

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AFFORDABLE WIRE MANAGEMENT, LLC,
Petitioner,

v.

CAMBRIA COUNTY ASSOCIATION FOR THE BLIND AND HANDICAPPED,
INC.,
Patent Owner.

IPR2024-00178
Patent 11,349,291

**DECLARATION OF EDWARD C. KERN, JR., PH. D.
IN SUPPORT OF PATENT OWNER'S RESPONSE**

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I, Edward C. Kern, Jr., declare as follows:

I. INTRODUCTION

1. I have been retained by counsel for Cambria County Association for the Blind and Handicapped, Inc. (“CAB”) as an expert witness in connection with IPR2024-00178, concerning U.S. Patent No. 11,349,291 (“the ‘291 Patent”), pending before the U.S. Patent and Trademark Office, Patent Trial and Appeal Board (“the Board”).

2. I understand that on April 24, 2024, the Board instituted inter partes review (the “Institution Decision” Paper 17) as to all of the challenged claims of the ‘291 patent on all of the grounds of unpatentability set forth in a petition for inter partes review filed by Petitioner Affordable Wire Management, LLC (“Petitioner” or “AWM”) (the “Petition”), which was supported by the Declaration of Omid Beik, Ph. D. (“the Beik declaration,” cited to herein as EX1002).

3. I have been asked to provide my opinion about the grounds for unpatentability of the claims of the ‘291 Patent as asserted in the Petition. The following is my written declaration on these topics. I am personally knowledgeable about the matters stated herein and am competent to make this declaration.

4. The Petition challenges the patentability of the following claims:

- Ground 1 – Claims 1-5 and 9-10 as allegedly being unpatentable as obvious over *Caveney* in view of the knowledge of a POSITA;

- Ground 2 – Claims 14-18 and 21-22 as allegedly being unpatentable as obvious over *Caveney* and *Almy* in view of the knowledge of a POSITA;
- Ground 3 – Claims 1-10, 14-22, and 24-25 as allegedly being unpatentable as obvious over *Carr* and *Almy* in view of the knowledge of a POSITA.

5. I understand that as for Ground 1, the Board determined that Petitioner had not established a reasonable likelihood that Claims 1-5 and 9-10 are unpatentable over *Caveney*. As for Ground 2, the Board determined that Petitioner had not established a reasonable likelihood that Claims 14-18 and 21-22 are unpatentable over *Caveney* and *Almy*. As for Ground 3, the Board determined that Petitioner had established a reasonable likelihood that it will prevail in showing that Claims 1-10, 14-22, and 24-25 are unpatentable over *Carr* and *Almy*. Specifically, the Board determined that Petitioner had “shown sufficiently that a skilled artisan would have combine *Carr* and *Almy* to replace *Almy*’s wire loops with *Carr*’s hangers to provide a simple, cheap construction that separates electrical cables and prevents the cross-induction effect between conductors . . . as *Carr* teaches.” Institution Decision, at 31.

6. This declaration provides my opinions and their bases regarding the asserted grounds of unpatentability of the challenged claims, and includes my

rebuttal of assertions made by Dr. Beik in his declaration in support of the petition, as well as Dr. Beik's assertions in his deposition (EX2004).

7. The conclusions I present reflect my own judgment, based on my knowledge, background, education, training and experience in the field of energy technology, including specifically in the design and development of solar power systems. My opinions expressed herein are based on the issues and materials that I have reviewed to date, including the '291 patent, asserted prior art references and other materials submitted to the Board in support of the Petition, materials and information including declarations and exhibits submitted to the Board in support of Patent Owner's Response, and the materials and information cited in my declaration. If additional issues, materials or information are provided to me for review, I may supplement, amend or modify my opinions based upon that further review.

8. I am being compensated for my work as an expert with respect to this inter partes review proceeding at the rate of \$400 per hour. I have no financial interest in CAB or in the '291 Patent, and my compensation is not dependent on the outcome of this or any other proceeding relating to the '291 Patent.

II. BACKGROUND AND QUALIFICATIONS

9. A summary of my relevant experience follows. More details of my background and experience, including my relevant projects, publications, and speaking engagements, are included in my Curriculum Vitae. EX2039.

10. I earned an Artium Baccalaureus (Bachelor of Arts) with a major in Engineering Sciences from Dartmouth College in June 1967 and a Bachelor of Engineering from Dartmouth's Thayer School of Engineering in June 1968. In September 1968 I began graduate studies at the Massachusetts Institute of Technology (MIT) and in 1971 I received a Master of Science Degree in the field of Naval Architecture and Marine Engineering. I received my Ph.D. in the field of hydrodynamics from MIT in 1973.

11. My professional career has centered on developing energy sector technology to function in the natural, outdoor environment, exposed to the forces and varying conditions of nature. Early in my career my focus changed from design in the marine environment to design for exposed terrestrial locations, in both the built environment and in the natural environment. My work in the marine environment concluded with participation with the US Coast Guard in immediate

recovery efforts following the Argo Merchant grounding in December 1976.¹ I began my work with photovoltaic (PV) power systems in January 1977 at MIT's Lincoln Laboratory. My solar power development activities span 47 years and six continents.

12. I am currently retired from running my own company, Irradiance, Inc. (formerly named Ascension Technology) which I founded in 1987. I am now consulting part time as the sole member of KRNLPWR LLC applying my forty-seven-plus years' experience designing and developing photovoltaic power systems, beginning during the formative years of the photovoltaic industry in the mid-1970s.

13. I have been involved in the design for many of the first "large" scale PV systems deployed starting in 1977 at the DOE's Field Tests and Applications Project at MIT Lincoln Laboratory. My first project involved roof-mounting solar panels at the Museum of Science and Industry in Chicago. This and other systems at the time deployed some of the first terrestrial solar panels manufactured and involved collaboration between the MIT Lincoln Laboratory (MITLL) and the California Institute of Technology (Caltech) Jet Propulsion Laboratory (JPL). I

¹ <https://response.restoration.noaa.gov/oil-and-chemical-spills/significant-incidents/argo-merchant-oil-spill/argo-merchant-birth-modern-oil>

worked closely with JPL staff in my role developing PV systems for terrestrial applications using the solar PV panels then being developed by JPL. Both MITLL and JPL were engaged in applying their experience with space applications for solar photovoltaics to terrestrial applications. In space applications as with my background in ocean engineering there are few if any jurisdictions applying codes or standards and engineering design evolved from “first principles” of physics and mathematics. For novel terrestrial PV applications at that time there were no standards (e.g. the National Electrical Code or the National Electric Safety Code) specific to solar power and code enforcement officials (e.g. building wiring inspectors) had no code guidance dealing with the idiosyncrasies of solar electricity. At that time both my group at MITLL and JPL engaged in developing both UL standards and National Electrical Code provisions (e.g., Article 690) for terrestrial solar PV applications.

14. At MITLL I planned and implemented the US Department of Energy’s Residential Rooftop PV Applications Program, which involved engineering development of prototype roof mounted PV arrays and testing them at research stations in Massachusetts, New Mexico and Florida starting in 1979.

15. Throughout my career I have authored reports and made presentations for DOE PV Program Management meetings starting in 1977; for the IEEE Photovoltaics Specialists Conferences starting in 1978; for Electric Power

Research Institute (Palo Alto, CA); the World Bank and International Finance Corporation (Washington, DC); the Central Research Institute for the Electric Power Industry (Tokyo, Japan); the IEEE Power Systems Relay and Protection Standards Development; China Light and Power (Hong Kong), Tata Power Company (Mumbai, India), Solar PACES Meetings; (Perpignan, France and Granada, Spain); and Saudi Electricity Company and King Abdullah City for Atomic and Renewable Energy (Riyadh, Saudi Arabia).

16. In 1987 I left MIT and founded Ascension Technology to continue my work researching, designing, engineering, and constructing solar power systems. Ascension Technology's first project was sponsored by the New England Electric System R&D department and Massachusetts Electric Company and involved installing PV systems on 30 homes at the end of a power distribution circuit in Gardner, Massachusetts to demonstrate the safety and performance of roof mounted PV on homes, and to demonstrate for the first time the ability of numerous distributed generation systems to operate collectively and properly when connected to utility power distribution lines and equipment. This project led to collaboration and subsequent developments of rooftop PV in Japan through ongoing exchanges with engineers from the Kansai Electric Company in Osaka and their first testing of rooftop PV at a test station at Rokko Island, near Kobe, Japan. Through Ascension I designed, developed, sought and received UL listings,

and manufactured components for and installed pioneering grid tie PV systems with support and sponsorship from numerous electric power companies, the US Environmental Protection Agency, and the US Department of Energy and the National Renewable Energy Laboratory. My projects in the late 1980s and early 90s installed some of the first grid-interconnected solar PV systems in Hawaii, California, Oregon, Arizona, Nevada, Idaho, Utah, Wyoming, Texas, Oklahoma, Colorado, Minnesota, Wisconsin, Michigan, North Carolina, Virginia, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine. Ascension also designed and installed systems in Mexico and India during the mid-1990s.

17. Throughout my career after forming Ascension Technology, I maintained a close working relationship with MIT, initially the MIT Energy Laboratory, then the MIT Laboratory for Energy and the Environment, and finally the MIT Energy Initiative. I both lectured on solar and wind energy at MIT and installed the first two grid-tie PV systems on buildings on the MIT Campus. I have lectured at my alma mater Dartmouth College's Thayer School of Engineering and installed Dartmouth's first grid-tie PV system in 1995 and have continued pro bono support to the present for Dartmouth's deployment of solar technology.

