

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JinkoSolar Co., Ltd.

Petitioner,

v.

LONGi Green Energy Technology Co., Ltd.,

Patent Owner.

Case No. IPR2025-00859

Patent No. 9,515,214

PATENT OWNER'S PRELIMINARY RESPONSE

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I. INTRODUCTION

Patent Owner, LONGi Green Energy Technology Co. Ltd. (“LONGi”), respectfully requests that the Board deny institution of the *inter partes* review (“IPR”) Petition for U.S. Patent No. 9,515,214 (the “214 Patent” or the “Challenged Patent”) filed by Petitioner, Jinko Solar Co. Ltd. (“Petitioner”).

Petitioner has not established that there is a reasonable likelihood of success on any of the eight proposed grounds, all based on obviousness.

First, Petitioner does not even attempt to show that Boretz, a reference relied on in Grounds 1-4, and Krishnamurthy, a reference relied on in Grounds 4 and 8, qualify as prior art printed publications.

Second, Grounds 1-4 rely on the combination of Boretz and Maehane, but the Maehane reference was expressly considered and overcome during prosecution of the 214 Patent. Petitioner has not shown that the combination discloses the limitation that the examiner found missing during prosecution, and Petitioner’s reliance on impermissible hindsight does not establish a motivation to combine.

Third, Grounds 5-8, which rely on a combination Zhang and Ravi328, fare no better. Petitioner fails to show a motivation to combine Zhang and Ravi328 and likewise relies on impermissible hindsight. Further, neither Zhang nor Ravi328 discloses the limitation that the Examiner found missing during prosecution.

Fourth, with respect to independent claim 10, Grounds 4 and 8 further rely on Krishnamurthy, which is neither prior art nor analogous art.

For these reasons, described more fully below, LONGi respectfully submits that institution be denied under 35 U.S.C. §§ 314 and 325(d). Petitioner has failed to show that any of Grounds 1-8 demonstrate a reasonable likelihood of invalidating any of the challenged claims.

II. THE CHALLENGED PATENT

The effective filing date of the 214 patent is July 2, 2010, the filing date of PCT Application No. PCT/JP2010/061334, which Petitioner does not dispute.

A. Overview of the 214 Patent

Solar cells (also called “solar battery cells”) convert light to electricity. Multiple solar cells are usually connected by wires into a string and assembled together into a solar module, and a plurality of solar modules are further connected to each other for installation on a roof or in a solar power generation system. Ex. 1001, 1:6-10. With improvements in solar cell efficiency, electric current output by a solar cell is increased, but resistance loss at the wiring (interconnectors) connecting the cells is also increased. *Id.*, 1:18-26. This resistance loss negates some of the improvement in cell efficiency. *Id.*

The 214 Patent is directed at reducing the resistance loss of the wiring (without increasing the cross-sectional size of the wiring) and thereby increasing

the electrical output. This is done by dividing/cutting the rectangular solar cells (e.g., in half) and electrically arranging them in a module in a way that still maintains electrical interchangeability with a conventional module having non-divided cells. Ex. 1001, 1:60-2:55.

Specifically, the inventors solved the problem of increased cell current and the resulting increased resistance losses by dividing/cutting each cell into n substantially rectangular cells, such that the ratio of the short side length to the long side length is $1/n$ to 1. *Id.*, 1:64-67, 2:13-27. Cutting a non-divided cell into n divided cells reduces the amount of current generated by each of the n divided cells to $1/n$. *Id.*, 8:65-9:1. This reduces the resistance loss because the resistance loss in the wiring/interconnector is equal to the resistance of the interconnector $\times$ the square of the current through the interconnector (i.e., $W = R \times i^2$). *Id.*, 9:1-5. For example, when a non-divided (full) cell is divided into two halved-cells ($n = 2$), each halved-cell generates half of the power and provides half ($1/n$, where $n = 2$) of the current of the original non-divided cell. And the resistance loss is advantageously reduced to $1/4$ that of the non-divided cell ($(1/n)^2$, where $n = 2$). *Id.*, 8:65-9:5.

However, if the divided cells are simply connected in series in a module like the non-divided cells, the serially connected divided-cells will not be electrically interchangeable with another module using serially connected non-divided cells

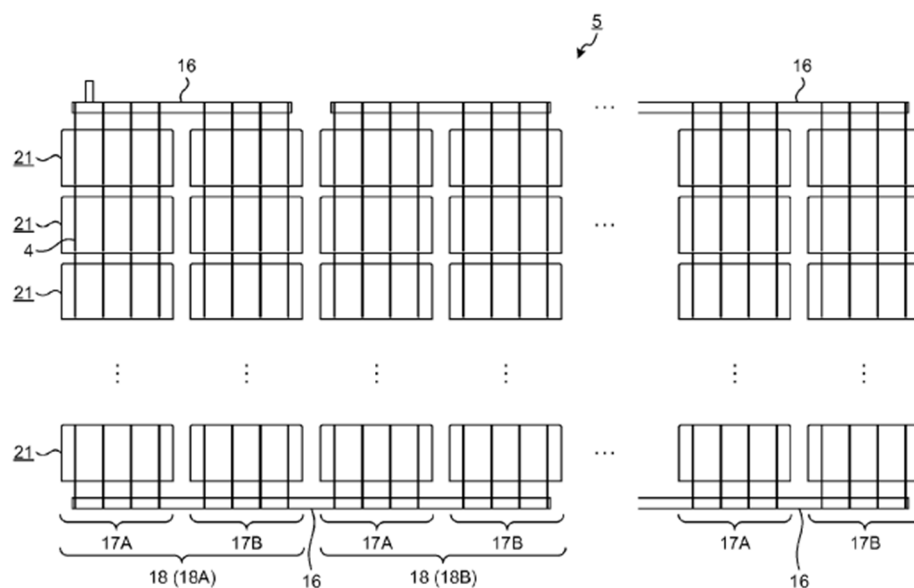
because of the difference in voltage. For example, as disclosed in the 214 Patent, a non-divided cell generates V volts with a current of I . Serially connecting sixty (60) non-divided cells together results in a module with a voltage of $60 \times V$ and a current of I . *Id.*, 9:13-17. When each of these cells are divided into two, each halved-cell continues to generate V volts, but the current is reduced to $0.5 \times I$. *Id.*, 9:17-18. Thus, 120 halved-cells are needed to provide the same output power as 60 non-divided cells. *Id.*, 9:18-22. However, if these 120 halved-cells are simply connected in series like the non-divided cells, the module would provide a voltage of $120 \times V$ and a current of $0.5 \times I$, i.e., double the voltage and half the current of the module containing non-divided cells. *Id.* Thus, a module using 120 serially connected halved-cells would not be electrically interchangeable with a module using 60 serially connected non-divided cells. *Id.*, 9:22-28.

To address this interchangeably, the 214 Patent teaches to connect the divided cells first into a number of strings and then to electrically connect these strings in parallel (which are further connected in series) such that the number of cell strings parallelly connected is equal to the number of divided cells into which a non-divided cell is cut. That is, a predetermined number of divided cells are first serially connected together to form a cell string, then n serially connected cell strings are connected in parallel, and the parallel-connected cell strings are further serially connected together such that “the n in the number of columns of the cell

strings connected in parallel [is] equal to the n in the ratio of the long side length to the short side length.” *Id.*, 12:9-13. This results in a module that will have the same electrical output characteristics as a module formed from serially-connected non-divided cells. *Id.*, 9:29-46, 12:9-12. Thus, connecting multiple modules on a roof to an inverter is simplified, and it further allows for interchangeability with modules in existing solar power generation system formed by the conventional non-divided cells. *Id.*, 9:38-46.

