	X	X	X
Ravi328 (Ex. 10), Maehane (Ex. 7), & Guy (Ex. 5)	X	X	X	X	X	X	X	X
Zhang (Ex. 15) & Boretz (Ex. 1)	X	X	X	X		X	X	X
Zhang (Ex. 15), Boretz (Ex. 1), & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Zhang (Ex. 15), Boretz (Ex. 1), & Fujii (Ex. 4)	X	X	X	X	X	X	X	X
Zhang (Ex. 15), Boretz (Ex. 1), & Yagiura (Ex. 13)	X	X	X	X	X	X	X	X
Zhang (Ex. 15), Boretz (Ex. 1), & Tomiyuki (Ex. 12)	X	X	X	X	X	X	X	X

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	<u>Asserted Claims of the '214 Patent</u>							
<u>Prior Art</u>	1	2	3	4	5	6	8	11
Zhang (Ex. 15), Boretz (Ex. 1), & Guy (Ex. 5)	X	X	X	X	X	X	X	X
Zhang (Ex. 15) & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Zhang (Ex. 15) & Guy (Ex. 13)	X	X	X	X	X		X	X
Zhang (Ex. 15) & Matsubara (Ex. 8)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13) & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13) & Fujii (Ex. 4)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13), Fujii (Ex. 4), & Matsubara (Ex. 8)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13), Fujii (Ex. 4), & Guy (Ex. 5)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13) & Ravi260 (Ex. 9)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13), Ravi260 (Ex. 9), & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13), Ravi260 (Ex. 9), & Tomiya (Ex. 12)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13) & Guy (Ex. 5)	X	X	X	X	X	X	X	X
Yagiura (Ex. 13), Guy (Ex. 5), & Maehane (Ex. 7)	X	X	X	X	X	X	X	X
Skylab (Ex. 16) & Maehane	X	X	X	X	X	X	X	X

For each specified combination, Defendants rely on the references herein, as well as the knowledge of a person of ordinary skill in the art, including that which will be discussed through expert discovery. Although Defendants provide exemplary disclosures and motivations to combine below, Defendants will present expert opinion in accordance with the procedural schedule.

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Defendants reserve the right to supplement or modify the anticipation and obviousness grounds in response to, for example, LONGi's positions regarding the scope and meaning of the Asserted Claims taken in this case, before the PTAB, or during prosecution of pending matters related to the Asserted Patent, claim construction determinations made in this case or other proceedings involving the Asserted Patent, updates or changes to LONGi's infringement positions, and materials later obtained during discovery, including from LONGi or in response to any third party subpoenas.

In support of its invalidity contentions, Defendants incorporate by reference their petition for *inter partes* review of the '214 patent (IPR2025-00850), filed with the PTAB on April 18, 2025. In particular, Defendants incorporate the arguments in their petition, the expert testimony in the supporting declaration of Dr. Hamid Toliyat, and the references cited in, and attached to, the petition and declaration.

Defendants hereby cite the following additional references as being relevant to the subject matter claimed in the '214 patent. Defendants are producing concurrently herewith a number of such references that are relevant to the validity of the '214 patent, the state of the art, and as evidencing a motivation to combine various references. Defendants reserve the right to rely on one or more of the references produced concurrently herewith as anticipatory references under 35 U.S.C. § 102, as further evidence of obviousness under 35 U.S.C. § 103 (including as evidence of motivation to combine or reasonable expectation of success), as background references demonstrating the state of the art, as a limitation upon the doctrine of equivalents, or for any other purpose. Based on further investigation and discovery, based on positions that LONGi may take regarding the scope of the asserted claims, and/or based on the Court's claim construction (once issued), Defendants reserve the right to revise these contentions and to rely on these references to

prove the invalidity of the '214 patent in a manner consistent with the Court's orders and the Local Rules.

- Narayanan Krishnamurthy, *Dynamic Modelling of CubeSat Project MOVE* (2008)
- Tom Markvart & Luis Castaner, *Solar Cells: Materials, Manufacture and Operation* (2005)
- Daniel Cunningham et al., *Reaching Grid Parity Using BP Solar Crystalline Silicon Technology*, IEEE (2010)
- U.S. Patent No. 8,709,154
- European Patent Application Publication No. EP 1796177 A1
- *Solar Cell Array Design Handbook*, Jet Propulsion Lab, Vol. 1 (Oct. 1976)
- U.S. Patent No. 8,871,169
- M. Gillanders, *Pilot Production and Testing of High Efficiency Wraparound Contact Solar Cells*, NASA CR-165302 (June 1981)
- European Patent Application Publication No. EP1564816 A1
- A. Goetzberger & V.U. Hoffmann, *Photovoltaic Solar Energy Generation* (2005)
- U.S. Patent No. 7,951,640
- Japanese Patent Publication No. 2005-276896A
- Fundamentals of Electric Circuits (3d Ed. 2007)
- Photovoltaic Systems Engineering (3d Ed. 2010)
- U.S. Patent No. 3,094,439

1. Level of Ordinary Skill in the Art

To assess the level of ordinary skill of a POSITA, the following factors can be considered:

(i) the type of problems encountered in the art; (ii) the prior solutions to those problems; (iii) the

rapidity at which innovations are made; (iv) the sophistication of the technology; and (v) the level of education of active workers in the relevant field.

Based on the foregoing, Defendants contend that a POSITA for the '214 patent as of July 2, 2010 would have had a bachelor's degree in engineering, physics, or a related field, and at least two years of experience researching, developing, designing, or evaluating photovoltaic cells or solar module systems. A person with less formal education but additional relevant practical experience, or vice versa, would also qualify as a person of ordinary skill in the art.

2. Obviousness and Motivation to Combine

Motivations to combine, as well as the general state of the art, may be found in a variety of places including in the references defined above and the specification of the '214 patent. For example, each piece of prior art relates to the design and/or structure and/or function of solar battery modules. A person of ordinary skill in the art at the time of the alleged invention would have been motivated to combine any one piece of identified prior art with any other identified piece of prior art. For at least this reason, it would have been obvious to a person of skill in the art at the time of the alleged invention of the Asserted Claims to combine the various references cited herein so as to practice the Asserted Claims and there was a motivation in the art to make such a combination.

Motivations to combine various prior art references are present in the references themselves, the common knowledge of one of ordinary skill in the art, the prior art as a whole, or the nature of the problems allegedly addressed by the '214 patent. Further reasons to combine the references identified in these charts include the nature of the problem being solved, the express, implied, and/or inherent teachings of the prior art, the knowledge of persons of ordinary skill in the art, the fact that the prior art is generally directed towards methods and systems for the design and/or structure and/or function of solar battery modules that such combinations would have

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yielded predictable results, and the fact that such combinations would have represented known alternatives to a person of ordinary skill in the art.

In *KSR International Co. v. Teleflex, Inc.*, the United States Supreme Court held that, among other things, “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” 550 U.S. 398, 416 (2007); *see also id.* at 401 (“[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.”). In particular, a patent is obvious where “the content of the prior art, the scope of the patent claim, and the level of ordinary skill are not in material dispute, and the obviousness of the claim is apparent in light of these factors.” *Id.* at 427. The Supreme Court explained that “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *Id.* at 401.

Moreover, the Supreme Court recognized that market pressures will motivate a person of ordinary skill to survey known art for solutions to problems. *Id.* at 402 (“When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp.”). When a person of ordinary skill uses an identified, predictable solution to solve a problem, “it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* at 402-03.

In addition, when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. *Id.* at 417. If a person of ordinary skill can implement a predictable variation, § 103 bars its patentability. *Id.*

The rationale to combine or modify prior art references is significantly stronger when references seek to solve similar problems, come from the same field, and correspond well with one another. *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023).

The references share commonalities in terms of their general subject matter as well as the types of equipment, products, systems, and/or methods used. Further, the prior art references explicitly or implicitly reference other prior art references, share common authors or inventors, were published in the same journals, were compiled by a common author of a compilation or reference book, were presented at the same conferences, and/or were developed at common companies, schools, or organizations which would motivate one of skill in the art to combine them. Additionally, the references, and any products, devices, or processes described in the references, existed and/or were invented in the same time period providing further motivation for combination.

These disclosures are provided without prejudice to any arguments or objections concerning the relevance of motivation to combine in connection with any invalidity contentions. Defendants reserve the right to further specify the motivations to combine the prior art in response to positions that LONGi may take later in this case and as discovery proceeds. Defendants may rely on any and all portions of the prior art, other documents, and expert testimony to establish that a person of ordinary skill in the art would have been motivated to modify or combine the prior art so as to render the claims invalid as obvious. Moreover, Defendants reserve the right to rely on later identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the '214 patent.

One or more combinations of the prior art references identified in Exhibits 1 through 16 would have been obvious because these references would have been combined using a simple substitution of one known, equivalent element for another to obtain predictable results and/or a

teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Exhibits 1 through 16 would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

All the Asserted Claims are directed to solar battery modules to purportedly improve efficiency. Such technology was widely known before the alleged priority date of the '214 patent, as evidenced by the references in Exhibits 1 through 16. Additional motivations to combine specific references are discussed below.

a) Boretz and Maehane

It would have been obvious to combine Boretz with Maehane. Both Boretz and Maehane are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Boretz, 1-2, 2-1; Maehane, Abstract, [0001]. Both Boretz and Maehane specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Boretz, 3-1–3-5; Maehane, [0005]–[0009]. Both Boretz and Maehane disclose a process of connecting substantially rectangular-shaped solar cells in series from the front surface of a first cell to the back surface of an adjoining cell. *See, e.g.*, Boretz, 2-1, 4-1, 5-1, Fig. 2.1, Fig. 2.2; Maehane, [0004], [0016], [0019], Fig. 3, Fig. 4, Fig. 5, Fig. 8. Maehane also discloses a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. Maehane, Abstract, [0003], [0009], [0013]–[0016], [0019], Figs. 1–8. Maehane also teaches that

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adopting its electrode configuration—wherein the electrodes are not formed within a region extending inwards from the perimeter of the cell surfaces—helps to prevent short circuits. *See, e.g.,* Maehane, Abstract, [0010], [0017], [0018], [0021], Figs. 1–8.