18. I am a Senior member (emeritus) of IEEE and a Fellow and Life Member of the American Solar Energy Association.

19. In my opinion, it is vitally important to possess practical “real world” experience in solar PV installations to fully understand and grasp the unique technical issues, challenges, and practicalities, in this area of technology. Academic qualifications, while helpful, are alone insufficient. My opinions as stated in this declaration are based on my education, background, training and experience, including extensive field experience in solar power plants. I believe that I am qualified to opine as to the knowledge and level of skill of one of ordinary skill in the art at the time of the alleged invention underlying the ‘291 Patent, as well as the state of the art at that time.

III. LEGAL STANDARDS

20. As a technical expert, I am not offering any legal opinions. Rather I am offering technical assessments and opinions. In rendering my analysis, I have been informed by counsel regarding various legal standards for determining patentability. I have applied those standards informing my technical opinions expressed in this declaration.

A. CLAIM CONSTRUCTION

21. I understand that in this proceeding the ‘291 Patent claim terms are to be interpreted according to the so-called *Phillips* standard.

22. I further understand that under the *Phillips* standard, claims are to be given their ordinary and customary meaning, i.e., the meaning that the claim term

would have to a person of ordinary skill in the art in question at the time of the invention, in light of the specification and prosecution history. It is further my understanding that the specification is the single best guide, and usually dispositive, as to the meaning of any disputed claim terms.

B. PERSON OF ORDINARY SKILL IN THE ART

23. I further understand that in this matter, Petitioner has asserted that a person of ordinary skill in the art (“POSITA”) with respect to the technology described in the ‘291 Patent would be a person with a “bachelor’s degree in a pertinent discipline, such as electrical engineering, civil engineering, mechanical engineering, or equivalent with 2-3 years of experience in electrical utility systems, planning, and design, with the understanding that the number of years of experience could be higher or lower given the level of education and vice versa.” (Pet. at 20.)

24. I also understand that in its Institution Decision, the Board adopted the Petitioner’s articulation of the level of skill in the art. Therefore, for purposes of my analysis, I have assumed the Petitioner’s definition of a POSITA.

C. OBVIOUSNESS

25. I understand that a claim in a patent is unpatentable based on obviousness if the differences between the claim and the prior art are such that the subject matter of the claims 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 the subject matter pertains.

26. I understand that an issued patent claim can be obvious in view of a single prior art reference or multiple prior art references. I have also been informed that when asserting obviousness under § 103, whether based on a single prior art reference or a combination of references, a petitioner must articulate a reason, with rational underpinnings, why a POSITA *would* have been motivated to modify that single prior art reference or combine multiple references to arrive at the claimed invention.

27. I understand that obviousness concerns not whether a skilled artisan *could have made*, but *would have been motivated to make*, the modifications or combinations of prior art to arrive at the claimed invention.

28. I understand that the determination of obviousness requires the consideration of the following factors: 1) the scope and content of the prior art; 2) the differences between the prior art and the claims at issue; and 3) the knowledge of a person of ordinary skill in the pertinent art. I also understand that secondary considerations of non-obviousness, such as commercial success, long-felt need, failed attempts, copying, unexpected results, praise of the invention, expressions of skepticism in the industry, and the patent owner proceeding contrary to accepted

wisdom of the prior art, are particularly important in evaluating the obviousness of challenged patent claims.

29. I understand that in making an obviousness analysis, the fact that individual elements of the claimed invention are disclosed in the prior art is not alone sufficient to reach a conclusion of obviousness.

30. I understand that in making an obviousness analysis, one may not use hindsight when comparing the prior art to the claimed invention, or consider what was learned from the teachings of the patent. In particular, I understand that it is improper to use the patent claims as a road map for selecting and combining items of prior art. In other words, one must avoid using the challenged patent as a guide through the prior art references, using hindsight to combine references solely for the purpose of achieving the result of the claims at issue. Instead, one must put oneself in the place of a person of ordinary skill at the time the invention was made and consider only what was known before the invention was made and not consider what became known subsequently. Therefore, I understand that defining the problem in terms of its solution reveals improper hindsight in the selection of the prior art relevant to obviousness.

D. REASONABLE EXPECTATION OF SUCCESS

31. I understand that where a party argues a skilled artisan would have been motivated to modify a single prior art reference or combine references, it

must show the artisan would have had a reasonable expectation of success from doing so.

IV. OVERVIEW OF THE RELEVANT TECHNOLOGY

A. EARLY DEVELOPMENT OF SOLAR INSTALLATIONS

32. From the inception of federal R&D programs in the mid-1970s in response to the OPEC oil embargoes to the present, solar photovoltaic technology has evolved through collaborations between federal research laboratories such as JPL, MITLL, Sandia National Laboratories and the Solar Energy Research Institute (now the National Renewable Energy Laboratory, NREL), private organizations such as Underwriters Laboratories and the National Fire Protection Association which oversees the National Electrical Code (NEC), electric utilities and their jointly sponsored research arm the Electric Power Research Institute, and private sector companies ranging from major industrials to academic spin-off startups.

33. Fifty years later, in the first 10 months of 2023, solar power accounted for 42% (10,937 MW of a total 25,968 MW) of new electric power generation and now accounts for 7% of power generation capacity in the United States.² Solar power has evolved from a vision into a booming industry.

² <https://cms.ferc.gov/media/energy-infrastructure-update-october-2023>

34. A key attribute of solar photovoltaic (PV) energy is that, by its nature, it is a spatially distributed power generation resource. Before solar PV, the economies of scale in traditional power generation favored the construction of large power plants. Consequently, electric power systems developed with a model of power flowing outward from large sources (e.g. coal and nuclear power stations) to many distributed consumers. This meant that the power carrying wires and cables in these systems could be protected by fuses and circuit breakers “upstream” of the many distributed consumers and power consuming devices. Typically, these circuit protection devices are “opened” when current levels exceed safe values, as can happen with a short circuit or short to ground.

35. PV’s spatially distributed nature is the exact opposite. Power is aggregated from smaller to larger currents, as with brooks, streams and creeks aggregating to form rivers. In solar PV wiring, lethal voltages that occur both directly as a shock hazard and indirectly through electrical arcs igniting a fire, exist throughout PV arrays and power aggregation cannot be protected in the same way as power distribution.

36. PV system building and wiring inspectors, engaged in assuring public safety, are trained to verify that equipment meets certain standards and installed to meet certain codes including the National Fire Protection Association’s “National Electrical Code” (NEC).

37. PV system designers and installers, while seeking to lower both manufacturing and construction costs, are guided and constrained by these NEC safety codes as well as structural codes. Non-compliance can result in a costly failure to pass an electrical inspection and professional liability in the case of an injury, accident, or damage. Accordingly, persons engaged in designing and constructing PV systems are and have been advisably cautious in designing so-called “balance of systems” in PV systems, which include mounting structures, foundations, wire and cable management and organization, electrical panels, switching gear, battery storage and other structural features of a typical solar plant.

38. The unique nature of power collection and aggregation in solar PV facilities introduced novel constraints and challenges in wire and cable design, management, and organization not arising in other fields and industries. These unique challenges related to, for example, aggregating and collecting power in a PV array DC “string” of modules, transmitting power output to string combiners that output “feeder” cables to inverters that convert the DC current to AC current in PV output circuits, and proper management of ground faults that occurred in the system.

39. Aside from highly instrumented experimental technology R&D prototypes, PV systems initially had only DC wiring and fixed panels. Early “commercial” markets for battery charging in remote (“off-grid”) places were DC

only. Most “demonstration” and R&D grid-tied systems also had DC only wiring in their PV arrays, and most were relatively small (in comparison to PV systems prevalent today)— in the range of 5 to 20 kW in rated power, though several “utility scale” demonstrations were built up to 1 MW scale.

40. Commercial solar power plant applications at ~1 MW capacity and larger, producing electricity for bulk power markets, began appearing in the early to mid-2000s. The first large solar power plants used fixed (non-tracking) arrays with DC power cables only, together with lower cost “thin film solar modules.” These modules were typically less efficient than standard silicon solar cell-based modules and therefore required greater land areas per unit of power produced and longer wire runs to gather the power to collection points.

41. During the 2000-2010 period, prices for higher efficiency silicon solar cell modules dropped precipitously. Higher module efficiencies for these modules reduced land costs, structural support costs, and favored simple single-axis tracking to improve electricity production by 20 to 25%. As time went on, however, it also complicated array field wiring by introducing the requirement for control cabling.

42. With tracking came the need for both powering the mechanical tracking devices and for data signals from panel orientation, irradiance, wind speed, fault conditions such as ground faults, and temperature sensors within the

array field, and for signals to the mechanical tracking devices to control their positioning. The increased use of tracking devices, therefore, resulted in the increased use of AC cables to power the devices, as well as the increased use of signal wiring, or data wiring, to monitor and communicate data within the PV solar array.

B. EVOLUTION OF POWER CABLES IN SOLAR INSTALLATIONS

43. As solar PV arrays became commercially viable in the mid- to late 2000 time-frame and transitioned to larger multi-megawatt installations, lower voltage solar wiring gave way to the need for higher voltage cables, enabling lower cost for comparable performance.

44. The power carried in DC electrical cables is the product of the circuit voltage and current. Electrical cables are rated at their current carrying and voltage isolation capabilities. Increasing current capacity requires increased diameters and more copper or aluminum cross sectional area and therefore larger and heavier cables.

45. Over this period, NEC allowable voltages increased from 600 to 1500 V, increasing the power that could be transported on a given wire size by a factor of 2.5 (150% gain). The increase in system voltage also increased the number of modules that the wires could connect in series, in concert with the growing size of

PV power plants, and significantly increased the length of these power cables, and the need to manage them.