An example of this configuration is shown in Fig. 12 in which 17A and 17B are each a serially-connected cell string. Two cell strings 17A and 17B are connected together in parallel to form a parallel-connected cell string 18A, 18B, and two or more sets of parallel-connected cell strings 18A and 18B are connected in series to form the cell array.

FIG.12



B. Prosecution of the 214 Patent

During prosecution, the Applicants submitted Maehane (JP 07-106619) to the Patent Office in the First Information Disclosure Statement on December 24, 2012. Ex 1002, 111. Throughout prosecution, the Examiner repeatedly rejected the claims based on various combinations of Maehane and other references, all of which were overcome by the Applicants.

In the first non-final office action, dated May 9, 2014, the Examiner rejected claim 1 over Maehane in view of U.S. 2010/0295377 to Sok and U.S. 5,994,641 to Kardauskas. Ex. 1002, 285, 289. In a final office action dated November 20, 2014, the Examiner rejected claim 1 over Maehane in view of U.S. 2010/0126550 to Foss. *Id.*, 384, 387.

Throughout the prosecution, the Examiner recognized that Maehane “teaches one single column of cell strings instead of n column of cell strings” as claimed. Ex. 1002, 290. According to the Examiner, even if Maehane were “modified” to have “duplicate columns of cell strings,” it still would not disclose “ n /two columns of the cell strings are connected in parallel, and the n /two-column parallel-connected cell strings are further serially connected, thereby configuring an entire cell array” as recited in claim 1. *Id.*, 290-291. See also, *id* at 389.

In rejecting claim 1 over Maehane in view of Foss, the Examiner asserted that Foss discloses cell strings connected in parallel, and that the parallel-

connected strings are serially connected to another set of parallel connected strings. *Id.*, 389. After the Applicants explained that the parallel-connected strings in Foss are not serially connected to each other (*Id.*, 410), the Examiner took the position that Foss teaches that “cells can be connected in series and in parallel” and that “it is obvious to combine these two electrical connections.” *Id.*, 419. Applicants then amended the claims in a Request for Continued Examination to add “the *n* in the number of columns of the cell strings connected in parallel being equal to the *n* in the ratio of the long side length to the short side length.” *Id.*, 430.

In a later non-final office action dated July 2, 2015, the Examiner again rejected claim 1 over Maehane, this time in view of U.S. 2007/0175509 to Yagiura. *Id.*, 448, 451. The Examiner took the position that the limitation “the *n* in the number of columns of the cell strings connected in parallel being equal to the *n* in the ratio of the long side length to the short side length” was “necessarily present in the above combination” of Maehane and Yagiura. *Id.*, 455. The Examiner repeated this rejection in a final office action dated December 17, 2015. *Id.*, 497, 500. However, after applicants filed a Pre-Appeal Brief Request for Review explaining the Examiner’s error, the Examiner withdrew all rejections and issued a Notice of Allowance, acknowledging that “[t]he prior art of record, whether alone or in combination, fails to teach or fairly suggest the limitation ‘*the n in the number of columns of the cell strings connected in parallel being equal to the n in*

the ratio of the long side to the short side length' in the context of other limitations in the claim." *Id.*, 543-545, 550.

C. Issued Claims

Claims 1 and 10 are the two independent claims of the 074 Patent. Claim 1 as issued recites:

1[pre] A solar battery module comprising:

1[a] a plurality of solar battery cells, a plain shape of each being a substantial rectangle, and 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[b] includes a plurality of light-receiving-surface bus electrodes parallel to the short side of the substantial rectangle on a light receiving surface, and includes rear-surface bus electrodes each at a position on a non-light-receiving surface corresponding to each of the light-receiving-surface bus electrodes; and

1[c] an interconnector that electrically connects the light-receiving-surface bus electrodes of a first one of the solar battery cells to the rear-surface bus electrodes of an adjacent second one of the solar battery cells,

1[d] wherein a predetermined number of the solar battery cells are serially connected to each other, thereby configuring a cell string,

1[e] n columns of the cell strings are connected in parallel by a first string connector at one end of the n columns, the n in the number of

columns of the cell strings connected in parallel being equal to the n in the ratio of the long side length to the short side length, and

1[f] the n -column parallel-connected cell strings are further serially connected to another n -column parallel-connected cell strings by a second string connector at an opposite end of the n columns, thereby configuring an entire cell array.

214 Patent, 11:57-12:17.

Claim 10 as issued recites:

10[pre] A solar battery module comprising:

10[a] a plurality of solar battery cells, a plain shape of each being a substantial rectangle, and 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),

10[b] includes a plurality of light-receiving-surface bus electrodes parallel to the short side of the substantial rectangle on a light receiving surface, and includes rear-surface bus electrodes each at a position on a non-light-receiving surface corresponding to each of the light-receiving-surface bus electrodes; and

10[c] an interconnector that electrically connects the light-receiving-surface bus electrodes of a first one of the solar battery cells to the rear-surface bus electrodes of an adjacent second one of the solar battery cells,

10[d] wherein long sides of the substantial rectangle include a first long side and a second long side, the substantial rectangle has chamfered corners on both ends of only the first long side such that the second long side is without chamfered corners, and

10[e] the first one of the solar battery cells and the second one of the solar battery cells are arranged in the module such that the first long side and the second long side of the first one and the second one of the solar battery cells do not face each other.

214 Patent, 13:11-14:16.

III. LEVEL OF ORDINARY SKILL

The Petition proposes that “[a] person of ordinary skill in the art at the time of the alleged invention of the ’214 patent 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.” Pet., 8. For purposes of this preliminary response only, Patent Owner does not dispute this definition.

IV. CLAIM CONSTRUCTION

The Petition does not propose any constructions for the terms of the 214 Patent. Pet., 8. For purposes of this preliminary response, Patent Owner does not

dispute that the plain and ordinary meaning should apply to all claim terms and phrases.

**V. THE PETITION FAILS TO ESTABLISH A REASONABLE
LIKELIHOOD OF PREVAILING ON ANY CHALLENGED CLAIM**

The Petition asserts eight grounds of unpatentability as follows:

Ground	Claims	Basis	References
1	1-5, 8, 11	§ 103	Boretz and Maehane
2	6	§ 103	Boretz, Maehane, and Ravi328
3	7	§ 103	Boretz, Maehane, and Ravi260
4	9-10	§ 103	Boretz, Maehane, and Krishnamurthy
5	1-4, 6, 8, 11	§ 103	Zhang and Ravi328
6	5	§ 103	Zhang, Ravi328, and Fujii
7	7	§ 103	Zhang, Ravi328, and Ravi260
8	9-10	§ 103	Zhang, Ravi328, and Krishnamurthy

Pet., 3-4. Claims 1 and 10 are the independent claims.

A. Grounds 1-4 and 8: Petitioner Has Not Shown that Boretz and Krishnamurthy are Not Prior Art

Petitioner does not even attempt to show that Boretz (Ex 1004), a reference relied on by half of the asserted grounds,¹ and Krishnamurthy (Ex 1012),² a Master's thesis, are prior art printed publications. *See* Pet., 3-4. The Petition simply asserts, without evidence, that “Boretz is prior art under 35 U.S.C. §§ 102 (a) and (b) because it was published on September 15, 1971” and that “Krishnamurthy is prior art under pre-AIA 35 U.S.C. § 102 (a) and (b) because it was published in 2008.” *Id.*, 4-5, 9, 18.

Whether a reference qualifies as a printed publication “involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to members of the public.” *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was “sufficiently accessible to the public interested in the art” before the effective filing date. *In re Lister*, 583 F.3d 1307, 1311 (Fed. Cir. 2009) (quoting *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989)). “A reference is considered publicly accessible if it

¹ Ground 1-4 rely on the combination of Boretz and Maehane.