A POSITA would have been motivated to incorporate Maehane’s electrode configuration in Boretz’s solar panel module to obtain the aforementioned benefits taught by Maehane. Incorporating Maehane’s electrode configuration would help to improve current collection and connection efficiency. The grid line and bus electrode pattern disclosed in Maehane is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells in order to maximize current collection, and the adjoining bus electrodes then transfer the collected current across connected cells to a desired endpoint (e.g., terminal). In addition, a POSITA would have recognized that incorporating Maehane’s electrode configuration with Boretz’s solar panel module would also confer the same benefit of helping to prevent short circuits, as described above.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Maehane’s electrode configurations in Boretz’s solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, Maehane’s grid line and bus electrode configuration is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Maehane’s electrode configuration in Boretz’s solar panel module would result in a more reliable and functional

photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by Maehane.

b) Boretz and BP 3280T

It would have been obvious to combine Boretz with BP 3280T. Both Boretz and BP 3280T are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Boretz, 1-2, 2-1; BP 3280T, 1, 2. Both Boretz and BP 3280T specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Boretz, 3-1–3-5; BP 3280T, 1, 2. Both Boretz and BP 3280T disclose a solar module comprised of a plurality of solar cells connected in a series-parallel configuration made up of multiple strings of cells. *See, e.g.*, Boretz, 2-1, 4-1, 5-1, Fig. 2.1, Fig. 2.2; BP 3280T, 2. BP 3280T also discloses a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. BP 3280T, 1.

A POSITA would have been motivated to incorporate BP 3280T's electrode configuration in Boretz's solar panel module to obtain the aforementioned benefits taught by BP 3280T. Incorporating BP 3280T's electrode configuration would help to improve current collection and connection efficiency. The grid line and bus electrode pattern disclosed in BP 3280T is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells in order to maximize current collection, and the adjoining bus electrodes then transfer the collected current across connected cells to a desired endpoint (e.g., terminal).

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing BP 3280T's electrode configurations in Boretz's solar panel module

would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, BP 3280T's grid line and bus electrode configuration is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating BP 3280T's electrode configuration in Boretz's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by BP 3280T.

c) Boretz and Fujii

It would have been obvious to combine Boretz with Fujii. Both Boretz and Fujii are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Boretz, 1-2, 2-1; Fujii, Abstract, [0001]. Both Boretz and Fujii specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Boretz, 3-1–3-5; Fujii, [0009]–[0013]. Both Boretz and Fujii disclose a solar module comprised of a plurality of solar cells connected in a series and/or parallel fashion made up of multiple strings of cells. *See, e.g.*, Boretz, 2-1, 4-1, 5-1, Fig. 2.1, Fig. 2.2; Fujii, [0064], [0065], [0129], [0131], [0245], Figs. 3(a)–3(b), Fig. 12, Fig. 13. Fujii also discloses a common industry design for an electrode configuration on the surfaces of a solar cell, which includes a series of grid lines and bus electrodes to ensure collected electrons are carried through a solar module with minimum losses. Fujii, Abstract, [0007]–[0011]. Fujii further teaches that adopting its careful balance of the dimensions of these electrodes helps to maintain a high conversion efficiency while reducing resistance. Fujii, [0011], [0045]. Fujii also discloses a configuration wherein electrodes

are not formed on a peripheral region extending inwards from the perimeter of the solar cells. Fujii, Figs. 1(a)–1(b), Fig. 5(a), Fig. 9(a).

A POSITA would have been motivated to incorporate Fujii’s electrode configuration in Boretz’s solar panel module to obtain the aforementioned benefits taught by Fujii. Incorporating Fujii’s electrode configuration would help to appropriately balance the dimensions of the cross-sectional area of the electrode surfaces in Boretz’s solar cells and thus in turn the electrical efficiency against resistance losses. Moreover, the grid line and bus electrode pattern disclosed more generally in Fujii is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells to maximize current collection, and the adjoining bus electrodes then transfer the collected current across connected cells to a desired endpoint (e.g., terminal). A POSITA would further have understood that adopting Fujii’s teaching of leaving a perimeter surface of the solar cell where no bus electrodes are formed would also help to prevent undesirable short circuits due to soldering overflow.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Fujii’s electrode configurations in Boretz’s solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, Fujii’s grid line and bus electrode configuration is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Fujii’s electrode configuration

in Boretz's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by Fujii.

d) Boretz, Fujii, and Ravi328

It would have been obvious to combine Boretz with Fujii and Ravi328. All three references are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Boretz, 1-2, 2-1; Fujii, Abstract, [0001]; Ravi328, 1, 3. Further, all three references specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Boretz, 3-1–3-5; Fujii, [0009]–[0013]; Ravi328, 3–5. All three disclose a solar module comprised of a plurality of solar cells connected in a series and/or parallel fashion made up of multiple strings of cells. *See, e.g.*, Boretz, 2-1, 4-1, 5-1, Fig. 2.1, Fig. 2.2; Fujii, [0064], [0065], [0129], [0131], [0245], Figs. 3(a)–3(b), Fig. 12, Fig. 13; Ravi328, 3–5, Fig. 5, Fig. 6. Fujii also discloses a common industry design for an electrode configuration on the surfaces of a solar cell, which includes a series of grid lines and bus electrodes to ensure collected electrons are carried through a solar module with minimum losses. Fujii, Abstract, [0007]–[0011]. Fujii further teaches that adopting its careful balance of the dimensions of these electrodes helps to maintain a high conversion efficiency while reducing resistance. Fujii, [0011], [0045]. Fujii also discloses a configuration wherein electrodes are not formed on a peripheral region extending inwards from the perimeter of the solar cells. Fujii, Figs. 1(a)–1(b), Fig. 5(a), Fig. 9(a). Ravi328 discloses a similar such electrode design, also comprising both grid line electrodes and bus electrodes. Ravi328, 3–5, Fig. 4, Fig. 6. Ravi328 further teaches that substantially rectangular cells may be produced by cutting a substantially square solar cell in half. Ravi328, 1, 3–5, Fig. 4. Because solar cells are commonly manufactured and sold in a substantially square form factor, substantially rectangular cells can be readily obtained in this manner.

A POSITA would have been motivated to incorporate Fujii's electrode configuration in Boretz's solar panel module to obtain the aforementioned benefits taught by Fujii. Incorporating Fujii's electrode configuration would help to appropriately balance the dimensions of the cross-sectional area of the electrode surfaces in Boretz's solar cells and thus in turn the electrical efficiency against resistance losses. Moreover, the grid line and bus electrode pattern disclosed more generally in Fujii is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells to maximize current collection, and the adjoining bus electrodes then transfer the collected current across connected cells to a desired endpoint (e.g., terminal). A POSITA would further have understood that adopting Fujii's teaching of leaving a perimeter surface of the solar cell where no bus electrodes are formed would also help to prevent undesirable short circuits due to soldering overflow.

A POSITA also would have been motivated to incorporate Ravi328's teachings regarding the production of half-cut solar cells in Boretz's solar panel module to obtain the aforementioned benefits taught by Ravi328. Ravi328 describes a standard and convenient method of obtaining solar cells in a substantially rectangular form factor as used in Boretz. A POSITA would have recognized that solar cells for use in Boretz's solar panel could be readily produced in the same manner, by cutting a standard substantially square solar cell, as this is typically the initial form factor after the ingot and wafering process.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing either Fujii's or Ravi328's electrode configurations in Boretz's solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, both Fujii's and

Ravi328's grid line and bus electrode configuration represent a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating either Fujii's or Ravi328's electrode configuration in Boretz's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by both Fujii and Ravi328. In addition, a POSITA would have also had a reasonable expectation of success in adopting Ravi328's teaching of producing substantially rectangular solar cells by halving substantially square solar cells. This would have been well within the scope of the abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, a POSITA would have readily recognized that obtaining substantially rectangular solar cells by first cutting a substantially square solar cell represents the standard practice for achieving such a form factor, given the typical silicon ingot growth and wafer formation process that results in such dimensions.

e) Boretz and Matsubara

It would have been obvious to combine Boretz with Matsubara. Both Boretz and Matsubara are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Boretz, 1-2, 2-1; Matsubara, Abstract, [0001]. Both Boretz and Matsubara specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Boretz, 3-1–3-5; Matsubara, [0002]–[0004]. Both Boretz and Matsubara disclose a process of connecting substantially rectangular-shaped solar cells in series from the front surface of a first cell to the back surface of an adjoining cell. *See, e.g.*, Boretz, 2-1, 4-1, 5-1, Fig. 2.1, Fig. 2.2; Matsubara, Abstract, [0002]–[0004], [0008], [0009]–[0014], Fig. 2,

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Fig. 5. Matsubara also discloses a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. Matsubara, Abstract, [0002]–[0004], [0009]–[0014], Figs. 1–5. Matsubara also discloses that the bus electrodes may be further formed in a manner where they do not extend completely to the outside perimeter of the solar cell surfaces. Matsubara, Figs. 1–5. Further, Matsubara teaches that the process of soldering and wiring adjoining solar cells can be improved by including a wider tabbed portion at one end of the bus electrodes. Matsubara, [0002]–[0008], [0014], Fig. 1, Fig. 2, Fig. 4, Fig. 5.