46. As noted above, large solar PV systems involve the aggregation of small amounts of electricity generated from sunlight falling over large areas toward a single point for interconnection to the power grid. Each square meter of solar panel area will produce about 200 Watts of DC electricity in full sunlight, on a clear day, tilted toward the sun at noon. To prevent tilted panels from shading one another they need to be spaced apart. Spacing the modules apart increases the land area needed, to about twice the total area of solar modules. Accordingly, it would be expected that there would be approximately 100 Watts of DC electricity generated for each square meter of land. Viewed another way, a 250 Megawatt solar power plant would occupy a square mile of land, and have hundreds of miles of DC power cables aggregating electricity to a single point for interconnection to the power grid.

47. DC power cabling begins with module-to-module series connection of panels to form a “series string.” About 30 such panels, each producing 10-15 Amps, and extending over an area of about 150 square meters, are connected in series forming 1500 V DC series strings producing 15-20 kW. A number of DC power strings (source circuits) are then extended to a “string combiner” and wired in parallel to aggregate their current. For this stage, wire support systems such as

cable trays or wire ties were used to support multiple DC cables. These DC cables are larger in diameter and heavier than 10 AWG to reduce power losses, for a range of wire length runs (up to ~150 meters).

48. “Feeder cables” are output from the string combiner, and output current from a typical DC cable string combiner could be 100 Amps (150 kW power at 1500 Vdc) and needs to be routed to an inverter (which converts DC power to AC power required for eventual distribution via the power grid). The output from multiple string combiners then needs to be combined again and converted to AC power. At 100 Amps, significantly larger wires are needed, typically 4/0 which is about 3/4” diameter and weighs (aluminum conductor) about 1/3 pound per foot. Such output wires from multiple string combiners run to second aggregation points at inverters, typically capable of converting about a megawatt of DC power to three phase AC power. At this stage, the wire runs would likely be routed 90 degrees from the direction of the rows of PV panels, and would typically be placed in trenches with risers to the string combiners. This cabling might also be protected by buried conduit.

49. Following this example, the DC power from eight string combiners would aggregate at an inverter and be converted to three phase AC power. Inverter output power would then be wired to a transformer and boosted to a distribution level voltage, such as 13,800 volts. At larger than 1 MW scale, multiple 1 MW

building blocks would be replicated, and the output wiring from each building block would be three phase AC distribution voltage. A square mile would accommodate 250 of such building blocks forming a 250 MW solar farm.

50. As discussed above, the increased use of trackers in PV arrays also required AC cables to power the trackers. Prior to 2014, the AC cables were typically bundled together with the DC cables.

C. THE NEED FOR IMPROVED SYSTEMS FOR CABLE MANAGEMENT

51. Wiring for increasingly large solar power plant arrays initially evolved from well understood and proven methods for outdoor wiring. But as the size scale, number of solar projects, and competitive entrants in the industry grew, exponentially in the 2000-2010 time-period, the high costs of materials, supply chain logistics, installation, and maintenance of using older methods of cable management, such as trenching and metal wire trays, provided an opportunity for needed innovation in developing improved and more efficient cable management systems.

52. To meet electrical code, cabling prior to 2014 was usually bundled and buried underground, with or without conduit, or placed in a metal wire tray. Trenching and direct burial of the cabling, however, are expensive and present issues for increasing “capacity” as PV output circuits are added along the path to the inverter. The tradeoff between direct burial (without conduit) and laying

conduit relates to site soil conditions, such as the likelihood of sharp rocks abrading the cable. While direct burial is cheaper than burial with conduit, it is more prone to failure and once in place cannot be easily maintained or replaced.

53. Yet another impact of trenching is the construction sequence of events. Access within the array field for mounting and wiring individual modules or panels is required and once the structure is in place the only means of access by construction vehicles is along pathways between the rows. While a trench is open it introduces a dead-end barrier along the pathway during construction.

54. Cable trays, on the other hand, are even more expensive than trenching and cumbersome to build. They need to be designed to match the array field structure's length and repetition scales for aligning attachment points. These structural length scales are in turn dictated by PV module dimensions which are highly variable from one product to another. The required cable tray lengths, attachment points, and "capacity" (width and depth) are in constant play complicating supply chain logistics and impacting costs.

55. A further consideration is that cable tray capacity requirements change along the row as additional cables are added as the tray collects additional "home run" wires along its path to a combiner box, further complicating design choices and cost considerations.

56. To complicate matters further, as stated above, and as the ‘291 patent explains, prior to 2014, AC and DC cables could be bundled together, and there was no requirement to separate AC from DC cables, including in solar power plant installations. In fact, commingling the AC and DC cables was the cheapest and most direct way of managing these cables. Changes to the 2014 NEC, however, for the first time required that AC and DC cables be separated from each other in PV arrays. *See* EX1001, 1:32-42; *see also* EX2055, Art. 690.31(B). Notably, however, the NEC code provision for separating DC and AC cables in PV arrays does not mention or contemplate utilizing cable hangers for separating electrical cables or of utilizing messenger wire supported cable hangers to support and separate the various kinds of electrical cables within a solar installation array. In fact, Art. 690.31(B) specifically states that DC and AC cables shall not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting unless separated. *Id.*

57. In addition, as discussed above, with the increased size of solar power plants and the increased use of more sophisticated trackers came the increased need in solar installations for signal wiring and data cabling for monitoring and communicating data from the PV array. Because it was known that AC and DC power cables could interfere with such signal and data wires that are located

adjacent to them, there was also a known need for separating AC and DC power cables from signal and data wiring. *Id.*, 1:37-56.

58. Separation from each other the DC wiring extending from the solar panels, AC wiring used to power the trackers and signal wiring necessitated by the increased use of tracking devices is imperative to guard against the potential for one type of wiring to interfere with the proper operation of another via deleterious cross induction and alternating magnetic fluxes.

59. As further discussed below, the '291 patent addressed the need for an improved cable management system in the solar industry. At the time of the '291 invention, however, there were significant challenges unique to the solar industry to developing such improved cable management systems.

60. Prior to 2000, there were significant industry investments in solar module and power electronics manufacturing, but little if any in solar power plant structures and wiring. The period from 2000 leading up to the 2014 priority date of the '291 patent saw some PV module industry investment in structures to support PV modules. But there was still the expectation within the industry that wire management for solar installations would simply involve selection and application of existing methods and equipment.

61. Some of these unique challenges at the time of the invention claimed in the '291 patent are discussed in an article from early 2013 in a leading trade

industry publication, SolarPro Magazine, entitled “PV Array Wire Management,” which is an exhibit introduced by Petitioner in these proceedings. EX1011.

62. This article begins by stating that “designers and installers face persistent challenges to managing free-air conductors within the PV array,” and that “[i]mplementing a safe, reliable and *Code*-compliant wire management system for exposed PV conductors is not an easy task.” *Id.*, at 1-2.

63. The author further states that “[w]hile securing array wiring seems like it should be a straightforward exercise, the reality is that integrators continue to face numerous challenges.” *Id.*, at 2.

64. One of the most significant challenges is the extreme environments in which PV arrays are installed. In fact, as aptly stated by the author, “[c]oupled with the harsh environmental conditions that PV array conductors are exposed to – UV radiation, high winds and extreme ambient temperatures, and ice, snow and other debris – wire management continues to be the *Achilles heel* of the majority of PV installations.” *Id.* (emphasis added).

65. Bill Brooks, of Brooks Engineering, is a leading consultant in the PV industry including electrical cable management. Indeed, individuals from all facets of the solar industry continue to attend his courses and seminars in large numbers given the tremendous amount of respect for his expertise in the field. Mr. Brooks is quoted throughout the SolarPro article, EX1011.

66. For example, Mr. Brooks discusses provisions of the NEC that specifically relate to electrical cable wiring and management in PV systems. EX1011, at 7. As Mr. Brooks notes, those sections of the NEC placed additional requirements upon cable management systems and installation in PV systems adding to the complexity and cost of these systems. *Id.*

67. The 2014 NEC introduction of new requirements for separating DC and AC power cables only further complicated the unique challenges of cable management that already existed in the solar industry. The SolarPro article, Petitioner’s EX1011, further expresses concerns with the need for solar wire management techniques to comply with NEC requirements. For example, one industry expert complains that “[b]esides squirrels, the biggest issue we face is a “recreate the wheel” approach at every site as we strive to meet *NEC* requirements while installing systems that will last 25 years.” EX1011, at 4.

68. The author also discusses concerns from a senior research engineer at the Institute for Energy and the Environment that even literal compliance with NEC requirements for spacing of supports such as hangers to support PV cables could be insufficient to protect against damage to PV conductors in certain weather conditions. *Id.*, at 7 (expressing concern that in windy conditions, the specified spacing “would be inadequate to prevent conductor motions that would abrade the insulations over time”). The author of the article concludes that while compliance

with the NEC “provides a good baseline for wire management,” additional steps must be considered “to provide a safe and reliable installation.” *Id.*, at 8.

69. All of these challenges and concerns discussed by the SolarPro article only increased the need for innovative solutions for cable management in solar installations.

V. OVERVIEW OF THE ‘291 PATENT

70. The ‘291 patent was filed on June 16, 2021, and issued to CAB, as the assignee, on May 31, 2022. The ‘291 patent names Allen Garrett Smith, Frank Edward Hodge, David James Prasko, and Timothy Joseph Wedding as the inventors. EX1001.

71. Set forth below are exemplary independent claims 1 and 6 at issue in this IPR:

1. A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:
 - a messenger wire structured to be supported a distance above the ground; and
 - a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables, wherein adjacent cable carrying surfaces of the plurality of cable

carrying surfaces are separated by a cable carrier divider.

* * * *

6. A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:

a messenger wire structured to be supported a distance above the ground; and

a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables, wherein each cable hanger of the plurality of cable hangers comprises:

a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon;

outermost lateral spaced apart opposing sides forming the boundary of said hanger;

opposite shoulders extending toward each other from said spaced apart opposite sides, each of said shoulders having an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire.