² Ground 4 relies on the combination of Boretz, Maehane, and Krishnamurthy; Ground 8 relies on the combination of Zhang, Ravi328, and Krishnamurthy.

was ‘disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.’” *Id.* (quoting *Kyocera Wireless Corp. v. ITC*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)). That standard is not satisfied merely by a date, copyright, or internet address appearing on the face of the document. *See, e.g., Content Square SAS v. Medallia Inc.*, IPR2022-00316, Paper 13 at 26–27 (PTAB Jul. 14, 2022) (“Numerous Board decisions have held that simply pointing to a date, even a copyright date, is not sufficient at the institution stage to demonstrate public accessibility.”). Further, “a work is not publicly accessible if the only people who know how to find it are the ones who created it.” *Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1372 (Fed. Cir. 2019).

At the institution stage, the Petitioner is required to “identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent and therefore that there is a reasonable likelihood that it qualifies as a printed publication.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29, 13 (PTAB Dec. 20, 2019) (precedential). The Board explained that “[t]his standard is far more than is required in a typical notice pleading, which only requires that a party make plausible claims.” *Id.*

1. Boretz

Boretz (Ex 1004) purports to be the fourth phase of a set of technical reports prepared for the National Aeronautics and Space Administration (NASA) by TRW Systems Group. Ex. 1004, 1. The report indicates that it was prepared for NASA's George C. Marshall Space Flight Center, Huntsville, Alabama in fulfillment of a government contract. *Id.*, 4. Petitioner only provides a conclusory statement that "Boretz is prior art under 35 U.S.C. §§ 102 (a) and (b) because it was published on September 15, 1971." Pet., 9. Simply pointing to a date on the face of the document, however, is not sufficient to demonstrate public availability. *Hulu*, IPR2018-01039, Paper 29, 17-18 (rejecting petitioner's argument that "any particular indicia [on the face of a reference] per se is sufficient" to meet the reasonable likelihood standard for institution).

There is no indication that Boretz was intended for distribution to the public in 1971, or that a member of the interested public would have known to even look for it. Indeed, the report itself indicates that "Distribution of this document is established by the Contracting Officer, Lawrence Garrison, or his authorized representative." Ex. 1004, 4. This is yet another indication that it was not meant for public dissemination.

Petitioner has provided no evidence that Boretz was published and accessible by the public on September 15, 1971, or at any point thereafter before

the effective filing date of the 214 Patent. Nor has Petitioner provided any evidence of library indexing or cataloging. Indeed, contrary evidence strongly suggests that Boretz was *not* publicly available before the effective filing date of the 214 Patent. NTRS, the NASA Technical Reports Server, indicates that it did not even acquire Boretz (which it refers to as a “Contractor Report”) until August 6, 2013, over three years *after* the July 2, 2010 effective filing date of the Challenged Patent. Ex. 2012.

Further, the authenticity of Boretz is also suspect. The copy of Boretz relied on in the Grounds includes extra pages that do not appear to have been in the original document. Boretz contains a table of illustrations, which purports to list the figures included in the report. Ex. 1004, 7. The table shows that there should be two figures in chapter 2 (Figure 2.1 on page 2-2, and Figure 2.2 on page 2-3). *Id.* However, Ex. 1004 includes an additional two page of figures on which someone has handwritten page numbers “1” and “2” at the bottom. *Id.*, 12. Figure 2.1 then appears on page 2-2, which has a handwritten page number “3,” in addition to the typed page number 2-2. *Id.*, 13. Figure 2.2 then appears on page 2-3. *Id.* 14. It is unclear when the additional figures on handwritten pages 1 and 2 were added to the copy of Boretz used in the Grounds, and what changes were made to the original document. Petitioner has provided no explanation.

Thus, Petitioner has failed to show (1) that Boretz was publicly available before July 2, 2010, the effective filing date of the Challenged Patent, and (2) that the copy of Boretz relied on in the Grounds is an authentic copy that was available before that date.

2. Krishnamurthy

Krishnamurthy purports to be a Master's Thesis entitled "Dynamic Modelling of CubeSat Project MOVE." Ex. 1012, 1. As with Boretz, Petitioner only provided a conclusory statement that "Krishnamurthy is prior art under pre-AIA 35 U.S.C. § 102 (a) and (b) because it was published in 2008." Pet., 18. This not sufficient to satisfy Petitioner's burden to establish a reasonable likelihood that Krishnamurthy was publicly accessible before the priority date of the 214 Patent. *Hulu*, IPR2018-01039, Paper 29, 13 ("at the institution stage, the petition must identify, with particularity, evidence sufficient to establish a reasonable likelihood that the reference was publicly accessible before the critical date of the challenged patent").

Petitioner has provided no evidence of public accessibility, no evidence that the thesis was sufficiently disseminated, and no evidence of library indexing or cataloging. While Krishnamurthy shows an acknowledgement with an August 2008 date, there is no indication of when the thesis was actually published. Ex. 1012, 4. Petitioners are required to provide strong indicia of public accessibility,

and the Board has rejected arguments that any particular indicia, such as a copyright date or ISBN number is per se sufficient to meet the reasonable likelihood standard for institution. *Hulu*, IPR2018-01039, Paper 29, 17-18.

Further, several factors cast doubt on whether the copy of Krishnamurthy relied on in the Grounds was ever available to the public. First, the declaration page is unsigned. Ex. 1012, 3. Moreover, the first title page identifies the author as a student in the Department of Space Science in Kiruna, Sweden, but the acknowledgement page states that the student was enrolled in a Space Master Course Study on Space Technology at Lulea University of Technology. Ex. 1012, 1, 4. The second title page lists the student's supervisor as being from another institution, the Institute of Astronautics at the Technical University of Munich. *Id.*, 2. Thus, it is unclear whether this specific version of the thesis document was ever published, and if so, which institution published it, when it was issued, and when it was indexed and accessible to the public. *Apple Inc. v. Saint Lawrence Comms LLC*, IPR2017-01075, Paper 8, 6-7 (insufficient showing that a Master's thesis is prior art where Petitioner does not "provide an approximation of *when* ... the thesis issued" and "an approximation of *how long* it typically took to add a thesis to the searchable index after it was submitted to the Engineering Library.") (emphasis in original).

Thus, Petitioner has failed to show (1) that Krishnamurthy was publicly available before July 2, 2010, the effective filing date of the Challenged Patent, and (2) that the copy of Krishnamurthy relied on in the Grounds is an authentic copy that was available before that date.

B. Grounds 1-4: The Combination of Boretz and Maehane Does Not Disclose the Claimed Series-Parallel-Series Arrangement of Cells

Even assuming, *arguendo*, that Boretz is prior art, Boretz does not disclose all the limitations of the challenged claims, alone or in combination with Maehane. At the very least, Boretz does not disclose the limitation of “*n* columns of the cell strings are connected in parallel” as recited in claim 1 and which the Examiner found to be missing in Maehane during prosecution. Ex. 1002, 551. This is because the cells connected in parallel in Boretz are not configured in a cell string. Maehane also does not disclose the limitation of “*n* columns of the cell strings are connected in parallel,” and the Petition does not assert that it does. Pet., 32-34.