A POSITA would have been motivated to incorporate Matsubara’s electrode configuration in Boretz’s solar panel module to obtain the aforementioned benefits taught by Matsubara. Incorporating Matsubara’s electrode configuration would help to improve current collection and connection efficiency. The grid line and bus electrode pattern disclosed in Matsubara is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells in order to maximize current collection, and the adjoining bus electrodes then transfer the collected current across connected cells to a desired endpoint (e.g., terminal). In addition, a POSITA would have recognized that incorporating Matsubara’s electrode configuration, including its wider tabbed portions at one end of the bus electrodes, with Boretz’s solar panel module would also confer the same benefit of helping to improve the wiring and soldering process.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Matsubara’s electrode configurations in Boretz’s solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine

manufacturing steps with predictable results. As noted above, Matsubara's grid line and bus electrode configuration is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Matsubara's electrode configuration in Boretz's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by Matsubara.

f) BP 3280T and Maehane

It would have been obvious to combine BP 3280T with Maehane. Both BP 3280T and Maehane are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, BP 3280T, 1, 2; Maehane, Abstract, [0001]. Both BP 3280T and Maehane specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, BP 3280T, 1, 2; Maehane, [0005]–[0009]. Both BP 3280T and Maehane disclose a process of connecting substantially rectangular-shaped solar cells in series from the front surface of a first cell to the back surface of an adjoining cell. *See, e.g.*, BP 3280T, 2; Maehane, [0004], [0016], [0019], Fig. 3, Fig. 4, Fig. 5, Fig. 8. Both BP 3280T and Maehane also utilize a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. BP 3280T, 1; Maehane, Abstract, [0003], [0009], [0013]–[0016], [0019], Figs. 1–8. Maehane also teaches that adopting its electrode configuration—wherein the electrodes are not

formed within a region extending inwards from the perimeter of the cell surfaces—helps to prevent short circuits. *See, e.g.,* Maehane, Abstract, [0010], [0017], [0018], [0021], Figs. 1–8.

A POSITA would have been motivated to incorporate Maehane’s modified electrode configuration—wherein the bus electrodes are not formed within a region extending inwards from the perimeter of the cell surfaces—in BP 3280T’s solar panel module to obtain the aforementioned benefits taught by Maehane. Incorporating Maehane’s method of not forming the bus electrodes within a particular peripheral region of the solar cells would help to decrease the occurrence of short circuits caused by solder overflow when attempting to connect adjoining solar cells packed closely together. A POSITA would have recognized that these benefits would be readily conferred to BP 3280T’s solar panel module, as each short circuit could stand to significantly impact the operation of the solar module by disrupting current transfer along a series of cells connected to the problem cell.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Maehane’s busbar formation strategy in BP 3280T’s solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, both BP 3280T and Maehane utilize a grid line and bus electrode configuration that is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Maehane’s teachings regarding the formation region of the bus electrodes in BP 3280T’s solar panel module would result in a more reliable and functional photovoltaic system,

given the well-known benefits of preventing short circuits in electrical devices such as shown in Maehane.

g) BP 3280T and Ravi260

It would have been obvious to combine BP 3280T with Ravi260. Both BP 3280T and Ravi260 are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, BP 3280T, 1, 2; Ravi260, 1, 3. Both BP 3280T and Ravi260 specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, BP 3280T, 1, 2; Ravi260, 3–7. Both BP 3280T and Ravi260 disclose a solar module comprised of a plurality of solar cells connected in a series-parallel configuration made up of multiple strings of cells. *See, e.g.*, BP 3280T, 2; Ravi260, 3–7, Fig. 6. Ravi260 further teaches additional series-parallel configurations for columns of solar cell strings, wherein two sets of two-column cell strings in parallel are further connected to each other in series, which provides additional options for mitigating potential losses due to partial module shading and individual solar cell failures. Ravi260, 3–7, Fig. 6.

A POSITA would have been motivated to incorporate Ravi260's series-parallel solar string configuration in BP 3280T's solar panel module to obtain the aforementioned benefits taught by Ravi260. Incorporating Ravi260's electrical configuration—wherein two columns of serially connected cell strings are connected to each other in parallel, and then further connected to another such two columns in series—would help to provide additional configurations for mitigating the risk of partial module shading and individual solar cell failure. A POSITA would have readily recognized that depending on the geographical location and placement of the solar module and the pattern of shading, different such series-parallel configurations may perform better at mitigating such losses. A POSITA would have recognized that these benefits would be readily conferred to BP 3280T's solar panel module, as additional series-parallel configurations such as taught by

Ravi260 would allow for deployment and use of the module in greater variety of locations and environmental circumstances.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Ravi260's series-parallel configuration in BP 3280T's solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The process of wiring and connecting solar cells in a solar module in a desired electrical configuration is a common and necessary step in solar module fabrication, and the wiring of solar cells in series, parallel, and series-parallel would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar modules, including the manner in which the solar cells are electrically connected with each other in series, parallel, or series-parallel, would have been well known to a POSITA, having been commonplace to the solar industry for decades.

h) BP 3280T and Ravi328

It would have been obvious to combine BP 3280T with Ravi328. Both BP 3280T and Ravi328 are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, BP 3280T, 1, 2; Ravi328, 1, 3. Both BP 3280T and Ravi328 specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, BP 3280T, 1, 2; Ravi328, 3–5. Both BP 3280T and Ravi328 disclose a solar module comprised of a plurality of solar cells connected in a series-parallel configuration made up of multiple strings of cells. *See, e.g.*, BP 3280T, 2; Ravi328, 3–5, Fig. 5, Fig. 6. Both BP 3280T and Ravi328 also disclose the use of substantially rectangular solar cells, approximately half the size of a substantially square shape. BP 3280T, 1, 2; Ravi328, 1, 3–5, Figs. 4–6. Ravi328 further teaches that substantially rectangular cells may be produced by cutting a substantially square solar cell in half. Ravi328, 1, 3–5, Fig. 4. Because solar cells are commonly manufactured and sold in a

substantially square form factor, substantially rectangular cells can be readily obtained in this manner.

A POSITA would have been motivated to incorporate Ravi328's teachings regarding the production of half-cut solar cells in BP 3280T's solar panel module to obtain the aforementioned benefits taught by Ravi328. Ravi328 describes a standard and convenient method of obtaining solar cells in a substantially rectangular form factor as used in BP 3280T. A POSITA would have recognized that solar cells for use in BP 3280T's solar panel could be readily produced in the same manner, by cutting a standard substantially square solar cell, as this is typically the initial form factor after the ingot and wafering process.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Ravi328's teaching of producing substantially rectangular solar cells by halving substantially square solar cells would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, a POSITA would have readily recognized that obtaining substantially rectangular solar cells by first cutting a substantially square solar cell represents the standard practice for achieving such a form factor, given the typical silicon ingot growth and wafer formation process that results in such dimensions.

i) BP 3280T and Matsubara

It would have been obvious to combine BP 3280T with Matsubara. Both BP 3280T and Matsubara are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, BP 3280T, 1, 2; Matsubara, Abstract, [0001]. Both BP 3280T and Matsubara specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, BP 3280T, 1, 2; Matsubara, [0002]–[0004]. Both BP 3280T and Matsubara disclose a process of connecting substantially rectangular-shaped solar cells in series

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from the front surface of a first cell to the back surface of an adjoining cell. *See, e.g.*, BP 3280T, 2; Matsubara, Abstract, [0002]–[0004], [0008], [0009]–[0014], Fig. 2, Fig. 5. Both BP 3280T and Matsubara also utilize a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. BP 3280T, 1; Matsubara, Abstract, [0002]–[0004], [0009]–[0014], Figs. 1–5. Matsubara also discloses that the bus electrodes may be further formed in a manner where they do not extend completely to the outside perimeter of the solar cell surfaces. Matsubara, Figs. 1–5. Further, Matsubara teaches that the process of soldering and wiring adjoining solar cells can be improved by including a wider tabbed portion at one end of the bus electrodes. Matsubara, [0002]–[0008], [0014], Fig. 1, Fig. 2, Fig. 4, Fig. 5.

A POSITA would have been motivated to incorporate Matsubara’s modified electrode configuration—wherein the bus electrodes are not formed within a region extending inwards from the perimeter of the cell surfaces, and one end of the electrode busbars ends in a wider tabbed portion—in BP 3280T’s solar panel module to obtain the aforementioned benefits taught by Matsubara. In addition, a POSITA would have recognized that incorporating Matsubara’s electrode configuration, including its wider tabbed portions at one end of the bus electrodes, with BP 3280T’s solar panel module would also confer the same benefit of helping to improve the wiring and soldering process. A POSITA would have recognized that these benefits would be readily conferred to BP 3280T’s solar panel module, as an improperly formed connection between serially connected solar cells could stand to significantly impact the operation of the solar module by disrupting current transfer along a plurality of cells connected to the problem cell.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Matsubara's busbar formation strategy in BP 3280T's solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, both BP 3280T and Matsubara utilize a grid line and bus electrode configuration that is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Matsubara's teachings regarding the formation region of the bus electrodes in BP 3280T's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of ensuring proper connectivity between serially connected cells in electrical devices such as shown in Matsubara.

j) Ravi260 and Boretz

It would have been obvious to combine Ravi260 with Boretz. Both Ravi260 and Boretz are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Boretz, 3-1. Both Ravi260 and Boretz specifically address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi260, 3; Boretz, 1-1. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Boretz discloses a solar module comprising a series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2.

A POSITA would have been motivated to implement Boretz's half-cell configuration in Ravi260's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, and enhanced power-to-weight performance. *See,*

e.g., Boretz, 1-1, 3-1, 4-1. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi260 and Boretz, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about half-cell configurations and organized array layouts to Ravi260's structure of rectangular cut-cell solar modules arranged in parallel columns. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's half-cell configuration with Ravi260's series-parallel module would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of both Ravi260 and Boretz, and with the predictable performance characteristics desired in modern solar modules.

k) Ravi260, Boretz, and Maehane

It would have been obvious to combine Ravi260 with Boretz and Maehane. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Boretz, 3-1; Maehane, Abstract. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi260, 3; Boretz, 1-1; Maehane, Abstract. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Boretz discloses a solar module comprising a series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Maehane discloses a method for manufacturing

solar cells aimed at preventing short-circuiting during the electrical connection of segmented solar cell elements. *See, e.g.,* Maehane, Abstract. Specifically, Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. Maehane, [0086].