EX1001, 10:24-37; 10:49-67.

72. The ‘291 patent claims priority from U.S. Patent Application No. 14/556,117, filed on November 29, 2014, and which issued as U.S. Pat. No. 9,722,405. While the specification of the ‘291 patent discusses cable hangers, methods of using hangers, and systems utilizing cable hangers in organizing various electrical cables, the claims of the ‘291 patent are directed to systems and methods of *organizing electrical cables extending from solar panels*. EX1001, 10:24-13:8 (emphasis added).³

73. With respect to the solar industry, the Background of the Invention Section of the ‘291 patent specification discusses the “need for electrical cables to extend from a power or signal source to a location of application.” *Id.*, 1:20-22. In describing the types of electrical cables and other wires utilized in solar plant installations, the ‘291 patent states that “[i]n solar plants, direct current wires attach first to the solar panels and then run to combiner boxes before extending further to power inverters. In addition, alternating current power cables are used to

³ In addition to independent claims 1 and 6 reciting a system for organizing electrical cables extending from solar panels, independent claims 14 and 19 also recite solar plants with a plurality of solar panels and a plurality of electrical cables extending from the plurality of solar panels, and a system for organizing the plurality of electrical cables extending from the plurality of solar panels.

power the motors that control the trackers, devices that rotate the solar panels to follow the sun in order to obtain maximum power during daylight hours.” *Id.*, 1:25-31 (emphases added).

74. The ‘291 patent states that in solar power plants “there are various sized wires and bundles of wires with an almost unlimited variety of wire bundle sizes.” *Id.*, 1:57-59.

75. The ‘291 patent specification further states that “[i]n a solar plant there is a recent move to tracker systems which utilize more wiring than previously fixed in place systems.” *Id.*, 2:1-3. The patent also notes the harsh environmental conditions, including the “stifling heat of the desert where solar power plants are usually located [which can reach 120 degrees F].” *Id.*, 2:37, 49-50.

76. As discussed above in my overview of the relevant technology (Section IV), prior to the priority date of the ‘291 patent, cable management of electrical cables extending from solar panels to the combiner boxes and power inverters in solar installations utilized direct burial cables, cables in conduit, or metal wire trays.

77. Notably, as discussed in the ‘291 patent:

Prior to 2014, AC and DC cables could be bundled immediately adjacent to, and touching, one another in a wire management system for the solar panels. In the new National Electric Code of 2014, the AC and DC cables must not be immediately

adjacent to one another, but must have a degree of separation from one another. Power carrying cables have a tendency to induce errors or interfere with the signal wires that are located in close proximity to them. This new requirement also applies to other applications outside the solar power industry, such as the mining and electrical industries.

Id., 1:32-42.

78. The '291 patent further explains:

Because of the increased use of trackers in solar power plants, there is increased use of category five cables and other data wiring. This type of control wiring is used to give power plant operators feedback from the solar power plant array on what angles the panels are stationed, and what the proper angle should be to maximize power output from the sun. This data and information is constantly monitored to obtain maximum power output from the thousands of solar panels in the solar power plant. The type of wiring used in collecting data is sensitive to cables used for AC and DC power and because of that sensitivity, data wiring cannot be bundled with power cables and must be supported by a separate carrier that is at least one inch away from all power cables.

Id., 1:43-56.

79. The '291 patent states that “[b]ecause of [the] changes [to the NEC], the wire management systems are much more complex, especially given the vast number of wires involved in a utility scale solar power plant.” *Id.*, 2:6-9.

80. The '291 patent, therefore, provides for an improved cable management system that addresses these challenges.

81. Claim 1 of the '291 patent claims a system for organizing a plurality of electrical cables extending from a plurality of solar panels. As claimed, a plurality of cable hangers are structured to support the plurality of electrical cables, each hanger having multiple cable carrying surfaces separated by a cable carrier divider, and further structured to be disposed along, and suspended from, a messenger wire. The claimed system is shown in an exemplary embodiments depicted in Fig. 1 and annotated versions of Fig 2 of the '291 patent, below. The system shown in annotated Fig. 2 includes a messenger wire 12 and a plurality of cable hangers 10 suspended from the messenger wire 12. Annotated Figure 2 also illustrates a plurality of electrical cables positions in side-by-side hanger surfaces separated from each other, as well as a data cable in a separate data carrier loop.

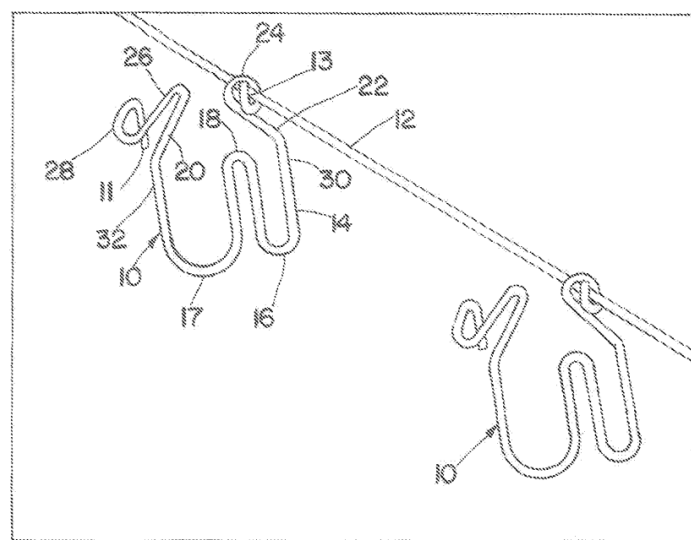


Fig. 1

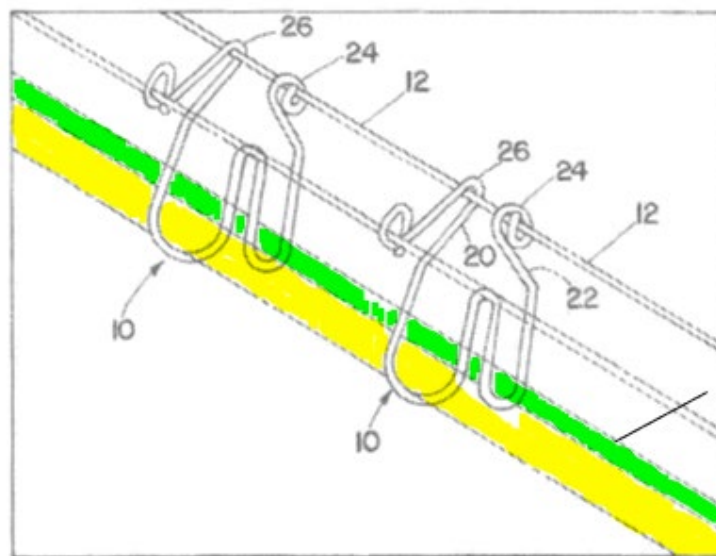


Fig. 2

Id., 5:19-20; 6:50-54; 7:27-41; FIGS. 2, 4.

82. Independent claim 1 recites that each of a plurality of cable hangers has a plurality of cable carrying surfaces, with each cable carrying surface structured to support at least one electrical cable of the plurality of electrical cables extending from a plurality of solar panels. While Figure 2 above shows only one cable in each of two cable carrying surfaces, dependent claims 2-4 the ‘291 patent also claim cable hangers with at least three, four and five cable carrying surfaces, each structured to support at least one of the plurality of electrical cables. *See id.*, 10:38-46; *see also*, e.g., FIG. 23.

83. The ‘291 patent states that “[w]hat is important is that the hanger 10 provides a sufficient separation between both cable carrier formations 16, 17 and a further sufficient separation between the two carriers formations 16, 17, and the

data carrier loop 28” *Id.*, 7:14-17. The systems and methods of the ‘291 patent, therefore, provide for separating a plurality of DC and AC cables extending from solar panels from each other and to be separated from data carrying wires. Providing sufficient separation in this way protects against errors and interference between the wires.

VI. CLAIM INTERPRETATION

A. THE PREAMBLE OF CLAIMS 1 AND 6 IS LIMITING

84. As an initial matter, in my opinion, a POSITA reading independent claim 1 of the ‘291 patent would understand that the language of the preamble is limiting and provides further limitation to claim 1. (The preamble of claim 6 is identical to the preamble of claim 1, and as such, my opinion that the preamble of claim 1 is limiting applies equally to the preamble of claim 6.)

85. Specifically, it is only by reading the language of the preamble that a POSITA would understand that the type of electrical cables organized and separated by the recited cable hangers in the body of the claim are specifically electrical cables *extending from a plurality of solar panels*, which would be those cables in a solar power plant array. This language is critical to a POSITA’s proper understanding of the scope of the invention claimed in the ‘291 patent. Dr. Beik appears to agree that in light of the preamble language, the plurality of electrical

cables recited in claim 1 are limited to the electrical cables extending from solar panels. *See* EX2004, 65:21-67:22, 68:25-69:3.

86. Indeed, the preamble of claim 1 is essential to understand the limitations and claim terms in the claim body, i.e., the preamble confirms that *the* plurality of electrical claims cited in the claim body are the electrical cables extending from solar panels as recited in the preamble. A POSITA can only understand the scope of claim 1 in light of the limitation of the preamble that defines the electrical cables being organized as the electrical cables extending from solar panels.

87. For these reasons, it is my understanding that the preamble of independent claim 1 of the ‘291 patent limits the scope of the claim specifically to organizing a plurality of electrical cables extending from a plurality of *solar panels*.

B. “ORGANIZING A PLURALITY OF ELECTRICAL CABLES EXTENDING FROM A PLURALITY OF SOLAR PANELS” IS PROPERLY CONSTRUED AS

88. As would be understood by a POSITA, and in light of the claim language and the ‘291 patent specification, the term “organizing a plurality of electrical cables extending from a plurality of solar panels,” as recited in independent claims 1 and 14 (and as required by each of the challenged claims)

would have an ordinary and customary meaning, specifically, *separating the electrical cables extending from the solar panels*.