Specifically, claim 1 requires that the “a predetermined number of the solar battery cells” first be “serially connected to each other, thereby configuring a *cell string*.” Ex. 1001, 12:5-7. The “*n* columns of the *cell strings*” are then “connected in parallel.” Id., 12:7-8. However, in Boretz, the parallel connection only connects two individual cells at a time, and these two parallelly connected cells (not cell strings) are then serially connected to 32 other pairs of similar two parallelly

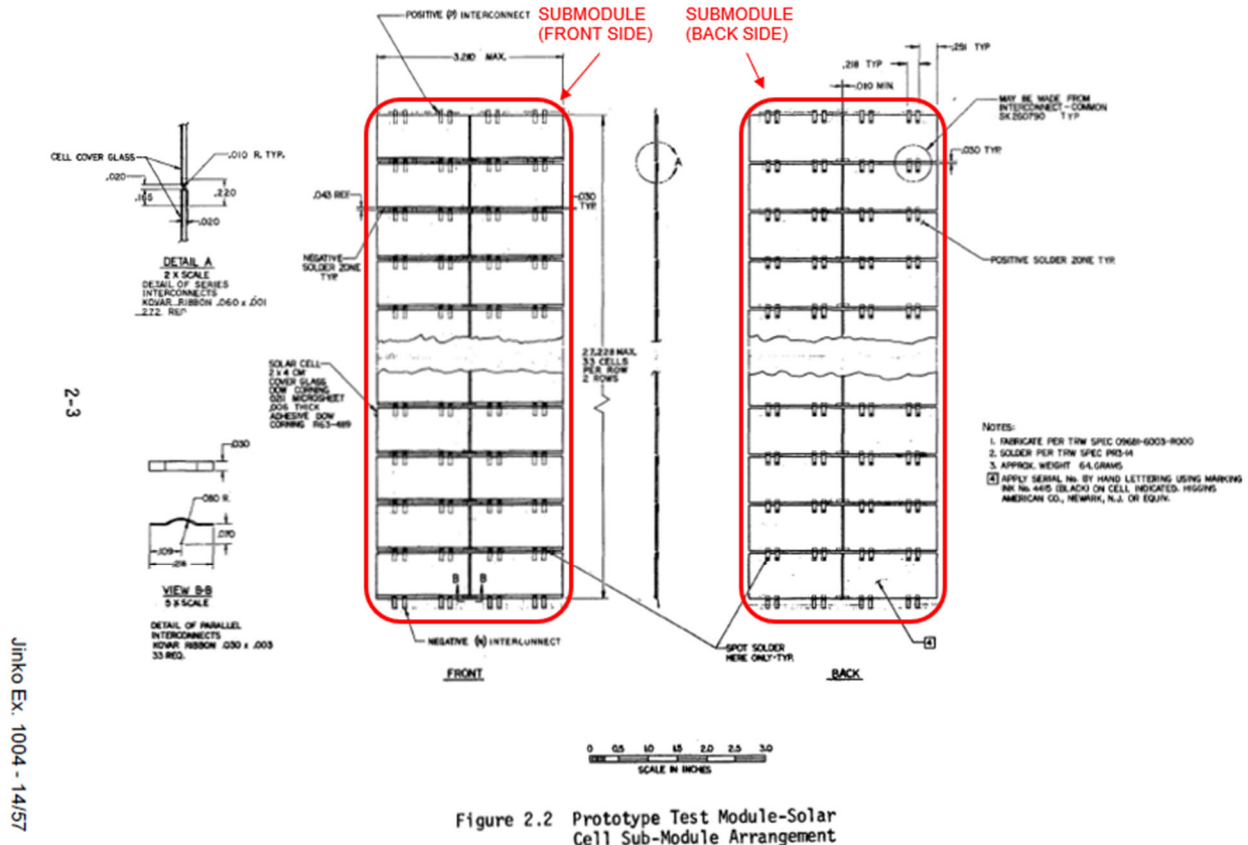
connected cells to form a submodule. Ex. 1004, 21 (“A submodule consisting of two cells in parallel and 33 cells in series”). These submodules of serially connected cell-pairs are **not** further connected in parallel in Boretz. Rather, they are connected in series to form “a string consisting of two cells in parallel and 66 in series.” *Id.*

The Petition incorrectly asserts that Boretz discloses “rectangular solar cells with a 1:2 ratio of short-to-long sides, arranged in two parallel columns.” Pet., 1. What Boretz actually discloses is “[t]he cellstack consisted of seven strings, **employing two cells in parallel** and 66 cells in series, for a total of 924 cells.” Ex. 1004, 11 (emphasis added).

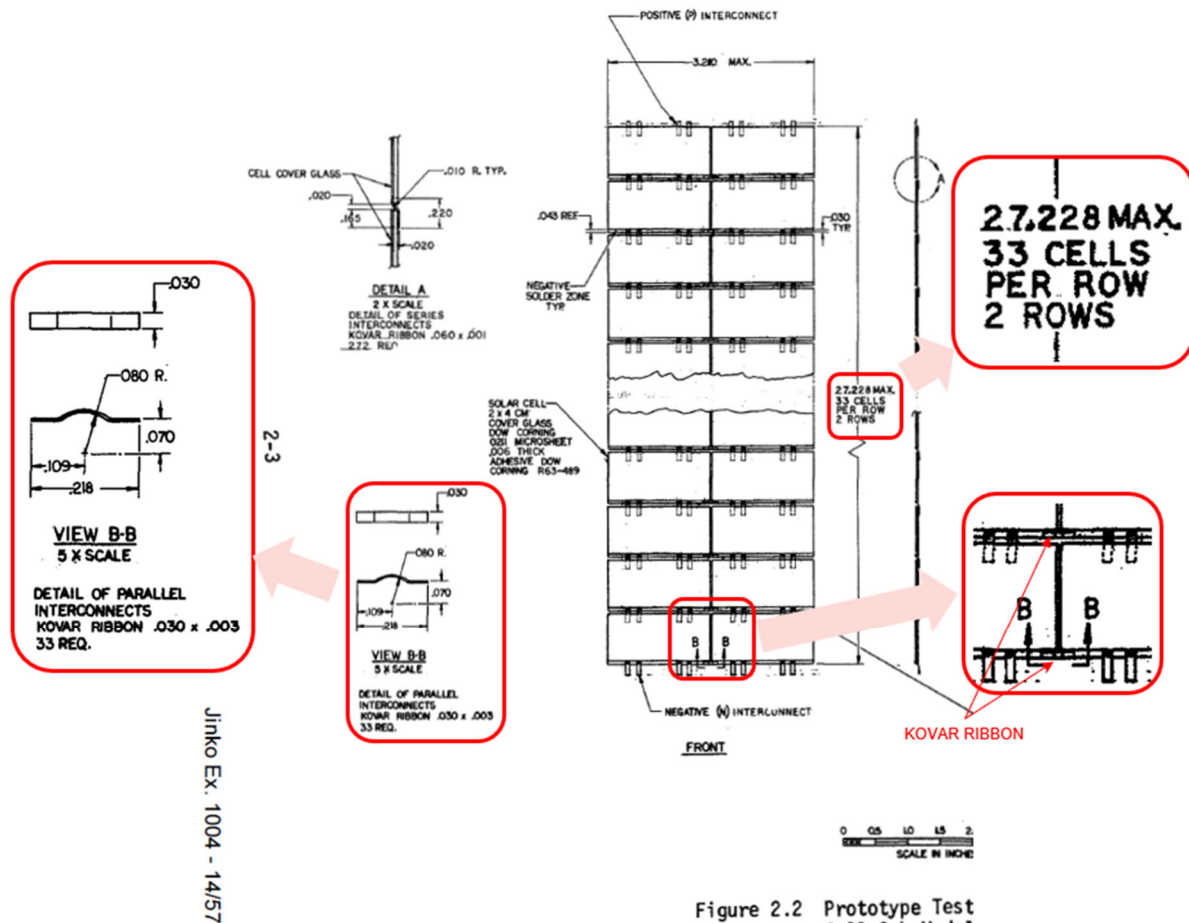
More specifically, Boretz provides a detailed explanation of the configuration of its cells in section 4.2 as follows:

A submodule consisting of **two cells in parallel** and 33 cells in series appeared attractive. By employing two of these submodules in a string consisting of two cells in parallel and 66 in series, an interconnected cell area of approximately 178 sq. in. results. This configuration permitted seven of these interconnected strings to be installed on the module substrate (see Figures 2.1 and 2.2).