A POSITA would have been motivated to implement Boretz's half-cell configuration and Maehane's electrode configuration in Ravi260's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and mitigated risk of solder overflow causing short circuits. *See, e.g.,* Boretz, 1-1, 3-1, 4-1; Maehane, [0010]. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi260, Boretz, and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about half-cell configurations and organized array layouts, and Maehane's electrode configuration to Ravi260's structure of rectangular cut-cell solar modules arranged in parallel columns. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's half-cell configuration with Ravi260's series-parallel module and Maehane's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the

objectives of Ravi260, Boretz, and Maehane, and with the predictable performance characteristics desired in modern solar modules.

l) Ravi260, Boretz, and Yagiura

It would have been obvious to combine Ravi260 with Boretz and Yagiura. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Boretz, 3-1; Yagiura, 1:12–21. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi260, 3; Boretz, 1-1; Yagiura, 1:31-39. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Boretz discloses a solar module comprising a series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Yagiura discloses solar cells with bus electrodes and series-parallel configurations. *See, e.g.*, Yagiura, 10:7-19, 14:48-60.

A POSITA would have been motivated to implement Boretz's half-cell configuration and Yagiura's teachings of front- and rear-surface bus electrode alignment with interconnection in Ravi260's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and simplified manufacturing process. *See, e.g.*, Boretz, 1-1, 3-1, 4-1; Yagiura, 1:31-39, 3:35-40. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi260, Boretz, and Yagiura, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about half-cell configurations and organized array layouts, and Yagiura's electrode configuration to Ravi260's structure of rectangular cut-cell solar modules arranged in parallel columns. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

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A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's half-cell configuration with Ravi260's series-parallel module and Yagiura's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi260, Boretz, and Yagiura, and with the predictable performance characteristics desired in modern solar modules.

m) Ravi260, Boretz, and Tomiyuki

It would have been obvious to combine Ravi260 with Boretz and Tomiyuki. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Boretz, 3-1; Tomiyuki, [0001]. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi260, 3; Boretz, 1-1; Tomiyuki, [0017]-[0018]. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Boretz discloses a solar module comprising a series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Tomiyuki discloses solar cells with bus electrodes and connection wiring connecting the cells. *See, e.g.*, Tomiyuki, [0041], [0044], [0081].

A POSITA would have been motivated to implement Boretz's half-cell configuration and Tomiyuki's teachings of front- and rear-surface bus electrode alignment with interconnection in Ravi260's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and simplified interconnection with reduced cost of solar modules. *See, e.g.*, Boretz, 1-1, 3-1, 4-1;

Tomiyuki, [0041], [0044], [0017]. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi260, Boretz, and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about half-cell configurations and organized array layouts, and Tomiyuki's electrode configuration to Ravi260's structure of rectangular cut-cell solar modules arranged in parallel columns. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's half-cell configuration with Ravi260's series-parallel module and Tomiyuki's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi260, Boretz, and Tomiyuki, and with the predictable performance characteristics desired in modern solar modules.

n) Ravi260, Boretz, and Guy

It would have been obvious to combine Ravi260 with Boretz and Guy. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Boretz, 3-1; Guy, 3:13-16. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi260, 3; Boretz, 1-1; Guy, 3:13-16. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Boretz discloses a solar module comprising a series-parallel configuration of half-cut cells. *See, e.g.*,

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Boretz, 1-1, Fig. 2.2. Guy discloses solar cells with bus electrodes and an interconnection element connecting two cells. *See, e.g.*, Guy, 7:11-22, 6:14-7:3, 5:5-8.

A POSITA would have been motivated to implement Boretz's half-cell configuration and Guy's teachings of bus electrode configuration and interconnection in Ravi260's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and increased manufacturing efficiency while providing a high voltage. *See, e.g.*, Boretz, 1-1, 3-1, 4-1; Guy, Abstract. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi260, Boretz, and Guy, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about half-cell configurations and organized array layouts, and Guy's electrode configuration to Ravi260's structure of rectangular cut-cell solar modules arranged in parallel columns. This would have amounted to nothing more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's half-cell configuration with Ravi260's series-parallel module and Guy's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi260, Boretz, and Guy, and with the predictable performance characteristics desired in modern solar modules.

o) Ravi260, Matsubara, and Yagiura

It would have been obvious to combine Ravi260 with Matsubara and Yagiura. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Matsubara, [0005]; Yagiura, 1:12–21. Ravi260 discloses a solar module using one-third cut 156-mm rectangular silicon solar cells arranged in two parallel columns to reduce resistive losses and adapt to larger wafer sizes while maintaining module efficiency. *See, e.g.*, Ravi260, 4–6. Matsubara discloses rectangular solar cells derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013]. Yagiura discloses solar cells with bus electrodes and series-parallel configurations. *See, e.g.*, Yagiura, 10:7-19, and 14:48-60.

A POSITA would have been motivated to incorporate Matsubara’s teachings of half-cell geometry, and Yagiura’s teachings of front- and rear-surface bus electrode alignment with interconnection, into Ravi260’s two-column, parallel-string solar module structure to obtain the aforementioned benefits taught by Matsubara and Yagiura. Given the aforementioned similarities in structure, function, and purpose of the solar modules described in Ravi260, Matsubara, and Yagiura, a POSITA would have recognized that this combination would have required nothing more than applying known techniques to Ravi260’s rectangular cut-cell module design. This would have amounted to little more than applying known techniques to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Matsubara’s half-cell geometry and Yagiura’s bus electrode alignment into Ravi260’s module would have been well within the abilities of a POSITA, involving routine fabrication steps such as cell cutting, electrode formation, and interconnection using standard materials and processes. Ravi260, Matsubara, and Yagiura each disclose well-established industry

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approaches for reducing resistive losses and optimizing solar module performance, and their combination would have achieved these objectives in a predictable, advantageous manner.

p) Ravi260, Matsubara, and Tomiyuki

It would have been obvious to combine Ravi260 with Matsubara and Tomiyuki. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Matsubara, [0005]; Tomiyuki, [0001]. Ravi260 discloses a solar module using one-third cut 156-mm rectangular silicon solar cells arranged in two parallel columns to reduce resistive losses and adapt to larger wafer sizes while maintaining module efficiency. *See, e.g.*, Ravi260, 4–6. Matsubara discloses rectangular solar cells derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013]. Tomiyuki discloses solar cells with bus electrodes and connection wiring connecting the cells. *See, e.g.*, Tomiyuki, [0041], [0044], [0081].

A POSITA would have been motivated to incorporate Matsubara’s teachings of half-cell geometry, and Tomiyuki’s teachings of front- and rear-surface bus electrode alignment with interconnection, into Ravi260’s two-column, parallel-string solar module structure to obtain the aforementioned benefits taught by Matsubara and Tomiyuki. Given the aforementioned similarities in structure, function, and purpose of the solar modules described in Ravi260, Matsubara, and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying known techniques to Ravi260’s rectangular cut-cell module design. This would have amounted to little more than applying known techniques to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Matsubara’s half-cell geometry and Tomiyuki’s bus electrode alignment into Ravi260’s module would have been well within the abilities of a POSITA, involving routine

fabrication steps such as cell cutting, electrode formation, and interconnection using standard materials and processes. Ravi260, Matsubara, and Tomiyuki each disclose well-established industry approaches for reducing resistive losses and optimizing solar module performance, and their combination would have achieved these objectives in a predictable, advantageous manner.

q) Ravi260, Matsubara, and Guy

It would have been obvious to combine Ravi260 with Matsubara and Guy. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi260, 1; Matsubara, [0005]; Guy, 3:13-16. Ravi260 discloses a solar module using one-third cut 156-mm rectangular silicon solar cells arranged in two parallel columns to reduce resistive losses and adapt to larger wafer sizes while maintaining module efficiency. *See, e.g.*, Ravi260, 4–6. Matsubara discloses rectangular solar cells derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013]. Guy discloses solar cells with bus electrodes and an interconnection element connecting two cells. *See, e.g.*, Guy, 7:11-22, 6:14-7:3, 5:5-8.

A POSITA would have been motivated to incorporate Matsubara's teachings of half-cell geometry, and Guy's teachings of bus electrode configuration and interconnection, into Ravi260's two-column, parallel-string solar module structure to obtain the aforementioned benefits taught by Matsubara and Guy. Given the aforementioned similarities in structure, function, and purpose of the solar modules described in Ravi260, Matsubara, and Guy, a POSITA would have recognized that this combination would have required nothing more than applying known techniques to Ravi260's rectangular cut-cell module design. This would have amounted to little more than applying known techniques to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Matsubara's half-cell geometry and Guy's bus electrode alignment into Ravi260's module would have been well within the abilities of a POSITA, involving routine fabrication steps such as cell cutting, electrode formation, and interconnection using standard materials and processes. Ravi260, Matsubara, and Guy each disclose well-established industry approaches for reducing resistive losses and optimizing solar module performance, and their combination would have achieved these objectives in a predictable, advantageous manner.

r) Ravi328 and Boretz

It would have been obvious to combine Ravi328 with Boretz. Both Ravi328 and Boretz are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Boretz, 3-1. Both Ravi328 and Boretz specifically address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Boretz, 1-1. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Boretz discloses a solar module comprising a two-column series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2.

A POSITA would have been motivated to implement Boretz's two-column series-parallel configuration in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, and enhanced power-to-weight performance. *See, e.g.*, Boretz, 1-1, 3-1, 4-1. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328 and Boretz, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about two-column series-parallel configuration to Ravi328's half-cut cell solar modules.

This would have amounted to nothing more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's modular array structure with Ravi328's half-cell module would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of both Ravi328 and Boretz, and with the predictable performance characteristics desired in modern solar modules.

s) Ravi328, Boretz, and Maehane

It would have been obvious to combine Ravi328 with Boretz and Maehane. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Boretz, 3-1; Maehane, Abstract. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Boretz, 1-1; Maehane, Abstract. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Boretz discloses a solar module comprising a two-column series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Maehane discloses a method for manufacturing solar cells aimed at preventing short-circuiting during the electrical connection of segmented solar cell elements. *See, e.g.*, Maehane, Abstract. Specifically, Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. Maehane, [0086].