89. As explained in my overview of the relevant technology discussed above and in my review of the ‘291 Patent (Section V), at the time of the invention of the ‘291 patent, the NEC mandated for the first time that “AC and DC cables must not be immediately adjacent to one another, but must have a degree of separation from one another.” EX1001, 1:34-37; *see also id.*, 2:1-9,

90. Further, as stated in the ‘291 patent, “[b]ecause of the increased use of trackers in solar power plants, there is increased use of category five cables and other data wiring [This] type of wiring . . . is sensitive to cables used for AC and DC power and because of that sensitivity, data wiring cannot be bundled with power cables and must be supported by a separate carrier that is at least one inch away from all power cables.” *Id.*, 1:43-56.

91. As set forth above, the ‘291 patent addresses the new requirements of the 2014 NEC to separate DC and AC power cables from each other. The ‘291 patent further addresses the need to separate DC and AC power cables from data wiring. *See* EX1001, 3:58-4:2, 4:63-67, 7:14-17, 10:2-9.

92. Dr. Beik agrees that the ‘291 patent describes its system for organizing electrical cables extending from solar panels as being directed to separating DC from AC power cables and DC/AC cables from data cables to avoid

cross induction and magnetic fluxes that would negatively affect their performance. *See* EX1002, ¶¶32, 41-42; *see also* EX2004, 61:21-63:2.

93. In the same way, a POSITA would understand the ‘291 patent’s “system for organizing a plurality of electrical cables extending from a plurality of solar panels” to be a system for separating the electrical cables extending from the solar panels.

94. In his deposition, Dr. Beik also stated that organizing a plurality of electrical cables extending from a plurality of solar panels as recited in claim 1 means separating DC and AC cables from data cables. EX2004, 86:6-14.

VII. DESCRIPTION OF ASSERTED PRIOR ART

A. CAVENEY

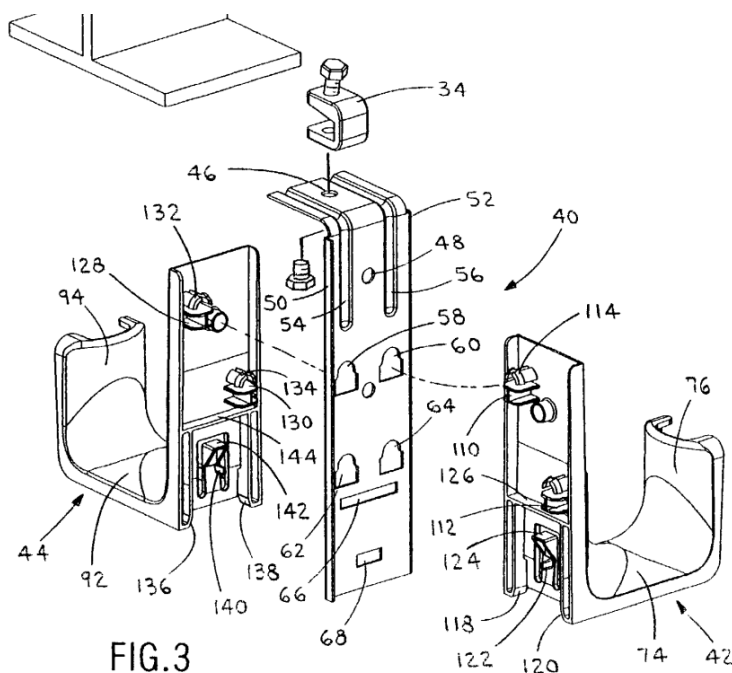
95. U.S. Patent No. 7,520,476 (“Caveney”) issued on April 21, 2009, and is titled “Cable Support System.” EX1003.

96. Caveney, titled “Cable Support System,” issued on April 21, 2009. EX1003. Caveney is directed to “a cable support system, and more particularly, to a multi-tiered system for supporting high-performance cabling.” *Id.*, 1:6-8.

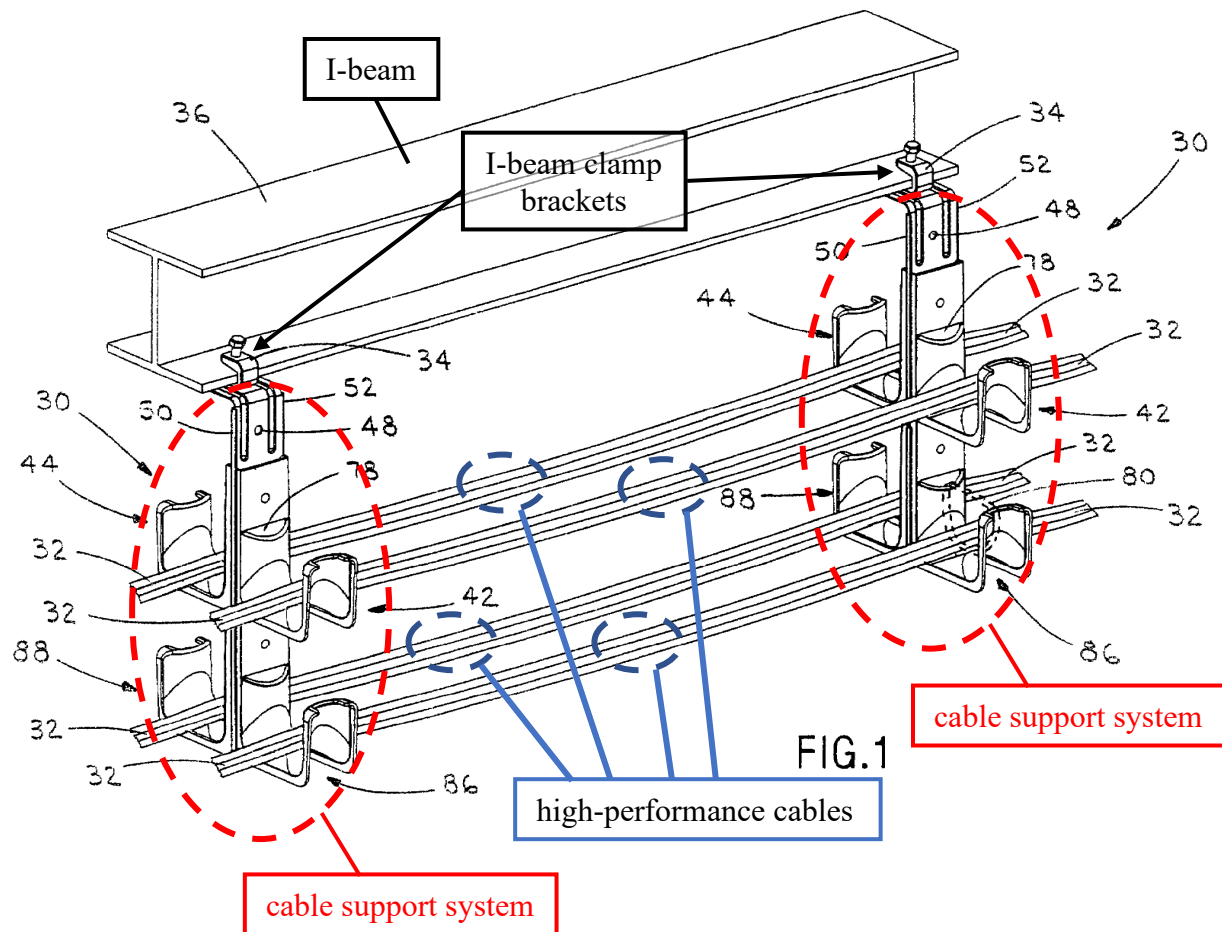
97. Caveney discloses that its cable supports are “secured directly to any fastener or structure” *Id.*, 3:3. The structures specifically disclosed in Caveney are pre-existing building structures, including an I-beam, a ladder rack, a joist, a ceiling or a wall. *Id.*, 2:65-3:9. The fasteners specifically disclosed in

Caveney are an I-beam clamp bracket, a threaded rod, a screw-on beam clamp bracket, a hammer-on beam clamp bracket, a C-purlin bracket, a Z-purlin bracket, a drop wire bracket, a floor support post bracket and a ladder rack bracket. *Id.*

98. Figure 3 of Caveney, reproduced below, illustrates its cable support system.

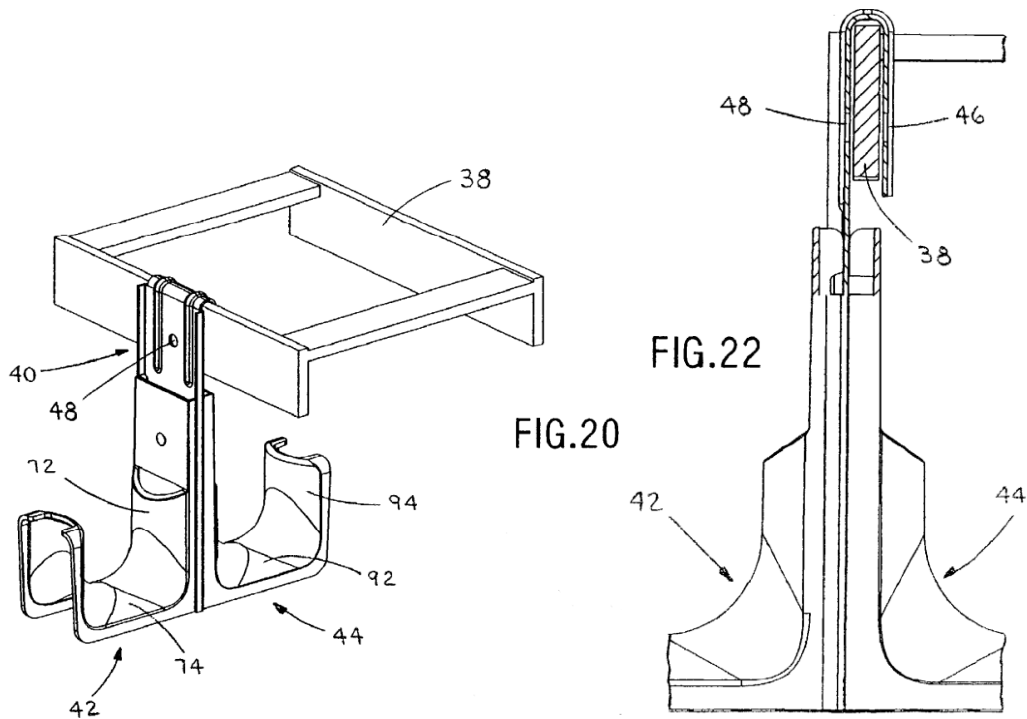


99. Figure 1 of Caveney (an annotated version of which is reproduced below) shows two of the multi-tiered cable support systems 30 secured to an I-beam clamp bracket 34, and the I-beam clamp bracket 34 attached to I-beam 36. *Id.*, 2:65-66; FIG. 1.