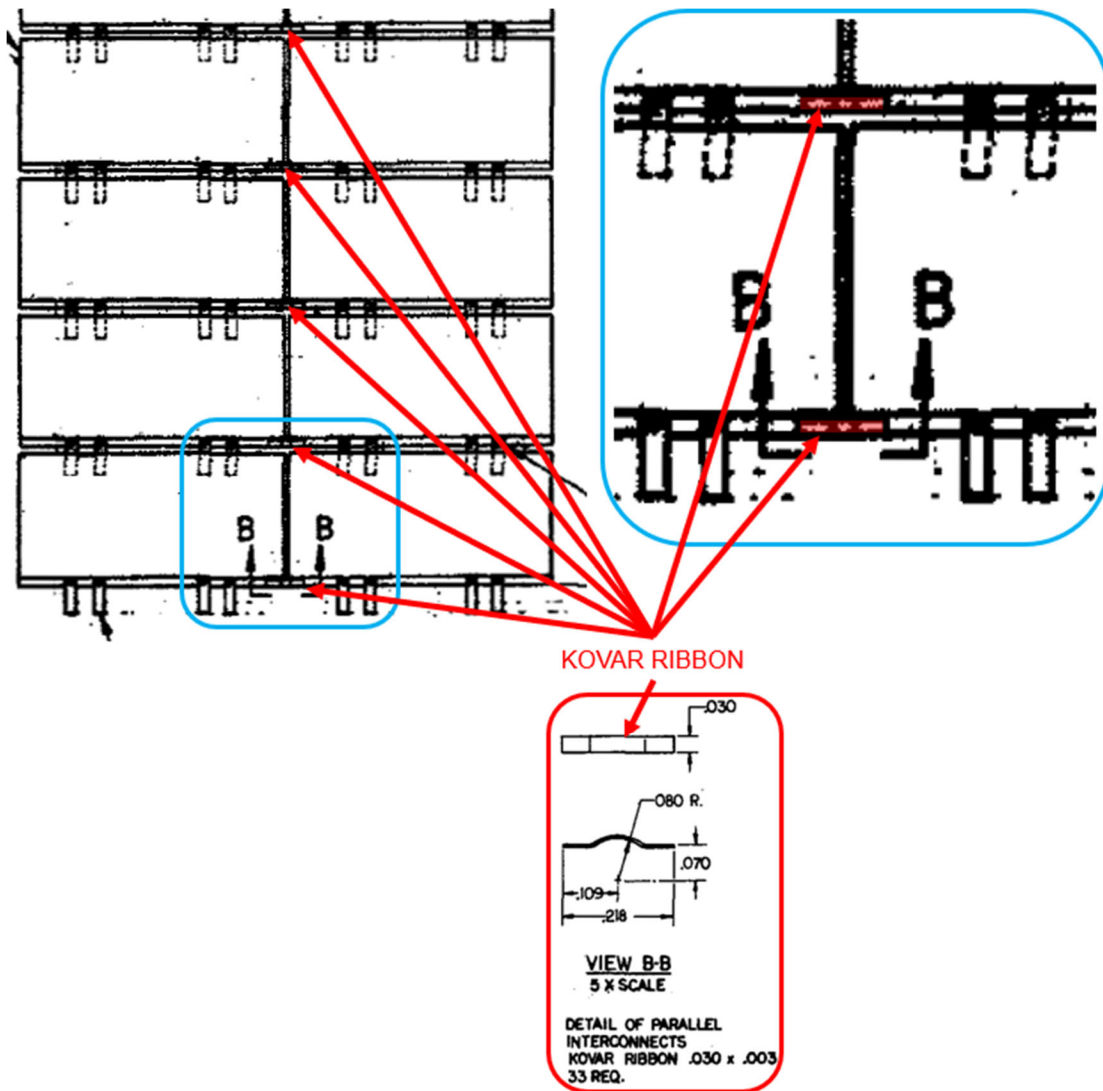
Ex. 1004, 21. Fig. 2.2 of Boretz (reproduced below) shows that each submodule starts with two side-by-side cells connected in parallel, and that 33 pairs of these parallel-connected two cell subgroups are then connected in series. *Id.*, 14.



The detailed “View B-B” on the bottom left of Figure 2.2 showing the “detail of the parallel interconnects” confirms that each of the two side-by-side cells are connected in parallel. This detailed view states explicitly “KOVAR RIBBONS .030 x .003” “33 REQ.” which indicates that there are 33 required parallel connecting “kovar ribbons.” This is because the note immediately to the right of the submodule states that there are “33 cells per row” and that there are “2 rows” shown vertically in the figure. *Id.* Thus, 33 kovar ribbons are required to connect each of the two side-by-side cells in parallel, and there are 33 sets of 2 parallel-connected cells that are then connected in series to form a submodule.



Further confirmation can be seen in the depiction of the parallelly connecting “kovar ribbons” between each of the two side-by-side cells, as denoted by annotations to Figure 2.2 in red below. The blue encircled image on the right below is a blow-up of the blue encircled portion in the left image below. The red arrows point to the parallel connector “kovar ribbons” between each of the two cells:



Except for each of the two side-by-side cells discussed above, there are no other parallel connections described by Boretz for its modules.

As shown in Figure 2.1, two submodules (each assembled as described above) are connected together *in series* as shown by a “long interconnect busbar.” This serial connection is denoted by the connection of the negative (N) terminal of the submodule on the left with the positive (P) terminal of the submodule on the right. *Id.*, 13. By connecting the submodule on the left in series with the

submodule on the right, a “string consisting of two cells in parallel and 66 in series” is formed. *Id.*, 21. Boretz then discloses that there are seven of these strings, but does not disclose whether or how the seven strings are connected to each other. *Id.*, 13 (“14 required connected in series groups of 2 modules, for 7 series groups.”), 21 (“This configuration permitted seven of these interconnected strings to be installed on the module substrate.”).