A POSITA would have been motivated to implement Boretz's modular array structure and Maehane's electrode configuration in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and mitigated risk of solder overflow causing short circuits. *See, e.g.,* Boretz, 1-1, 3-1, 4-1; Maehane, [0010]. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Boretz, and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about two-column series-parallel configuration and organized array layouts, and Maehane's electrode configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's modular array structure with Ravi328's half-cell module and Maehane's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Boretz, and Maehane, and with the predictable performance characteristics desired in modern solar modules.

t) Ravi328, Boretz, and Yagiura

It would have been obvious to combine Ravi328 with Boretz and Yagiura. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.,* Ravi328, 1; Boretz, 3-1; Yagiura, 1:12–21. And all three references address optimizing solar module

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configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Boretz, 1-1; Yagiura, 1:31-39. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Boretz discloses a solar module comprising a two-column-series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Yagiura discloses solar cells with bus electrodes and series-parallel configurations. *See, e.g.*, Yagiura, 10:7-19, 14:48-60.

A POSITA would have been motivated to implement Boretz's modular array structure and Yagiura's teachings of front- and rear-surface bus electrode alignment with interconnection in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and mitigated risk of solder overflow causing short circuits. *See, e.g.*, Boretz, 1-1, 3-1, 4-1; Yagiura, 1:31-39, 3:35-40. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Boretz, and Yagiura, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about two-column-series-parallel configuration and organized array layouts, and Yagiura's electrode configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's modular array structure with Ravi328's half-cell module and Yagiura's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process

would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Boretz, and Yagiura, and with the predictable performance characteristics desired in modern solar modules.

u) Ravi328, Boretz, and Tomiyuki

It would have been obvious to combine Ravi328 with Boretz and Tomiyuki. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Boretz, 3-1; Tomiyuki, [0001]. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Boretz, 1-1; Tomiyuki, [0017]-[0018]. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Boretz discloses a solar module comprising a two-column series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Tomiyuki discloses solar cells with bus electrodes and connection wiring connecting the cells. *See, e.g.*, Tomiyuki, [0041], [0044], [0081].

A POSITA would have been motivated to implement Boretz's modular array structure and Tomiyuki's teachings of front- and rear-surface bus electrode alignment with interconnection in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and mitigated risk of solder overflow causing short circuits. *See, e.g.*, Boretz, 1-1, 3-1, 4-1; Tomiyuki, [0041], [0044], and [0017]. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Boretz, and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's

teachings about two-column-series-parallel configuration and organized array layouts, and Tomiyuki's electrode configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's modular array structure with Ravi328's half-cell module and Tomiyuki's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Boretz, and Tomiyuki, and with the predictable performance characteristics desired in modern solar modules.

v) Ravi328, Boretz, and Guy

It would have been obvious to combine Ravi328 with Boretz and Guy. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Boretz, 3-1; Guy, 3:13-16. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Boretz, 1-1; Guy, 3:13-16. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Boretz discloses a solar module comprising a two-column series-parallel configuration of half-cut cells. *See, e.g.*, Boretz, 1-1, Fig. 2.2. Guy discloses solar cells with bus electrodes and an interconnection element connecting two cells. *See, e.g.*, Guy, 7:11-22, 6:14-7:3, 5:5-8.

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A POSITA would have been motivated to implement Boretz's modular array structure and Guy's teachings of bus electrode configuration and interconnection in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, enhanced power-to-weight performance, and mitigated risk of solder overflow causing short circuits. *See, e.g.,* Boretz, 1-1, 3-1, 4-1; Guy, Abstract. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Boretz, and Guy, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about two-column series-parallel configuration and organized array layouts, and Guy's electrode configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Boretz's modular array structure with Ravi328's half-cell module and Guy's electrode configuration would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Boretz, and Guy, and with the predictable performance characteristics desired in modern solar modules.

w) Ravi328, Maehane, and Yagiura

It would have been obvious to combine Ravi328 with Maehane and Yagiura. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.,* Ravi328, 1; Maehane, Abstract; Yagiura, 1:12–21. And all three references address optimizing solar module

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configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Maehane, Abstract; Yagiura, 1:31-39. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Maehane discloses a method for manufacturing solar cells aimed at preventing short-circuiting during the electrical connection of segmented solar cell elements. *See, e.g.*, Maehane, Abstract. Specifically, Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. Maehane, [0086]. Yagiura discloses solar cells with bus electrodes and series-parallel configurations. *See, e.g.*, Yagiura, 10:7-19, 14:48-60.

A POSITA would have been motivated to implement Maehane's electrode configuration and Yagiura's teachings of front- and rear-surface bus electrode alignment with interconnection in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, mitigated risk of solder overflow causing short circuits, and simplified manufacturing process. *See, e.g.*, Maehane, [0010]; Yagiura, 1:31-39, 3:35-40. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Maehane, and Yagiura, a POSITA would have recognized that this combination would have required nothing more than applying Maehane's electrode and interconnection configurations and Yagiura's electrodes to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Maehane's electrode and interconnection configurations and Yagiura's

electrodes with Ravi328's half-cell module would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Maehane, and Yagiura, and with the predictable performance characteristics desired in modern solar modules.

x) Ravi328, Maehane, and Tomiyuki

It would have been obvious to combine Ravi328 with Maehane and Tomiyuki. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Maehane, Abstract; Tomiyuki, [0001]. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Maehane, Abstract; Tomiyuki, [0017]-[0018]. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Maehane discloses a method for manufacturing solar cells aimed at preventing short-circuiting during the electrical connection of segmented solar cell elements. *See, e.g.*, Maehane, Abstract. Specifically, Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. Maehane, [0086]. Tomiyuki discloses solar cells with bus electrodes and connection wiring connecting the cells and the two-column-series-parallel configuration. *See, e.g.*, Tomiyuki, [0041], [0044], [0081], Fig. 5.

A POSITA would have been motivated to implement Maehane's electrode and interconnection configurations and Tomiyuki's teachings of front- and rear-surface bus electrode

alignment with interconnection and two-column series-parallel configuration in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, mitigated risk of solder overflow causing short circuits, and simplified manufacturing process. *See, e.g.*, Maehane, [0010]; Tomiyuki, [0041], [0044], [0017]. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Maehane, and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying Maehane's electrode and interconnection configurations and Tomiyuki's two-column-series-parallel configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Maehane's electrode and interconnection configurations and Tomiyuki's two-column-series-parallel configuration with Ravi328's half-cell module would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Maehane, and Tomiyuki, and with the predictable performance characteristics desired in modern solar modules.

y) Ravi328, Maehane, and Guy

It would have been obvious to combine Ravi328 with Maehane and Tomiyuki. All three references are directed to the same field of endeavor: solar cell modules. *See, e.g.*, Ravi328, 1; Maehane, Abstract; Guy, 3:13-16. And all three references address optimizing solar module configurations to improve electrical performance and efficiency. *See, e.g.*, Ravi328, 3; Maehane,

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Abstract; Guy, 3:13-16. Ravi328 discloses a solar module comprising three parallel strings each containing 18 serially connected 125-mm half cut cells to address a shortage of 156-mm wafers while reducing resistive losses and improving efficiency. *See, e.g.*, Ravi328, 4, Fig. 6. Maehane discloses a method for manufacturing solar cells aimed at preventing short-circuiting during the electrical connection of segmented solar cell elements. *See, e.g.*, Maehane, Abstract. Specifically, Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. Maehane, [0086]. Guy discloses solar cells with bus electrodes and the interconnection element connecting two cells and two-column series-parallel configuration. *See, e.g.*, Guy, 7:11-22, 6:14-7:3, 5:5-8, 11:3-6.

A POSITA would have been motivated to implement Maehane's electrode and interconnection configurations and Guy's two-column series-parallel configuration in Ravi328's module to achieve the aforementioned benefits, including improved structural reliability, reduced system-level resistive losses, mitigated risk of solder overflow causing short circuits, and simplified manufacturing process. *See, e.g.*, Maehane, [0010]; Guy, Abstract. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Ravi328, Maehane, and Guy, a POSITA would have recognized that this combination would have required nothing more than applying Maehane's electrode and interconnection configurations and Guy's two-column-series-parallel configuration to Ravi328's half-cell module. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Maehane's electrode and interconnection configurations and Guy's two-

column series-parallel configuration with Ravi328's half-cell module would have been well within the scope of abilities of a POSITA, as it would have involved routine fabrication steps with predictable results. The fabrication process would have involved standard materials, standard cutting techniques, and standard interconnection processes well known to a POSITA. A POSITA would have understood that the resulting module would reduce resistive losses without increasing size, consistent with the objectives of Ravi328, Maehane, and Guy, and with the predictable performance characteristics desired in modern solar modules.

z) Zhang and Boretz

It would have been obvious to combine Zhang with Boretz. Both Zhang with Boretz are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig.2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Both Zhang with Boretz specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig.3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig.3. Boretz discloses interconnection between adjacent cells. *See, e.g.*, Boretz, Table 2.1, Fig.2.2. Boretz further discloses cell array arrangement through series/parallel-connected columns. *See, e.g.*, Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1.

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang and Boretz, a POSITA would have recognized that this combination would have required

nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in making this combination. Implementing Boretz's interconnection between adjacent cells and cell array arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, as well as the cell array arrangement, were well known to a POSITA.

aa) Zhang, Boretz and Maehane

It would have been obvious to combine Zhang with Boretz and Maehane. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Maehane, Abstract, [0003], [0004], [0013], [0015], Fig. 3, Fig.8. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig.3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Maehane, [0004], [0016], [0019]. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Boretz discloses interconnection between adjacent cells. *See, e.g.*, Boretz, Table 2.1, Fig. 2.2. Boretz further discloses cell array arrangement through series/parallel-connected columns. *See, e.g.*, Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Maehane discloses a short side length and a long side length of a substantial rectangle. *See, e.g.*, Maehane, Abstract, [0003],

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[0004], [0013], [0015]. Maehane further discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. *See, e.g.*, Maehane, [0086].