Id., FIG. 1 (annotated).

100. Figures 20 and 22 of Caveney, reproduced below, show Caveney's cable support system attached to a ladder rack. As can be seen in Figure 22, the hanger portion of the cable support system includes apertures 46 and 48 for use in securing the hanger plate to a ladder rack. *Id.*, 3:21-25, 5:63-67.



EX1003, FIGS. 20, 22.

B. ALMY

101. U.S. Pub. No. 2010/0139731 (“Almy”) was filed on March 2, 2009 and published on June 10, 2010, and is titled “Wire-Based Hanging Wire-Way for Photovoltaic Modules or Module Groups.” EX1004.

102. Almy describes a “[w]ire-based hanging wire-way for photovoltaic modules or module groups.” *Id.*, at 1, Abstract.

103. In its Background Section, Almy states that “[g]round based power distribution networks require significant cabling between photovoltaic modules or discrete groups of modules” *Id.*, at 8, [0004]. Almy further states that “[t]o meet electrical code, the cabling is usually placed in a metal wire tray or conduit,”

but that “metal wire trays or conduits can be both expensive and cumbersome to build.” *Id.* Thus, “additional improvements are needed in the evolution of photovoltaic systems which include arrays of photovoltaic modules and ground based power distribution networks.” *Id.*

104. Almy discloses only DC cables, and Almy’s wire-based hanging wire-way only supports bundles of DC cables. As explained in Almy’s specification and shown in Figure 6 (reproduced below), bundles of electrical cables extending from each of photovoltaic module groups 602, 604 and 606 (e.g., bundle of electrical cables 612 extending from photovoltaic module group 602) are all connected to combiner box 620, which is coupled to inverter 624. *Id.*, at 11, [0034]. Inverter 624 “combines lines from several combiner boxes and converts DC current to AC current.” *Id.* In other words, all the cables extending from the solar panels in Almy and bundled in Almy’s wire-loops are exclusively DC power cables.

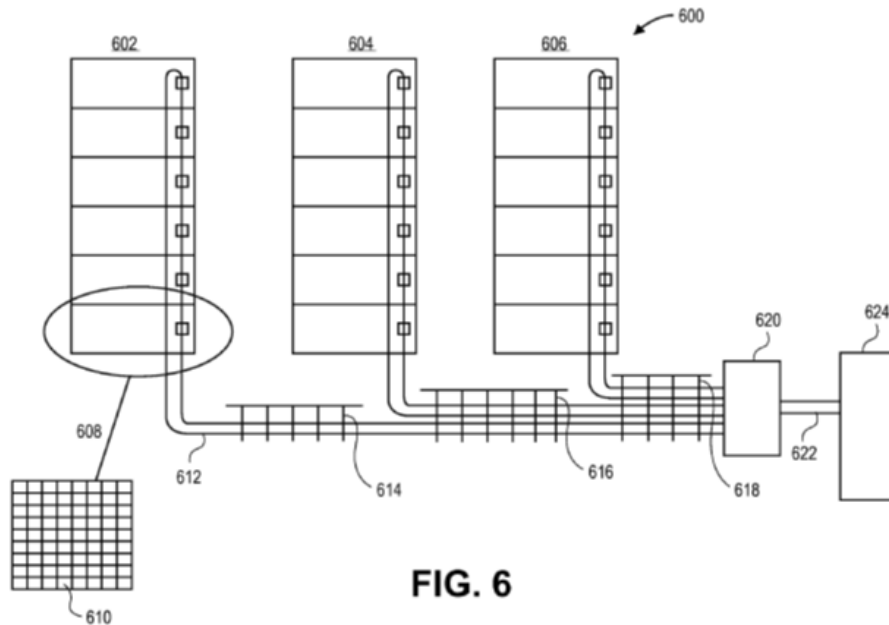


FIG. 6

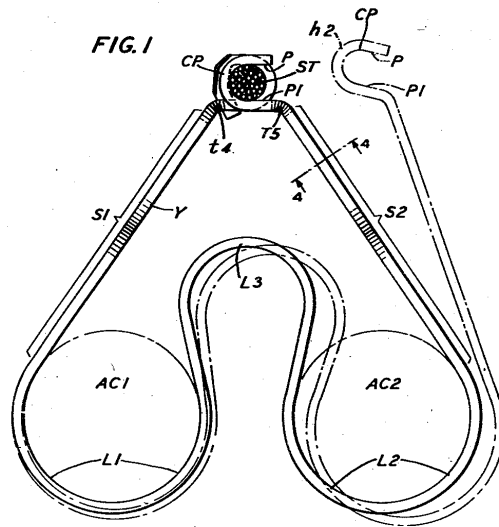
EX1004, at 7, FIG. 6.

C. CARR

105. U.S. Pat. No. 2,384,440 (“Carr”) issued on September 11, 1945, and is titled “Hanger Device.” Carr was assigned to Bell Telephone Laboratories, Incorporated. EX1005, Cover.

106. Carr discloses a hanger device for the purpose of supporting “two parallelly disposed aerial conducting cables” for “carrier transmission,” i.e., telecommunications cables, suspended from a “supporting strand.” *Id.*, at 1:1-7.

107. A hanger taught by Carr is shown in Fig. 1, reproduced below:



Id., FIG. 1.

108. Figure 1 shows Carr's hanger device on a "supporting strand," with one aerial conducting cable in each of the spaced loops of the hanger. *Id.*, 1:36-38.

109. Carr further states that "[t]he object of this invention is the provision of a hanger device of a simple and cheap construction which is capable of supporting two aerial conducting cables in an efficient manner and in large spaced relation to each other so as to minimize the cross induction effect between the cables, a single supporting strand being employed for the two cables." *Id.*, 1:27-34.

110. Carr only discloses "aerial conducting cables" for "carrier transmission" (which are for transmitting voice communications).

**VIII. OPINIONS REGARDING PETITIONER'S ASSERTED GROUNDS
BASED ON 35 U.S.C. § 103**

111. For convenience, I again set forth below exemplary independent claims 1 and 6 at issue in this IPR:

1. A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:

a messenger wire structured to be supported a distance above the ground; and
a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables, wherein adjacent cable carrying surfaces of the plurality of cable carrying surfaces are separated by a cable carrier divider.

* * * *

6. A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:

a messenger wire structured to be supported a distance above the ground; and
a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables, wherein each cable hanger of the plurality of cable hangers comprises:

a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon;

outermost lateral spaced apart opposing sides forming the boundary of said hanger;

opposite shoulders extending toward each other from said spaced apart opposite sides, each of said shoulders having an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire.

EX1001, 10:24-37; 10:49-67.

A. GROUND 1 - CLAIMS 1-5 AND 9-10 OF THE ‘291 PATENT WOULD NOT HAVE BEEN OBVIOUS OVER CAVENEY IN VIEW OF THE KNOWLEDGE OF A POSITA

112. Claim 1 is an independent claim, claims 2-5 and claim 9 depend from claim 1, and claim 10 depends from claim 9.

113. In my opinion, Caveney in view of the knowledge of a POSITA does not render claims 1-5, and 9-10 of the ‘291 patent obvious.

1. Caveney Does Not Disclose the Claimed Messenger Wire or the Claimed Cable Hangers

114. Dr. Beik contends that Caveney discloses “a messenger wire structured to be supported a distance above the ground,” as claimed in the ‘291 patent, because Caveney discloses that its hanger is attached to a “structure,” and a

“structure” in Caveney can include a messenger wire. EX1002, ¶¶59-61. Dr. Beik further states that “a messenger wire is a support system for a cable, and hence a ‘structure’ as contemplated by Caveney.” *Id.*, ¶60. According to Dr. Beik, therefore, Caveney’s could be attached to a messenger just like it could be attached to any other structure disclosed by Caveney.

115. I disagree with Dr. Beik that the “structures” disclosed by Caveney include a messenger wire as claimed in the ‘291 patent.

116. Dr. Beik relies on the language of Caveney’s specification, set forth below:

FIG. 1 shows two multi-tiered cable support systems 30 secured to a fastener, such as I-beam clamp bracket 34. The I-beam clamp bracket 34 is attached to a structure, such as I-beam 36. As shown in FIG. 20, cable support system 30 may be attached directly to a structure, such as ladder rack 38. However, it is likewise contemplated that cable support system 30 may be secured directly to any fastener or structure, including but not limited to a threaded rod, a screw-on beam clamp bracket, a hammer-on beam clamp bracket, a C-purlin bracket, a Z-purlin bracket, a drop wire bracket, a floor support post bracket, a ladder rack bracket, a joist, a ceiling or a wall.