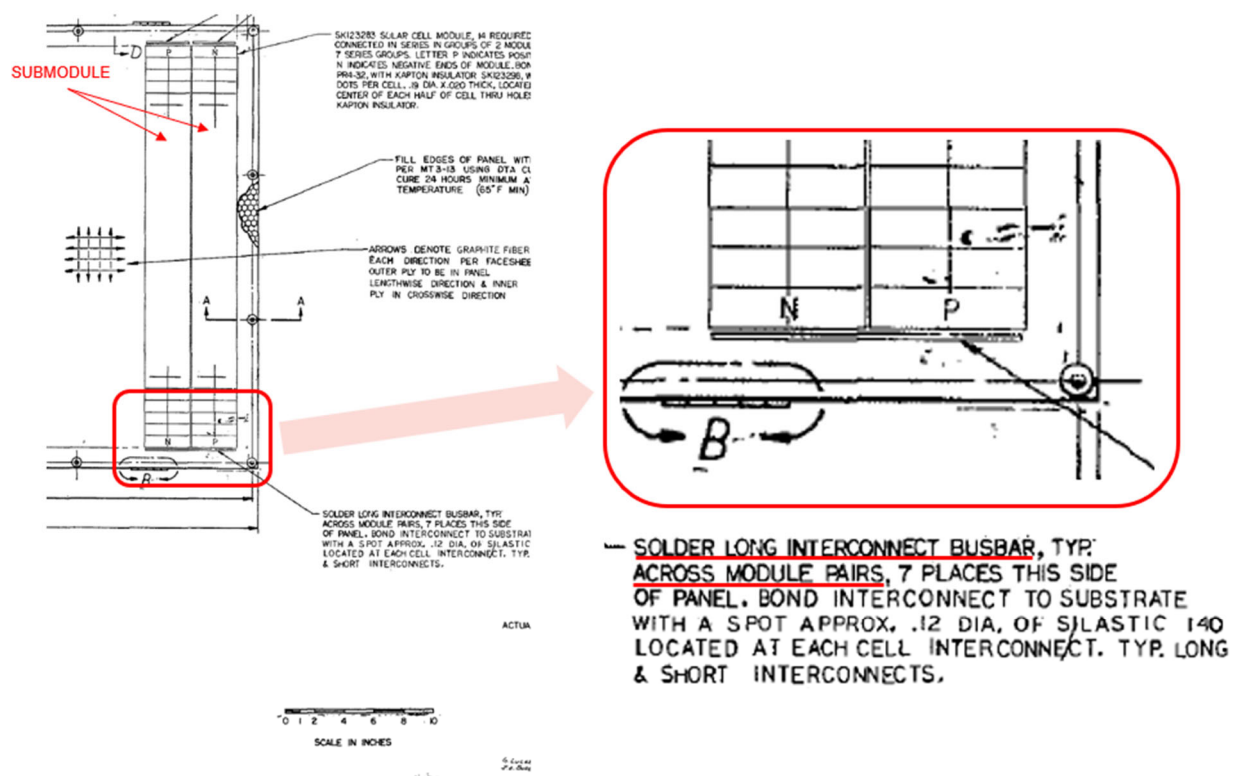
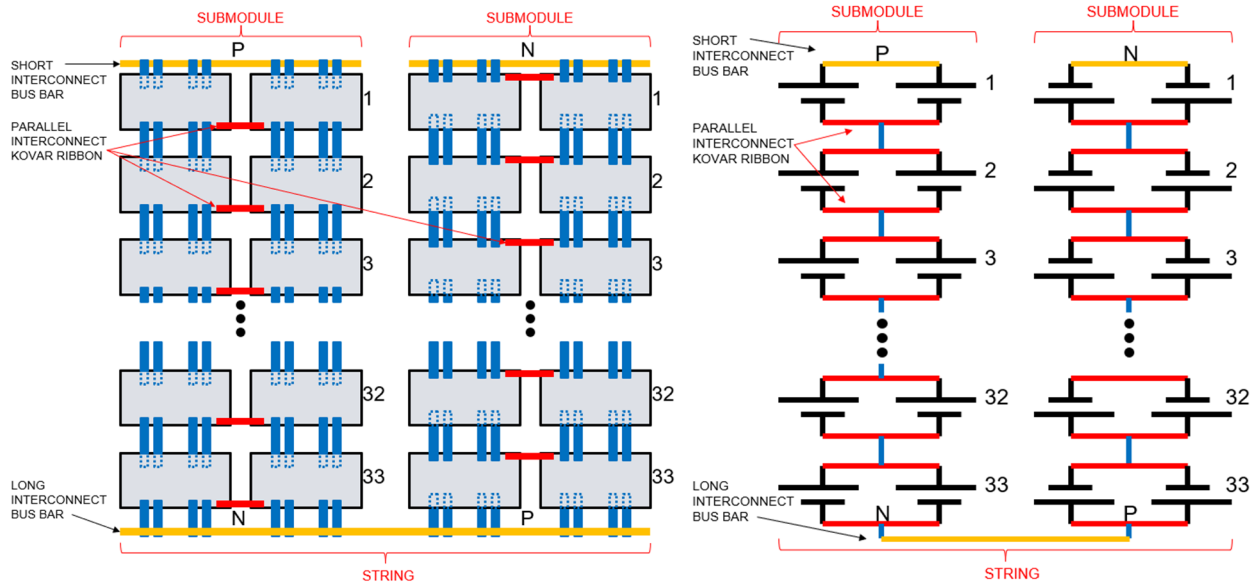


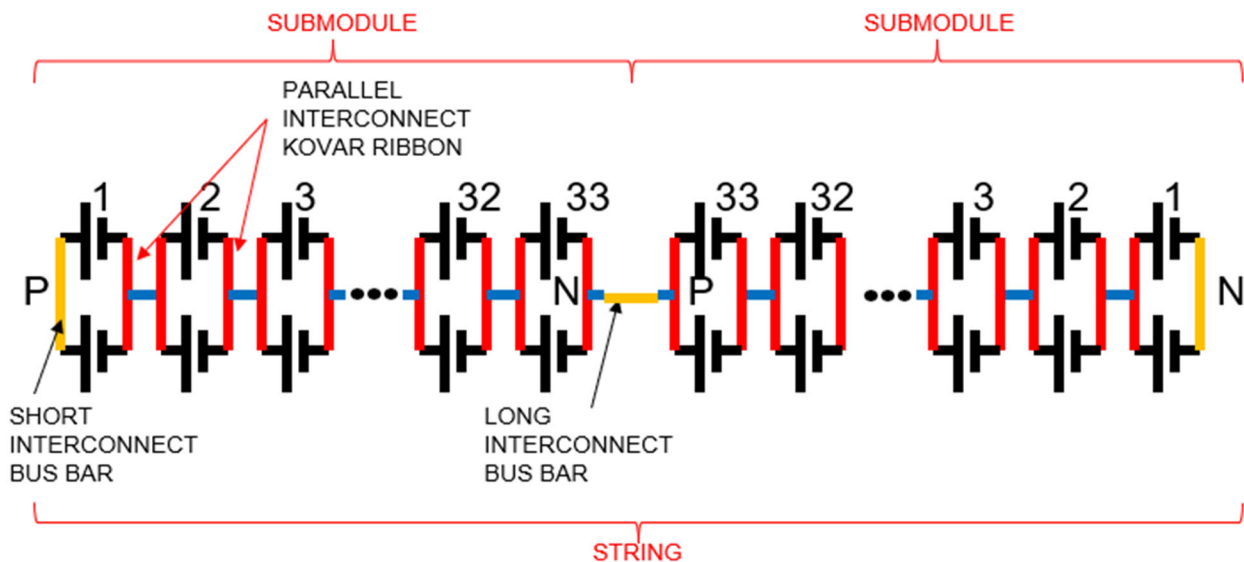
Figure 2.1

Thus, Boretz’s arrangement is different from the arrangement in Claim 1 and Boretz does not disclose the limitation of “n columns of cell strings are connected in parallel” as recited in claim 1. Rather, Boretz’s arrangement is illustrated by the

graphics below on the left and its electrical configuration is depicted on the right below:



The equivalent circuit diagram is shown below, in which the submodules on the left and right have been rotated to show the series connection of the two submodules, i.e., “a string consisting of two cells in parallel and 66 in series.” *Id.*, 21.



In describing Boretz, Petitioner’s Dr. Toliyat initially states that Boretz’ “configuration includes seven groupings of cells, each with *two cells in parallel* and 66 cells in series, totaling 924 cells.” Ex. 1003, ¶46 (emphasis added). This is simply a paraphrase of Boretz section 2.1, which states “[t]he cellstack consisted of seven strings, employing two cells in parallel and 66 cells in series, for a total of 924 cells.” Ex. 1004, 11. When addressing limitation 1[d], however, Dr. Toliyat states that “[a]ccording to Boretz, the solar module is comprised of columns of cells, where *each column* is comprised of 66 cells which are connected to each other in series—forming a cell string.” Ex. 1003, ¶109, citing Figure 2.2 (emphasis added). Following this, Dr. Toliyat does not show in limitation 1[e] how these “columns of 66 cells” are connected to other columns of 66 cells *in parallel* as would be required by the claims. Instead, Dr. Toliyat focuses only on the column of 33 cells and one parallel interconnect at the end of that column to argue parallel connection. *Id.* at ¶¶113-114. But this fails to satisfy the claimed limitation. Claim 1 requires that the “n columns of the cell strings [that] are connected in parallel” in limitation 1[e] must be the cell strings of serially connected cells previously configured in limitation 1[d]. But Dr. Toliyat’s analysis is in error because the column of 33 cells that he contends are parallelly connected are not the same as the column of 66 cells that he contends are serially connected. The Petition merely propagates this same erroneous analysis. Pet. at 31-32.