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. A POSITA would have been motivated to form the bus electrode and adopt the ratio of a short side length and a long side length as taught by Maehane in Zhang's solar battery module to obtain the aforementioned benefits taught by Maehane, since the arrangement of bus electrode and the adoption of the ratio are well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang, Boretz and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement and Maehane's teaching about the arrangement of bus electrode to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Boretz's interconnection between adjacent cells and cell array arrangement and Maehane's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved

standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

bb) Zhang, Boretz and Fujii

It would have been obvious to combine Zhang with Boretz and Fujii. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Fujii, [0001], [0011], [0046], [0062], Fig. 1(a), Fig. 1(b). All three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig.3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b). Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Boretz discloses interconnection between adjacent cells. *See, e.g.*, Boretz, Table 2.1, Fig. 2.2. Boretz further discloses cell array arrangement in series/parallel-connected columns. *See, e.g.*, Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Fujii discloses a specific arrangement of the bus electrode. *See, e.g.*, Fujii, [0044], [0045], [0051], [0052], [0053], [0054], Fig. 1(a), Fig. 1(b).

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. A POSITA would have been motivated to form the bus electrode as taught by Fujii in Zhang's solar battery module to obtain the aforementioned benefits taught by Fujii, since the arrangement of bus electrode is well within the routine skill of a POSITA. Given the aforementioned similarities

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in structure and function of the solar battery cell described in Zhang, Boretz and Fujii, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement and Fujii's teaching about the arrangement of bus electrode to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Boretz's interconnection between adjacent cells and cell array arrangement and Fujii's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

cc) Zhang, Boretz and Yagiura

It would have been obvious to combine Zhang with Boretz and Yagiura. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60. Zhang explains how to connect solar cells in a series-parallel configuration

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to increase voltage and current output. *See, e.g.,* Zhang, Abstract, 4, Fig. 3. Boretz discloses interconnection between adjacent cells. *See, e.g.,* Boretz, Table 2.1, Fig.2.2. Boretz further discloses cell array arrangement in series/parallel-connected columns. *See, e.g.,* Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Yagiura discloses solar cells with bus electrodes and series-parallel configurations. *See, e.g.,* Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60.

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. A POSITA would have been motivated to form the bus electrode and the series-parallel configuration as taught by Yagiura in Zhang's solar battery module to obtain the aforementioned benefits taught by Yagiura, since the arrangement of bus electrode is well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang, Boretz and Yagiura, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement and Yagiura's teaching about the number of columns of solar cells to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Boretz's interconnection between adjacent cells and cell array

arrangement and Yagiura's number of columns of solar cells in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

dd) Zhang, Boretz and Tomiyuki

It would have been obvious to combine Zhang with Boretz and Tomiyuki. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Tomiyuki, [0001], [0002], [0006], [0018], [0019], [0086], [0087], Fig. 3. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Tomiyuki, [0041], [0044], [0047], [0081], [0083], [0089], Fig. 1, Fig. 3. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig.3. Boretz discloses interconnection between adjacent cells. *See, e.g.*, Boretz, Table 2.1, Fig. 2.2. Boretz further discloses cell array arrangement in series/parallel-connected columns. *See, e.g.*, Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Tomiyuki discloses a specific arrangement of the bus electrode. *See, e.g.*, Tomiyuki, [0041], [0061], [0081], Fig. 1, Fig. 3.

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output.

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A POSITA would have been motivated to form the bus electrode as taught by Tomiyuki in Zhang's solar battery module to obtain the aforementioned benefits taught by Tomiyuki, since the arrangement of bus electrode is well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang, Boretz, and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement and Tomiyuki's teaching about the arrangement of bus electrode to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Boretz's interconnection between adjacent cells and cell array arrangement and Tomiyuki's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

ee) Zhang, Boretz and Guy

It would have been obvious to combine Zhang with Boretz and Guy. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Guy, 3:13-16, 4:5-13, 6:14-7:3, 7:5-10, Fig. 5. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module

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layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1; Guy, 6:14-7:3, 8:23-9:3, 11:3-6, 9:16-20, 11:3-6, 11:8-20. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Boretz discloses interconnection between adjacent cells. *See, e.g.*, Boretz, Table 2.1, Fig. 2.2. Boretz further discloses cell array arrangement in series/parallel-connected columns. *See, e.g.*, Boretz, 1-2, 2-1, 4-1, 4-2, 5-1, 5-2, Fig. 2.2, Fig. 5.1. Guy discloses a specific arrangement of the bus electrode. *See, e.g.*, Guy, 6:14-7:3, 7:11-22, 11:8-20, Fig. 7.

A POSITA would have been motivated to form the interconnection between adjacent cells and form the cell array through series/parallel-connected columns as taught by Boretz in Zhang's solar battery module to obtain the aforementioned benefits taught by Boretz, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. A POSITA would have been motivated to form the bus electrode as taught by Guy in Zhang's solar battery module to obtain the aforementioned benefits taught by Guy, since the arrangement of bus electrodes is well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang, Boretz and Guy, a POSITA would have recognized that this combination would have required nothing more than applying Boretz's teachings about interconnection between adjacent cells and cell array arrangement and Guy's teaching about the arrangement of bus electrodes to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Boretz's interconnection between adjacent cells and cell array

arrangement and Guy's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

ff) Zhang and Maehane

It would have been obvious to combine Zhang with Maehane. Both Zhang and Maehane are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Maehane, Abstract, [0003], [0004], [0013], [0015], Fig. 3, Fig. 8. And both Zhang and Maehane specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Maehane, [0004], [0016], [0019]. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Maehane discloses an electrode configuration common in the industry, wherein grid electrodes across the cell surface collect current, and bus electrodes direct the current to adjacent cells. *See, e.g.*, Maehane, [0086].

A POSITA would have been motivated to form the bus electrodes as taught by Maehane in Zhang's solar battery module to obtain the aforementioned benefits taught by Maehane, since the arrangement of bus electrodes are well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Maehane's teaching about the arrangement of bus electrode to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have

amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Maehane's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

gg) Zhang and Guy

It would have been obvious to combine Zhang with Guy. Both Zhang and Guy are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Guy, 3:13-16, 4:5-13, 6:14-7:3, 7:5-10, Fig. 5. And both Zhang and Guy specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Guy, 6:14-7:3, 8:23-9:3, 11:3-6, 9:16-20, 11:3-6, 11:8-20. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Guy discloses the specific arrangement of the bus electrode. *See, e.g.*, Guy, 6:14-7:3, 7:11-22, 11:8-20, Fig. 7.

A POSITA would have been motivated to form the bus electrode as taught by Guy in Zhang's solar battery module to obtain the aforementioned benefits taught by Guy, since the arrangement of bus electrodes is well within the routine skill of a POSITA. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang and Guy, a POSITA would have recognized that this combination would have required nothing

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more than applying Guy's teaching about the arrangement of bus electrodes to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Guy's bus electrode arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, the cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

hh) Zhang and Matsubara

It would have been obvious to combine Zhang with Matsubara. Both Zhang and Matsubara are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Zhang, Abstract, 1, 3, Fig. 2; Matsubara, [0005], Fig. 5. Both Zhang and Matsubara specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Zhang, Abstract, 4, Fig. 3; Matsubara, [0004], [0009], [0013], Fig. 2. Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. *See, e.g.*, Zhang, Abstract, 4, Fig. 3. Matsubara discloses rectangular solar cells derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013].

A POSITA would have been motivated to incorporate Matsubara's teachings of half-cell geometry and electrode arrangement in Zhang's solar battery module to obtain the aforementioned

benefits, since Zhang explains how to connect solar cells in a series-parallel configuration to increase voltage and current output. Given the aforementioned similarities in structure and function of the solar battery cell described in Zhang and Matsubara, a POSITA would have recognized that this combination would have required nothing more than applying Matsubara's teachings about electrode arrangement to Zhang's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Matsubara's electrodes arrangement in Zhang's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, as well as the cell array arrangement, were well known to a POSITA.

ii) Yagiura and Maehane

It would have been obvious to combine Yagiura with Maehane. Both Yagiura and Maehane are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Maehane, Abstract, [0003], [0004], [0013], [0015], Fig. 3, Fig. 8. And both Yagiura and Maehane specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Maehane, [0004], [0016], [0019]. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*,

Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Maehane discloses a technique in which a front-side bus electrode of a solar battery cell is connected to a rear-side electrode of an adjacent cell using interconnectors arranged through gaps between cells, thus enabling compact front-to-back connection. *See, e.g.*, Maehane, Abstract, [0004], [0013], [0014], [0015], Fig. 2.

A POSITA would have been motivated to implement a front-to-back interconnection structure as taught by Maehane in Yagiura's solar battery module to obtain the aforementioned benefits taught by Maehane, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As both references are directed to efficient electrical connection of rectangular solar cells, and both address modular string configuration, combining their teachings would have yielded predictable improvements in manufacturability and performance. Given the aforementioned similarities in structure and function of the solar battery cell described in Yagiura and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Maehane's teachings about interconnection between adjacent cells to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Maehane's interconnection between adjacent cells in Yagiura's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

It would have been obvious to combine Yagiura with Fujii. Both Yagiura and Fujii are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Fujii, [0001], [0011], [0046], [0062], Fig. 1(a), Fig. 1(b). And both Yagiura and Fujii specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b). Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Fujii discloses a solar module with aligned cell arrays and specific wiring paths that aim to simplify module structure and manufacturing while achieving reliable power generation. *See, e.g.*, Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b). Fujii further describes the shape, placement, and electrical connection layout of the busbars and interconnects, which is particularly useful for modular integration and fabrication flexibility. *See, e.g.*, Fujii, [0044], [0045], [0051], [0052], [0053], [0054], Fig. 1(a), Fig. 1(b).