Id., ¶59, quoting EX1003, 2:65-3:9.

117. Dr. Beik contends that this language broadly defines the term “structure” to include virtually any kind of structure whatsoever, and that Caveney

“places no particular importance on the ‘structure’ itself” EX1002, ¶¶ 59-60.

I disagree. Under Dr. Beik’s reasoning, there are no limits to the types of structures contemplated by Caveney.

118. A POSITA would understand from a plain reading of this disclosure in Caveney that the “structures” expressly identified in Caveney are an I-beam, a ladder rack, a joist, a ceiling or a wall. A POSITA would further understand from a plain reading of Caveney that the structures identified in Caveney are all pre-existing structures of a building, to which Caveney’s hangers (that support high-performance cabling) are fastened. And a POSITA would understand that a messenger wire is not a “structure” as contemplated by Caveney. *See* Institution Decision, at 15, 18 and 22.

119. Such an understanding is further supported when reviewing the Laughlin reference (describing Erico’s CableCat™ system) – U.S. Patent No. 5,740,994 (“Laughling”) (EX2002) – that Caveney expressly cites as one of the prior art references over which Caveney purports to be an improvement. EX1003, 1:9-36.

120. Laughlin discloses that “the trend is to install category 5 [cable] for all applications *in commercial buildings*.” EX2002, 1:20-21. Laughlin further discloses that its “supports may be positioned on or suspended from anything or

any surface *in the utilitarian part of a building such as the area above a drop ceiling.*” EX2002, Abstract.

2. Caveney Does Not Disclose a Plurality of Cable Hangers Structured To Be Disposed Along, and Suspended From, a Messenger Wire

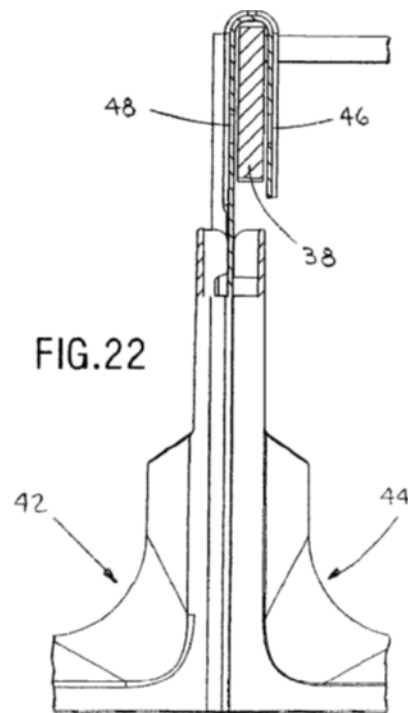
121. Despite the clear disclosure of structures in Caveney, Dr. Beik persists that Caveney’s cable support system, with the use of a “threaded rod,” could be structured to be attached to a messenger wire as easily as to an I-beam or ladder rack.

122. Initially, in his declaration, Dr. Beik appeared to confuse a “threaded rod” as a structure to which a Caveney hanger could be fastened, and seemed to liken a threaded rod to a messenger cable “because both structures have a circular cross-section.” EX1002, ¶60. At his deposition, however, Dr. Beik acknowledged that a threaded rod is not a structure, but a fastener. EX2004, 117:4-8.

123. Now, at his deposition, Dr. Beik seems to offer two different explanations. One explanation is that a messenger wire and threaded rod both have a circular shape, and because apertures 46 and 48 of Caveney’s cable supports are circular holes, they could as readily receive a messenger wire as a threaded rod since a messenger wire and threaded rod both have a circular shape. EX2004, 117:13-20, 119:18-22.

124. The other explanation offered by Dr. Beik is one could simply replace the ladder rack structure with a messenger wire, and use the threaded rod to secure the hook to the messenger wire. 121:17-25.

125. As clearly shown in Figure 22 of Caveney, shown below, apertures 46 and 48 are structured to receive a threaded rod that secures the hook to either side of ladder rack structure 38. Presumably, under Dr. Beik's theory, instead of a threaded rod securing the hook to each side of the ladder rack, a POSITA could simply replace the ladder rack with a messenger wire and use a threaded rod that extends through both apertures 46 and 48, although how exactly a POSITA would do so is far from clear.



EX1003, FIG. 22.

126. It is my opinion that a POSITA would have no reason or motivation to do as Dr. Beik suggests. The idea of Caveney was to use its cable support systems with already existing building structures, which would be more efficient and save cost. It would make no sense to introduce a messenger wire to already existing structures.

127. As such, it is my opinion that Caveney does not disclose “a messenger wire” as claimed in the ‘291 patent, nor does Caveney disclose a hanger structured to be disposed along or suspended from a messenger wire.

128. Dr. Beik opines nothing more than that a POSITA *could* thread a messenger wire through apertures 46 and 48, or that a POSITA *could* replace Caveney’s ladder rack 38 with a messenger wire, and that a POSITA *could* hang Caveney’s cable support system from a messenger wire.

129. Whether a POSITA *could* do as Dr. Beik suggests (and Dr. Beik provides inadequate explanation how a threaded rod could be used to secure the cable support system to a messenger wire), Dr. Beik provides no rational basis as to why a POSITA *would be motivated to do so*. In my opinion, a POSITA would have no motivation to modify Caveney in this way. When asked why a POSITA would do as Dr. Beik suggests, he could only ask in response “why wouldn’t POSITAs” do so. EX2004, 122:9-123:2.

130. For all these reasons, it is my opinion that Caveney does not disclose or render obvious independent claim 1, and, therefore, does not disclose or render obvious dependent claims 2-5 and claim 9 that depend from claim 1, or dependent claim 10 that depends from claim 9.

B. GROUND 2 - CLAIMS 14-18 AND 21-22 OF THE ‘291 PATENT WOULD NOT HAVE BEEN OBVIOUS OVER CAVENEY AND ALMY IN VIEW OF THE KNOWLEDGE OF A POSITA

131. Claim 14 is an independent claim, dependent claims 15-18 and 21 depend from claim 14, and claim 22 depends from claim 21.

132. In my opinion, Caveney and Almy in view of the knowledge of a POSITA does not render claims 14-18 and 21-22 of the ‘291 patent obvious.

1. A POSITA Would Not Have Been Motivated to Combine Caveney and Almy With a Reasonable Expectation of Success

133. At the outset of his analysis in Ground 2, Dr. Beik offers his opinion that a POSITA would have been motivated to replace Almy’s wire loops with Caveney’s cable support system hangers to support Almy’s bundle of electrical cables between photovoltaic modules or module groups in order to prevent cross linking. EX1002, ¶¶ 76-79.

134. For the very reasons discussed above with respect to Ground 1, Dr. Beik offers no explanation with rational underpinnings as to why a POSITA would replace Almy’s wire loops with Caveney’s cable support system hangers. As

discussed above, Caveney's cable support systems are structured to be attached to building structures – rigid, fixed structures such as an I-beam or ladder rack, in order to maximize efficiency by utilizing those pre-existing building structures.

135. As also discussed above, it is not even clear how Dr. Beik suggests a POSITA *could* use Caveney's fasteners to somehow attach Caveney's cable support systems to a messenger wire. Dr. Beik certainly offers no explanation with rational underpinnings as to why a POSITA *would* have been motivated to attempt to use Caveney's cable support system instead of Almy's wire-based hanging wire-way for supporting DC power cables in an outdoor PV installation as described in Almy.

136. While Almy does disclose a messenger wire where Caveney does not, the analysis is no different when applied to Almy's messenger wire rather than the undisclosed messenger wire of Caveney. Caveney's cable support systems are structured to be secured to fixed, rigid building structures by fasteners. They are *not* structured to be secured to a flexible messenger wire. *See* Institution Decision, at 26-27, 28.

137. In short, the combination of Caveney and Almy does not cure the deficiencies of Almy alone.

138. Dr. Beik provides no explanation as to why a POSITA would have been motivated to use Caveney's cable support system (that supports high

performance data cables and attaches to preexisting building structures and frames using fasteners) *instead of* Almy's wire-based hanging wire-way for supporting DC power cables in an outdoor PV installation described in Almy.

139. I further disagree that a POSITA would have been motivated to replace Almy's wire loops with Caveney's cable support systems in order to prevent cross-linking by separating different kinds of cables such as data and current-carrying cables. EX1002 ¶¶ 76-79.

140. As discussed more fully below with respect to Ground 3, the Carr and Almy combination, there is no need to separate Almy's bundle DC cables, because there is no cross linking or cross induction effect between DC cables.

2. The Combination of Caveney and Almy as Asserted by Dr. Beik Does Not Disclose the Limitations of Independent Claim 14

141. Regarding the limitations of claim 14, Dr. Beik only relies on Almy to disclose the limitations "a solar plant," "a plurality of solar panels" and "a plurality of electrical cables extending from the plurality of solar panels" recited in independent claim 14. EX1002, ¶¶ 80-85. For all other limitations, Dr. Beik relies solely on Caveney and on his analysis set forth in his Ground 1 of how Caveney renders obvious those limitations. *Id.*, ¶¶ 86-89.

142. Specifically, for the limitations "a system for organizing the plurality of electrical cables," "a messenger wire supported a distance above the ground

adjacent the solar panels,” Dr. Beik relies on Caveney, not Almy, to disclose those limitations, incorporating his analysis set forth in his Ground 1. *Id.*, ¶¶86-87.

Similarly, for the limitations relating to the claimed plurality of cable hangers, with each cable hanger having a plurality of cable carrying surfaces structured to support the electrical cables, Dr. Beik relies only on Caveney for these limitations, again relying solely on his analysis of these limitations set forth in his Ground 1. *Id.*, ¶¶88-89.