Moreover, while both the Petitioner and Dr. Toliyat refer to Boretz as disclosing “*two cells in parallel* and 66 cells in series,” they inexplicably ignore the express disclosure of Boretz, i.e., that there are 33 required “kovar ribbon” parallel interconnectors used with 33 pairs of parallel-connected two cell subgroups, which are connected in series to make up a single submodule.

Thus, the Petition fails to show that Boretz discloses the “n columns of the cell strings are connected in parallel” limitation of in 1[e] of Claim 1.

Because Boretz does not disclose this limitation,” Boretz likewise could not have disclosed the additional limitations in 1[e] and 1[f] of Claim 1 that “the n in the number of columns of the cell strings connected in parallel being equal to the n in the ratio of the long side length to the short side length” and “the n-column parallel-connected cell strings are further serially connected to another n-column parallel-connected cell strings.”

Therefore, Petitioner fails to show that the combination of Boretz and Maehane discloses all limitations of Claim 1.

C. Grounds 1-8: All Grounds are Based on Improper Hindsight

1. Grounds 1-4: The Combination Of Boretz And Maehane Is Based on Improper Hindsight

Grounds 1-4 challenges independent claims 1 and 10 based on the combination of Boretz and Maehane. In explaining the motivation to combine, the

Petition focuses only on the contribution of Maehane to limitation 1[b], which Petitioner admits is not described by Boretz. Pet., 20-21.³

Specifically, limitation 1[b] of Claim 1 requires the solar cell to have “a plurality of light-receiving-surface bus electrodes parallel to the short side of the substantial rectangle on a light receiving surface and includes rear-surface bus electrodes each at a position on a non-light-receiving surface corresponding to each of the light-receiving-surface bus electrodes.” Independent claim 10 includes the same limitation as 1[b]. Ex. 1003, ¶¶191-192; Pet., 60.

Here, the Petition admits that Boretz “does not describe the detailed shape or orientation of the [bus] electrodes on the front and rear surfaces of the solar cells.” Pet., 19-20. Petitioner’s expert, Dr. Toliyat, admits the same. Ex. 1003, ¶85 (“Boretz does not expressly disclose any significant detail about the electrodes which would necessarily be included on both front and rear faces of each solar

³ While Ground 4 additionally relies on the Krishnamurthy, Petitioner relies on the same argument for the alleged motivation to combine Boretz and Maehane. Pet. at 57 (“A POSITA would have further been motivated to combine Boretz and Krishnamurthy with Maehane for the same reasons discussed above in Section VI.A.1.”)

cell”); *Id.*, ¶102 (“Boretz does not expressly disclose the exact shape and orientation of these bus electrodes.”)

As such, Petitioner and Dr. Toliyat turn to Maehane to supplement Boretz’ disclosure. *Id.*, ¶¶85-87. However, Petitioner and Dr. Toliyat conveniently proceed to select the electrode configuration shown in Figure 2 of Maehane, and ignore other alternative configurations described by Maehane. Neither Petitioner nor Dr. Toliyat explain why a POSITA would select the first configuration of the back surface electrode over the second configuration, other than through hindsight.

Specifically, in the second configuration disclosed in Maehane, the back surface electrode 3 is “formed on the *entire back surface* of the semiconductor substrate.” Ex. 1005, ¶14 (emphasis added). Maehane further discloses that the solder layer can then be formed “over the entire area of the back surface electrode 3.” *Id.* That is, there are no individual “rear-surface bus electrodes *each* at a position on a non-light-receiving surface *corresponding to each* of the light-receiving-surface bus electrodes,” as required by the 214 Patent claims.

Neither Petitioner nor Dr. Toliyat explain why, or point to anything in the references to indicate that, a POSITA would select the first configuration of the back surface electrode over the second configuration, other than through hindsight. This is not sufficient to meet Petitioner’s burden to prove obviousness. *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 887-888 (Fed. Cir.

2024) (reversing Board’s obviousness determination based solely on alternative configurations being known in the prior art without any evidence or reason for choosing one over the other).

Thus, Petitioner has failed to show sufficient motivation to combine Boretz and Maehane to arrive at the specific claimed inventions (Claims 1 and 10) of the 214 Patent.

2. Grounds 5-8: The Combination Of Zhang And Ravi328 Is Also Based on Improper Hindsight

Grounds 5-8 are based on the combination of Zhang and Ravi328. Pet., 4. Petitioner relies on improper hindsight in combining Zhang and Ravi328 and fails to meet its burden to show motivation to combine.

First, *all* claims in the ‘214 Patent require substantially rectangular cells, which may result from cutting a square cell. However, Petitioner fails to establish a motivation to replace the square undivided cells of Zhang with the half-cut cells of Ravi328. Citing only to its expert, Petitioner asserts that a “POSITA would recognize these half-cut cells [of Ravi328], arranged in series-parallel layouts, minimize current through each string, thereby reducing resistive losses and boosting overall module efficiency.” Pet., 62 (citing Ex. 1003, ¶202). But Petitioner expert’s sole support for this proposition is a Cunningham paper (Ex. 1014) purporting to have a copyright notice of 2010. The Petition fails to establish the authenticity or public availability of this document, much less that it was

published before July 10, 2010. *Content Square SAS v. Medallia Inc.*, IPR2022-00316, Paper 13 at 26–27 (PTAB Jul. 14, 2022) (“Numerous Board decisions have held that simply pointing to a date, even a copyright date, is not sufficient at the institution stage to demonstrate public accessibility.”). Without this reference, Dr. Toliyat’s assertion that this motivation would have existed at the time of the invention is merely conclusory and without support. And it is not sufficient to show obviousness by merely showing that “two [] systems were disclosed in a prior art reference and were therefore ‘known.’” *Virtek Vision*, 97 F.4th at 888 (holding that the Board’s finding of motivation to combine not supported by substantial evidence).

Second, for claim 1 and its dependent claims, neither Zhang nor Ravi328 discloses claim limitations 1[a] “*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[d] “wherein a predetermined number of the solar battery cells are serially connected to each other, thereby configuring a cell string,” and 1[e] “ n columns of the cell strings are connected in parallel by a first string connector at one end of the n columns, *the n in the number of columns of the cell strings connected in parallel being equal to the n in the ratio of the long side length to the short side length.*” (emphasis added).

As discussed in Section II.B above, the Examiner acknowledged in the Notice of Allowance that limitation 1[e] was missing in the combination of Maehane and Yagiura and other prior art considered by the Examiner during prosecution.

Here, Zhang specifically discloses connecting *square, un-divided* 125×125 mm cells, as opposed to divided cells of “a substantial retangul[ar]” shape with “a ratio of a short side length and a long side length” being “1/n : 1 (n [being] an integer equal to or larger than 2),” as claimed. That is, the ratio of the cells in Zhang is 125/125 or 1, which is “not equal or larger than 2.” Zhang also discloses connecting in parallel two serially-connected cell strings (Ex. 1007, 4), and this results in the number of parallelly-connected cell strings not being equal to the cell-size ratio of 1 in Zhang.

To attempt to cure the deficiency of Zhang, the Petition attempts to combine Zhang with Ravi328. The Petition asserts that Ravi328 discloses “108 half-cut, 125-mm mono-crystalline silicon solar cells, arranged into two sub-sets of cells, each comprising *two parallel strings* of 18 half-cells each” Pet., 14-15 (emphasis added) (citing Ex. 1009, 5). This is a clear misreading of Ravi328. Ravi328 expressly contradicts the Petition’s characterizations, disclosing that the half-cut cells are arranged such that “*3 strings* each of 18 half-cut cells *are*

paralleled and then connected in series with another set of **18*3** strings.” Ex.