A POSITA would have been motivated to implement Fujii's module wiring and interconnection between adjacent cells in Yagiura's solar battery module to obtain the aforementioned benefits taught by Fujii, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As both references are directed to address series-parallel wiring, optimization of conductor layout, and module efficiency, a POSITA would have recognized that the combination merely applies known interconnect connection from Fujii to Yagiura's solar cell module structure, leading to predictable improvements in design flexibility

and production. Given the aforementioned similarities in structure and function of the solar battery cell described in Yagiura and Fujii, a POSITA would have recognized that this combination would have required nothing more than applying Fujii's teachings about interconnection between adjacent cells to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Fujii's conductor placement and interconnection techniques in Yagiura's solar module design would have been well within the capability of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

kk) Yagiura, Fujii and Matsubara

It would have been obvious to combine Yagiura with Fujii and Matsubara. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Fujii, [0001], [0011], [0046], [0062], Fig. 1(a), Fig. 1(b); Matsubara, [0005], Fig. 5. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b); Matsubara, [0004], [0009], [0013], Fig. 2. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See,*

e.g., Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Fujii discloses a solar module with aligned cell arrays and specific wiring paths that aim to simplify module structure and manufacturing while achieving reliable power generation. *See, e.g.*, Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b). Fujii further describes the shape, placement, and electrical connection layout of the busbars and interconnects, which is particularly useful for modular integration and fabrication flexibility. *See, e.g.*, Fujii, [0044], [0045], [0051], [0052], [0053], [0054], Fig. 1(a), Fig. 1(b). Matsubara discloses rectangular solar cells derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013].

A POSITA would have been motivated to implement module wiring and interconnection between adjacent cells as taught by Fujii and Matsubara in Yagiura's solar battery module to obtain the aforementioned benefits taught by Fujii and Matsubara, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As all three references are directed to address series-parallel wiring, optimization of conductor layout, and module efficiency, a POSITA would have recognized that the combination merely applies known interconnect connection from Fujii and Matsubara to Yagiura's solar cell module structure, leading to predictable improvements in design flexibility and production. Given the aforementioned similarities in structure and function of the solar battery cell described in Yagiura, Fujii and Matsubara, a POSITA would have recognized that this combination would have required nothing more than applying teachings about interconnection between adjacent cells as taught by Fujii and Matsubara to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing electrode arrangement and interconnection technique as taught by Fujii and Matsubara in Yagiura's solar module design would have been well within the capability of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

II) Yagiura, Fujii and Guy

It would have been obvious to combine Yagiura with Fujii and Guy. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Fujii, [0001], [0011], [0046], [0062], Fig. 1(a), Fig. 1(b); Guy, 3:13-16, 4:5-13, 6:14-7:3, 7:5-10, Fig. 5. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b); Guy, 6:14-7:3, 8:23-9:3, 11:3-6, 9:16-20, 11:3-6, 11:8-20. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Fujii discloses a solar module with aligned cell arrays and specific wiring paths that aim to simplify module structure and manufacturing while achieving reliable power generation. *See, e.g.*, Fujii, [0064], [0065], [0131], [0137], [0235], [0236], [0237], Fig. 3(a), Fig. 3(b). Fujii further describes the shape, placement, and electrical connection layout of the busbars and interconnects, which is particularly useful for modular integration and fabrication flexibility. *See, e.g.*, Fujii, [0044],

[0045], [0051], [0052], [0053], [0054], Fig. 1(a), Fig. 1(b). Guy discloses the specific arrangement of the bus electrodes. *See, e.g.*, Guy, 6:14-7:3, 7:11-22, 11:8-20, Fig. 7.

A POSITA would have been motivated to implement module wiring and interconnection between adjacent cells as taught by Fujii and bus electrodes as taught by Guy in Yagiura's solar battery module to obtain the aforementioned benefits, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As all three references are directed to address series-parallel wiring, optimization of conductor layout, and module efficiency, a POSITA would have recognized that the combination merely applies known interconnect connection from Fujii and bus electrode arrangement from Guy to Yagiura's solar cell module structure, leading to predictable improvements in design flexibility and production. Given the aforementioned similarities in structure and function of the solar battery cell described in Yagiura, Fujii and Guy, a POSITA would have recognized that this combination would have required nothing more than applying teachings about interconnection between adjacent cells as taught by Fujii and bus electrodes as taught by Guy to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing interconnection technique as taught by Fujii and electrode arrangement as taught by Guy in Yagiura's solar module design would have been well within the capability of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

mm) Yagiura and Ravi260

It would have been obvious to combine Yagiura with Ravi260. Both Yagiura and Ravi260 are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Ravi260, 1. And both Yagiura and Ravi260 specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Ravi260, 3. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6.

A POSITA would have been motivated to implement Ravi260's technique of using one-third cut solar cells and string arrangements to Yagiura's solar battery module structure to improve compactness, reduce shading losses, and achieve desirable current-voltage characteristics, since both references deal with series-parallel connections of rectangular solar cells, and both aim to optimize module efficiency and manufacturability. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Yagiura and Ravi260, a POSITA would have recognized that this combination would have required nothing more than applying Ravi260's teachings about one-third cut solar cells and string arrangements to Yagiura's solar cell module structure. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Ravi260's series-parallel module with Yagiura's solar cell module

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structure would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

nn) Yagiura, Ravi260 and Maehane

It would have been obvious to combine Yagiura with Ravi260 and Maehane. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Ravi260, 1; Maehane, Abstract, [0003], [0004], [0013], [0015], Fig. 3, Fig. 8. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output, efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Ravi260, 3; Maehane, [0004], [0016], [0019]. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Maehane discloses a technique in which a front-side bus electrode of a solar battery cell is connected to a rear-side electrode of an adjacent cell using interconnectors arranged through gaps between cells, thus enabling compact front-to-back connection. *See, e.g.*, Maehane, Abstract, [0004], [0013], [0014], [0015], Fig. 2.

A POSITA would have been motivated to implement Ravi 260's technique of using one-third cut solar cells and string arrangements as well as front-to-back interconnection structure as

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taught by Maehane to Yagiura's solar battery module structure to improve compactness, reduce shading losses, and achieve desirable current-voltage characteristics, since all three references deal with series-parallel connections of rectangular solar cells, and aim to optimize module efficiency and manufacturability. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Yagiura, Ravi260 and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying Ravi260's teachings about one-third cut solar cells and string arrangements as well as Maehane's interconnection structure to Yagiura's solar cell module structure. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Ravi260's series-parallel module and Maehane's interconnection structure with Yagiura's solar cell module structure would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

oo) Yagiura, Ravi260 and Tomiyuki

It would have been obvious to combine Yagiura with Ravi260 and Tomiyuki. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Ravi260, 1; Tomiyuki, [0001], [0002], [0006], [0018], [0019], [0086], [0087], Fig. 3. And all three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-

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67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Ravi260, 3; Tomiyuki, [0041], [0044], [0047], [0081], [0083], [0089], Fig. 1, Fig. 3. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Ravi260 discloses a solar module using one-third cut 156-mm multi-crystalline silicon rectangular cells arranged in two parallel columns to reduce resistive losses. *See, e.g.*, Ravi260, 4, Fig. 6. Tomiyuki discloses a specific arrangement of the bus electrode. *See, e.g.*, Tomiyuki, [0041], [0061], [0081], Fig. 1, Fig. 3.

A POSITA would have been motivated to implement Ravi 260's technique of using one-third cut solar cells and string arrangements as well as bus electrode arrangement as taught by Tomiyuki to Yagiura's solar battery module structure to improve compactness, reduce shading losses, and achieve desirable current-voltage characteristics, since all three references deal with series-parallel connections of rectangular solar cells, and aim to optimize module efficiency and manufacturability. Given the aforementioned similarities in structure, purpose, and function of the solar modules described in Yagiura, Ravi260 and Tomiyuki, a POSITA would have recognized that this combination would have required nothing more than applying Ravi260's teachings about one-third cut solar cells and string arrangements as well as Tomiyuki's bus electrode arrangement to Yagiura's solar cell module structure. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Integrating Ravi260's series-parallel module and Tomiyuki's bus electrode arrangement with Yagiura's solar cell module structure would have been well within the scope of

abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

pp) Yagiura and Guy

It would have been obvious to combine Yagiura with Guy. Both Yagiura and Guy are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Guy, 3:13-16, 4:5-13, 6:14-7:3, 7:5-10, Fig. 5. And both Yagiura and Guy specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Guy, 6:14-7:3, 8:23-9:3, 11:3-6, 9:16-20, 11:3-6, 11:8-20. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Guy discloses the specific arrangement of the bus electrode. *See, e.g.*, Guy, 6:14-7:3, 7:11-22, 11:8-20, Fig. 7.

A POSITA would have been motivated to form the bus electrodes as taught by Guy in Yagiura's solar battery module to obtain the aforementioned benefits taught by Guy, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As both references are directed to efficient electrical connection of rectangular solar cells, and both address modular string configuration, combining their teachings would have yielded predictable improvements in manufacturability and performance. Given the aforementioned similarities in structure and function of the solar battery cells described in Yagiura and Guy, a POSITA would have recognized that this combination would have required nothing more than applying Guy's

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teachings about interconnection between adjacent cells to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Guy's bus electrode arrangement in Yagiura's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

qq) Yagiura, Guy and Maehane

It would have been obvious to combine Yagiura with Guy and Maehane. All three references are directed to the same field of endeavor: a solar battery module comprising a plurality of solar battery cells. *See, e.g.*, Yagiura, 1:12-21, 1:31-39, 3:20-34, 3:35-40, 4:22-35, 12:20-29, 4:36-43, Fig. 1; Guy, 3:13-16, 4:5-13, 6:14-7:3, 7:5-10, Fig. 5; Matsubara, [0005], Fig. 5. All three references specifically seek to optimize the arrangement of solar cells to achieve better power output and efficient module layout. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36, 14:27-35, 14:48-60; Guy, 6:14-7:3, 8:23-9:3, 11:3-6, 9:16-20, 11:3-6, 11:8-20; Matsubara, [0004], [0009], [0013], Fig. 2. Yagiura explains how a plurality of rectangular solar cells are connected via wiring members to form a serial arrangement and how multiple such strings can be arranged in parallel to form a high-efficiency module. *See, e.g.*, Yagiura, 2:29-35, 4:1-8, 4:9-19, 7:58-67, 8:20-32, 10:25-36. Guy discloses the specific arrangement of the bus electrode. *See, e.g.*, Guy, 6:14-7:3, 7:11-22, 11:8-20, Fig. 7. Matsubara discloses rectangular solar cells

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derived from dividing square cells, with bus electrodes aligned to the short side and front-to-rear interconnection structures facilitating efficient current extraction. *See, e.g.*, Matsubara, [0004], [0013].

A POSITA would have been motivated to form the bus electrode as taught by Guy and interconnection between adjacent cells as taught by Maehane in Yagiura's solar battery module to obtain the aforementioned benefits, since Yagiura explains how a plurality of rectangular solar cells are connected via wiring members. As all three references are directed to efficient electrical connection of rectangular solar cells, and address modular string configuration, combining their teachings would have yielded predictable improvements in manufacturability and performance. Given the aforementioned similarities in structure and function of the solar battery cell described in Yagiura, Guy and Maehane, a POSITA would have recognized that this combination would have required nothing more than applying teachings about bus electrodes as taught by Guy and interconnection between adjacent cells as taught by Maehane to Yagiura's teaching of a solar battery module comprising a plurality of solar battery cells. This would have amounted to little more than applying a known technique to improve a similar device in the same way, and it would have yielded predictable results.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Guy's bus electrode and Maehane's interconnection between adjacent cells in Yagiura's solar battery module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. The fabrication process would have involved standard modules, standard techniques, and standard processes. The fabrication of solar cells, including interconnection between adjacent cells, cell array arrangement, as well as bus electrode arrangement were well known to a POSITA.

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It would have been obvious to combine Skylab with Maehane. Both Skylab and Maehane are directed to the same field of endeavor: solar cell technologies. *See, e.g.*, Skylab Eval, 107, 116, 118; Skylab V1, 2.0-74; Skylab V2, 2.2.5-1; Maehane, Abstract, [0001]. Both Skylab and Maehane specifically seek to connect a plurality of solar battery cells in a manner that efficiently collects and conducts current generated by exposure to the sun. *See, e.g.*, Skylab V2, 2.2.5-1–2.2.5-3, 2.2.5-6, 2.2.5-9, 2.2.5-11; Maehane, [0005]–[0009]. Both Skylab and Maehane disclose a process of connecting substantially rectangular-shaped solar cells in series from the front surface of a first cell to the back surface of an adjoining cell. *See, e.g.*, Skylab Eval, Table 5.1, Fig. 5.10b; Skylab V2, Fig. 2.2.5.2-2; Maehane, [0004], [0016], [0019], Fig. 3, Fig. 4, Fig. 5, Fig. 8. Maehane also discloses a common industry design for an electrode configuration on the front and back surfaces of a solar cell, which includes a series of grid lines and bus electrodes positioned over the surfaces of the cells to efficiently collect and conduct current through the connected solar cells to output terminals. Maehane, Abstract, [0003], [0009], [0013]–[0016], [0019], Figs. 1–8. Maehane also teaches that adopting its electrode configuration—wherein the electrodes are not formed within a region extending inwards from the perimeter of the cell surfaces—helps to prevent short circuits. *See, e.g.*, Maehane, Abstract, [0010], [0017], [0018], [0021], Figs. 1–8.

A POSITA would have been motivated to incorporate Maehane’s electrode configuration in Skylab’s solar panel module to obtain the aforementioned benefits taught by Maehane. Incorporating Maehane’s electrode configuration would help to improve current collection and connection efficiency. The grid line and bus electrode pattern disclosed in Maehane is a well-known industry design. The two types of electrodes work together in concert to efficiently concentrate current—the grid line electrodes span large portions of the surfaces of the solar cells in order to maximize current collection, and the adjoining bus electrodes then transfer the collected

current across connected cells to a desired endpoint (e.g., terminal). In addition, a POSITA would have recognized that incorporating Maehane's electrode configuration with Skylab's solar panel module would also confer the same benefit of helping to prevent short circuits, as described above.

A POSITA would also have had a reasonable expectation of success in performing this combination. Implementing Maehane's electrode configurations in Skylab's solar panel module would have been well within the scope of abilities of a POSITA, as it would have involved routine manufacturing steps with predictable results. As noted above, Maehane's grid line and bus electrode configuration is a common industry design, the fabrication of which would have involved standard materials, standard techniques, and standard processes. The fabrication process of solar cells, including the manner in which the electrodes are printed or formed on the surfaces of said cells, would have been well known to a POSITA, having been commonplace to the solar industry for decades. A POSITA would have further understood that integrating Maehane's electrode configuration in Skylab's solar panel module would result in a more reliable and functional photovoltaic system, given the well-known benefits of the grid line and bus electrode design disclosed by Maehane.

3. Secondary Considerations

Defendants are not aware of any secondary-considerations evidence demonstrating non-obviousness of the Asserted Claims of the '214 patent. Indeed, LONGi has not identified any such secondary considerations, let alone demonstrated a nexus between any such considerations and the alleged inventions of the Asserted Claims.

As discussed in these invalidity contentions, the prior art references confirm that the Asserted Claims of the '214 patent would have been obvious to a POSITA before the earliest possible priority date. Defendants reserve the right to supplement or modify these factors to address any evidence or arguments later identified by LONGi.

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C. Invalidity Grounds Under 35 U.S.C. § 112

Subject to Defendants' reservation of rights above, Defendants identify their grounds of invalidity for the '214 patent based on lack of enablement, written description, and indefiniteness pursuant to Section 112, ¶¶ 1–2 (pre-AIA) at least under the overbroad constructions that LONGi appears to be applying to the Asserted Claims of the '214 patent, which go beyond (and are not adequately described or enabled by) the purported inventions allegedly disclosed in the '214 patent. To the extent the Asserted Claims may eventually be construed so broadly as to cover the Accused Products, such a construction would render the Asserted Claims invalid for failure to meet the requirements of Section 112 (pre-AIA). A more detailed discussion of Defendants' written description, enablement, and indefiniteness defenses will be set forth in Defendants' expert report(s) on invalidity.

1. Lack of Written Description and/or Enablement

The '214 patent does not provide sufficient written description to establish that the applicants were in possession of the alleged inventions recited in certain of the Asserted Claims at the time the application leading to the '214 patent was filed. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that “reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.” *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus.

The specification of the '214 patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the Asserted Claims without undue experimentation. To the extent the following limitations are definite, the application that became the '214 patent fails to sufficiently describe or enable them as required:

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Term	Relevant Claim(s)	Basis
“a ratio of a short side length and a long side length of the substantial rectangle being 1/n:1 (n is an integer equal to or larger than 2)”	1-6, 8, 11	Insufficient disclosure to allow a POSITA to make and use the claimed solar battery module as n increases, approaching infinity.
wherein the light-receiving-surface bus electrodes of each solar battery cell are formed at positions that are line-symmetrical with respect to a line passing through a middle point of a side perpendicular to an extended line of the light-receiving-surface bus electrodes and parallel to the light-receiving-surface bus electrodes	3	Insufficient disclosure to allow a POSITA to make and use the claimed solar battery module.
wherein the light-receiving-surface bus electrodes of each solar battery cell are formed at positions that are line-symmetrical with respect to a line passing through a middle point of a side parallel to the light-receiving-surface bus electrodes and perpendicular to the light-receiving-surface bus electrodes	4	Insufficient disclosure to allow a POSITA to make and use the claimed solar battery module.
“dividing a basic solar battery cell ... into n respective boundaries of the n light-receiving-surface electrode areas”	6	Insufficient disclosure to allow a POSITA to make and use a basic solar battery cell divided into respective boundaries of an area.

2. Indefiniteness

Certain of the Asserted Claims are invalid because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite for failing to particularly point out and distinctly claim the subject matter the applicants regard as their invention.

The following of terms, phrases, or limitations recited in the Asserted Claims are indefinite in whole, in part or in combination:

Term	Relevant Claim(s)	Basis
“substantial rectangle”	1-6, 8, 11	The meaning of this term cannot be determined with reasonable

Term	Relevant Claim(s)	Basis
		certainty because it is a term of degree, and the specification fails to provide a standard for measuring the degree such that a POSITA would understand the scope of the term.
“a ratio of a short side length and a long side length of the substantial rectangle being 1/n:1 (n is an integer equal to or larger than 2)”	1-6, 8, 11	The meaning of this term cannot be determined with reasonable certainty because as n increases, the practicality of the claimed solar battery module fails, leaving POSITA unable to determine the bounds of the claim.
“substantial square”	6	The meaning of this term cannot be determined with reasonable certainty because it is a term of degree, and the specification fails to provide a standard for measuring the degree such that a POSITA would understand the scope of the term.
“dividing a basic solar battery cell ... into n respective boundaries of the n light-receiving-surface electrode areas”	6	The meaning of this term cannot be determined with reasonable certainty because the claims, read in light of the specification and prosecution history, fail to explain how a basic solar battery cell can be divided into respective boundaries of an area.
“the extension of the n-column parallel-connected cell strings”	11	No antecedent basis

Defendants reserve the right to supplement or modify their identification of terms, phrases, or limitations that are indefinite in conjunction with Defendants’ exchanges pursuant to P.R. 4-1 and 4-2.

IV. DOCUMENT PRODUCTION

Pursuant to P.R. 3-4 and the Docket Control Order (Dkt. No. 48), Defendants are producing with these contentions (a) technical documents sufficient to show the operation of the pertinent aspects or elements of the accused products analyzed in LONGi’s P.R. 3-1(c) chart (JINKO-

LONGI_000001 - JINKO-LONGI_001755) and (b) all prior art referenced in these contentions, including English translations as applicable (JINKO-LONGI-PA_000001 - JINKO-LONGI-PA_003510).

V. CONCLUSION

For the reasons discussed above, and those revealed through further discovery, the Asserted Claims of the Asserted Patent are invalid.

* * *

Defendants expect to have one or more experts provide relevant analysis and opinions regarding the invalidity of the '214 patent. Defendants' contentions are without prejudice to Defendants' expert(s)' analysis and opinions, which will be disclosed in accordance with the deadlines set forth in the Docket Control Order (Dkt. No. 48). Once such report(s) are served, they shall be deemed incorporated by reference herein.

Dated: July 9, 2025

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing document was served on all counsel who have consented to electronic service, Local Rule CV-5(a), on this the 9th day of July 2025.

/s/ Stephen Marshall