1009, 5 (emphasis added); Ex. 1003, ¶61 (Dr. Toliyat quoting the same statement).

Ravi328 also discloses a second embodiment in which the half-cut cells are arranged in 3 *parallel* strings of 36 solar cells each. Ex. 1009 (Abstract: “The cell array utilizes 3 parallel strings of 36- solar cells”); *id.* at 3 (“Still another object of this invention is to propose a method for parallel connection of 3 strings 36-half cut cells each.”).

Thus, in Ravi328, while the ratio of the short side length and the long side length of the substantial rectangular cell is 1/2:1, such that $n=2$, each embodiment in Ravi328 discloses three strings connected in parallel. Thus, “the n in the number of columns of the cell strings connected in parallel” is 3, and is not equal to 2 (“the ratio of the long side length to the short side length”) as required by claim 1 and all dependent claims.

Because neither Zhang nor Ravi328 discloses the limitation “the n in the number of columns of the cell strings connected in parallel being equal to the n in the ratio of the long side length to the short side length” (which is the same limitation the Examiner found missing in the prior art during prosecution), Petitioner impermissibly picks the half-cut cells of Ravi328, ignoring that Ravi328 teaches these *half-cut cells* as being connected in 3 *parallel strings* of 18 cells each (or 36 cells each in the second embodiment), and baselessly inserts them into

Zhang's configuration of ***two series groups connected in parallel used for undivided square cells***. Pet., 62. There is no suggestion or teaching in any of the references for why a POSITA would be motivated to arrange the half-cut cells of Ravi328 in two (2) (as taught by Zhang), rather than three (3) parallelly connected cell strings (as taught by Ravi328). Neither Petitioner nor its expert provides this explanation, especially in view of their misunderstanding of the Ravi328 reference.

Moreover, Petitioner's Ex. 1014 does not address at all the specific issue at hand, which is the specific arrangement and electrical connection of the half-cut cells. Indeed, Ravi328 explains that its specific arrangement of the cells was made "to obtain the required current and voltage" and thus would have provided no reason to the POSITA to further modify it. Ex. 1009, 3. Thus, neither the Petition nor Petitioner's expert has provided the requisite factual evidence showing why a POSITA would be motivated to modify the arrangement of Ravi328's half-cut cells in the way claimed by the 214 Patent.⁴

Third, the Petition's obviousness combination engages in impermissible hindsight. The use of half-cut cells in two parallel groups such that "the n in the number of columns of the cell strings connected in parallel being equal to the n in

⁴ "Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight." 37 C.F.R. § 42.65(a).

the ratio of the long side length to the short side length,” is something only taught in and suggested by the Challenged Patent itself. And, it is only because the Challenged Patent demonstrated this improvement that Petitioner is able to (through the improper use of hindsight) use the Challenged Claims as a template to piece together the half-cut cells of Ravi328 with the two parallel groups of Zhang to arrive at the claimed invention. *See In re Fritch*, 972 F.2d 1260, 1266 (Fed. Cir. 1992) (“It is impermissible to use the claimed invention as an instruction manual or ‘template’ to piece together the teachings of the prior art so that the claimed invention is obvious.”), *In re Wesslau*, 353 F.2d 238, 241 (C.C.P.A. 1965) (“It is impermissible... to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art.”).

D. Grounds 4 and 8: Krishnamurthy is Non-Analogous Art

Ground 4 relies on the combination of Boretz, Maehane, and Krishnamurthy while Ground 8 relies on the combination of Zhang, Ravi328, and Krishnamurthy.

For its obviousness analysis, Petitioner has the burden to show that all prior art used in a combination is analogous art, i.e., that it satisfies one of two tests: “(1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor’s

endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.” *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). “Whether a skilled artisan would be motivated to make a combination includes whether he would select particular references in order to combine their elements.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1337 (2016).

Here, the Petition provides no such analysis for Krishnamurthy. Krishnamurthy is not in the field of art of the 214 Patent—solar battery modules, “a plurality of which are arranged and installed on a roof or the like in a solar power generation system.” *See* Ex. 1001, 1:6-10; *see also* Pet., 1 (stating that “[t]he ’214 patent relates to solar battery modules connected in a specific series-parallel configuration to reduce resistive losses and improve module efficiency.”). Instead, Krishnamurthy is in the field of “small scale satellites” such as “satellites of micro and Pico scales,” which are said to “reduce [development] time frame and project cost.” Ex. 1012, 5 (Abstract). This is not surprising because the author is enrolled in a “Space Master Course study on Space Technology.” *Id.*, 4 (Acknowledgement). Thus, Krishnamurthy is not in the same field of endeavor as the 214 Patent.

Moreover, because Krishnamurthy is a Master’s Thesis, and there is no evidence that it was even indexed, catalogued, or shelved, it is unclear how a

POSITA (in the solar cell and module art) would even find out or be aware of Krishnamurthy, which is in the field of satellite design.

The Petition further fails to explain how Krishnamurthy addresses the problems the 214 Patent inventors sought to solve, (1) that as solar cell efficiency improves, current increases, resulting in increased resistive losses, (2) ease of connecting multiple modules to an inverter on a rooftop and (3) interchangeability with conventional solar modules in an array. Ex. 1001, 1:18-22. The 214 Patent solves these problems by using a specific electrical arrangement of divided solar cells in a module that increases efficiency by reducing resistive losses while maintaining electrical interchangeability with a module having non-divided cells. Ex. 1001, Abstract, 9:29-46.

Krishnamurthy has nothing to do with the problems the 214 Patent sought to address. Rather, Krishnamurthy is concerned with designing “cube-shaped Pico-satellites with a nominal length of 10cm per side” and a weight of “not more than 1kg.” Ex. 1012, 16 (Introduction). The project’s purpose is to “keep track of the product architecture and entire system parameters like mass, energy consumption, and mass memory size and so on.” *Id.* Krishnamurthy’s only concern with solar modules relates to determining the satellite’s power requirements such that the solar generator can provide the amount of power required by the satellite. *Id.*, 46-47 (“Solar generator dimensioning”).

Indeed, the only relevant part of Krishnamurthy, a single figure, is buried within the 129 pages of the Krishnamurthy thesis, as the Petition relies solely on Fig. 6-5 on page 53 for its purported disclosure of “chamfered half-cells” and its “arrangement in aligning adjoining half-cells.” Pet., 56-57. There is no explanation how a POSITA would have been motivated to select this particular reference in order to decipher the chamfered half-cell arrangement.

Krishnamurthy cannot be reasonably pertinent to the problem facing the 214 Patent inventors because Krishnamurthy’s only concern with the solar panel is that it meets the satellite’s power requirements. An inventor considering the problems addressed in the 214 Patent would not have been motivated to look to Krishnamurthy, not only because it is directed to “the development of generic dynamic model for space missions,” but because it is not directed to solving the problem of reducing resistive losses due to increases in efficiency of a solar cell while maintaining electrical interchangeability with a module having non-divided cells. Thus, Petitioner has not demonstrated a reasonable likelihood of prevailing in showing that the challenged claims would have been obvious over any combination of prior art relying on Krishnamurthy, which is required by Grounds 4 and 8.

VI. CONCLUSION

For the reasons provided above, in Board should decline to institute *inter partes* review.

Dated: August 21, 2025,

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitations of 37 C.F.R. § 42.24, because it contains 7,737 words (as determined by the Microsoft Word word-processing system used to prepare the brief), excluding the parts of the brief exempted by 37 C.F.R. § 42.24.

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CERTIFICATE OF SERVICE

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