143. In other words, for the claimed system for organizing a plurality of electrical cables from a plurality of solar panels in independent claim 14, Dr. Beik rests on his analysis in Ground 1 that Caveney discloses the same system claimed in independent claim 1, which parallels the claimed system in independent claim 14. *See* EX1002, ¶86.

144. For all the same reasons discussed above in connection with Ground 1 that Caveney does not disclose or render obvious the system claimed in independent claim 1, it is equally my opinion that Caveney does not disclose or render obvious the claimed system for organizing a plurality of electrical cables extending from a plurality of solar panels in independent claim 14.

145. Dependent claims 15-18, 21 and 22 all depend directly or indirectly from independent claim 14. Dr. Beik and Petitioner rely solely on Caveney for disclosing or rendering these claims obvious. EX1002, ¶¶90-95; *see also* Petition,

at 41-42. For the reasons stated above relating to independent claim 14, it is my opinion that Dr. Beik and Petitioner have not shown that Caveney discloses or renders obvious the limitations of these dependent claims.

146. Accordingly, it is my opinion that Petitioner and Dr. Beik have not offered any support for how Caveney and Almy in view of the knowledge of a POSITA would render claims 14-18, and 21-22 of the '291 patent obvious.

C. GROUND 3 - CLAIMS 1-10, 14-22 AND 24-25 OF THE '291 PATENT WOULD NOT HAVE BEEN OBVIOUS OVER CARR AND ALMY IN VIEW OF THE KNOWLEDGE OF A POSITA

147. Claim 1 is an independent claim and dependent claims 2-5, as well as claims 8 and 9, all depend from claim 1. Claim 10 depends from claim 9. Claim 6 is an independent claim, and dependent claim 7 depends from claim 6. Claim 14 is an independent claim, and dependent claims 15-18, as well as claims 20 and 21, all depend from claim 14, and claim 22 depends from claim 21. Claim 24 is an independent claim, and dependent claim 25 depends from claim 24.

148. As with the combination of Caveney and Almy in Ground 2, Dr. Beik begins his analysis in Ground 3 by offering his opinion as to why a POSITA would have been motivated to combine Carr's cable hanger with Almy's wire-based hanging wire-way for supporting a bundle of electrical cables between photovoltaic modules or module groups. EX1002, ¶¶96-99; *see also* Petition, at 45-47. I disagree with Dr. Beik's opinion.

149. Dr. Beik opines, and the Petitioner asserts, that a POSITA would have been motivated to *replace* Almy's wire loops with Carr's hangers. I disagree.

150. According to Dr. Beik, "[c]ombining the teachings of Carr and Almy would have involved routine implementation, would have posed no technical risk given their complementary teachings, and would have achieved predictable benefits of improving wire runs in solar installations by separating conductors and implementing a more robust hanger." *Id.* at ¶ 98.

1. A POSITA Would Not Have Been Motivated to Combine Carr and Almy for the Purpose of Preventing Cross-Induction

151. For the ostensible "improvement" of "separating conductors," Dr. Beik opines that "separation of different types of cables such as data from current-carrying cables would pose significant challenges when using wire loops." Dr. Beik further contends that "wire loops are not able to provide the required distance between sets of cables for both current-carrying and non-current-carrying to prevent cross linking as set forth by IEEE Standard 142, and NEC Rule 235G." *Id.*

152. Dr. Beik then states that Carr teaches that "there is a benefit to multi-surface hangers to minimize the cross induction effect between the cables. The spaced multi-surface approach is also advantageous for separating data cables from current-conducting cables." *Id.* at ¶ 99 (quotations and citations omitted); *see also* Institution Decision at 31-32.

153. In my opinion, a POSITA would have no motivation to combine Carr and Almy to replace Almy's wire loops with Carr's hangers to prevent the cross-induction effect between the cables disclosed in Almy. In fact, there would be no need to separate Almy's cables, because there would be no cross induction effect between Almy's cables.

154. As explained above in my overview of the Almy reference, a POSITA would understand that the electrical cables disclosed in Almy are DC power cables that attach to and extend from the PV modules to the combiner box or that extend from the combiner box to the inverter. A POSITA would also readily understand that none of the depicted electrical cables in Almy are AC power cables or data cables within a PV array.

155. Specifically, as explained in connection with Figure 6 (reproduced below), "[e]ach photovoltaic module group 602, 604, and 606 has an associated electrical cable or bundle of electrical cables, e.g., bundle of electrical cables 612 associated with photovoltaic module group 602." *Id.*, at 11 [0034].

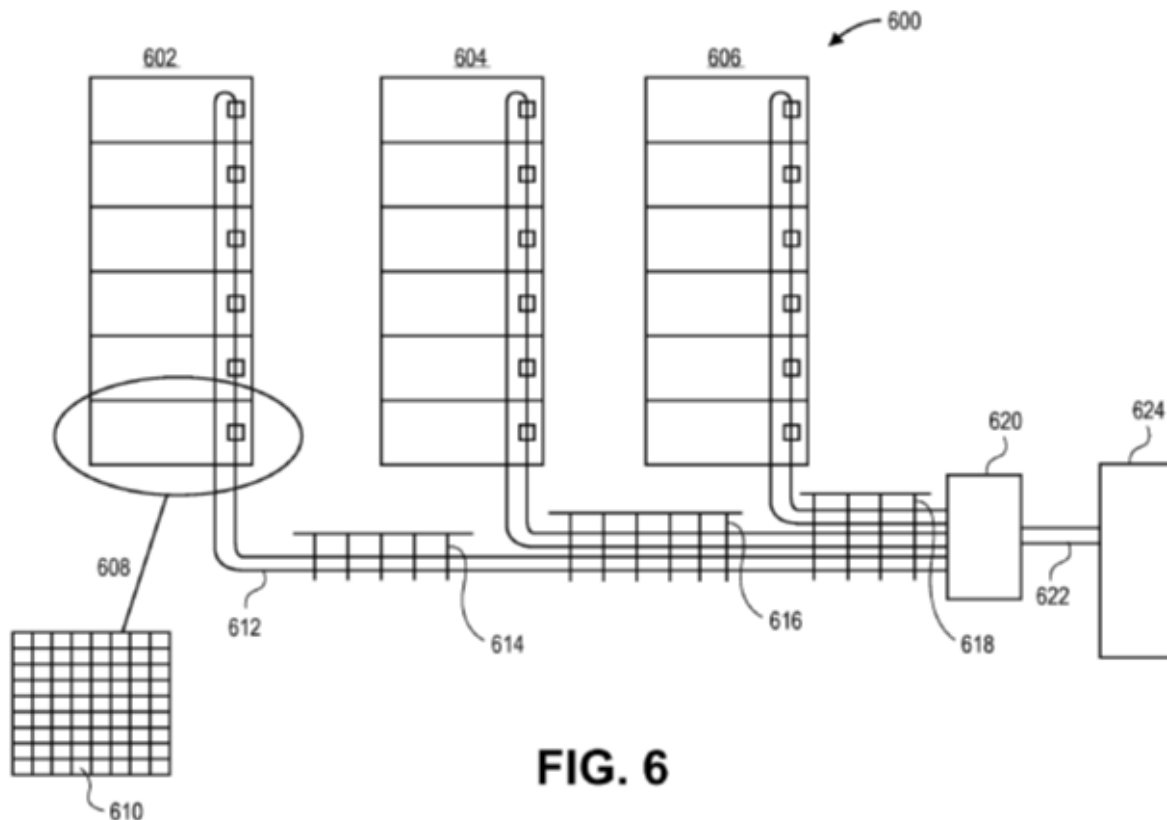


FIG. 6

EX1004, FIG. 6.

156. As shown in Figure 6, the unnumbered DC wires above DC bundle 612 connect to the solar cells of each of the various PV modules within the PV module group 602. The PV modules are connected in series. The bundle of electrical cables 612 are DC collectors of the aggregated DC power from photovoltaic module group 602. This is the same DC power collection process for each of the PV module groups 602, 604 and 606.

157. Further, “[t]he electrical cable or bundle of electrical cables [from] each photovoltaic module group 602, 604, and 606 is suspended in a plurality of

wire-based hanging wire-ways, e.g., wire-based hanging wire-ways 614, 616 and 618 in FIG 6.” *Id.*

158. Next, “[t]he electrical cables from photovoltaic module groups 602, 604 and 606 are collected in combiner box 620 which connects the electrical cables in parallel. A high current line 622 couples combiner box 620 with an inverter 624 . . . and **converts DC current to AC current.**” *Id.* (emphasis added).

159. A POSITA would understand that Almy’s electrical cable or bundle of electrical cables associated with each photovoltaic module group and suspended in a plurality of Almy’s wire-based hanging wire-ways system are **DC** power cables. A POSITA would also understand that the cables 622 output from combiner box 620 and input to inverter box 624 are also **DC** power cables only. In short, a POSITA would understand that the only type of cables disclosed by Almy that are bundled in Almy’s wire-way and wire loop system are DC cables. Indeed, Dr. Beik agrees that the cables extending from the PV module groups in Almy are “[l]ikely not AC.” EX2004, 148:9-14.

160. Further, Almy does not disclose any other types of wires, including AC cables or data wires, within Almy’s solar field array. Almy discloses a “rigid bar drive strut.” *See* EX1004, [0003], [0015]. A POSITA would understand from FIG. 3 that the tracker is driven by a rigid bar drive strut. A POSITA would also understand that the “rigid bar drive strut” disclosed in Almy and used to drive the

PV module tracker in FIG. 3 is controlled by a motor that is powered by electrical cables that may include AC or DC power cables. A POSITA would further understand, however, that these cables that power the motor, whether they be DC or AC, are not within the solar field array, but rather are on the periphery of the array, and that any such DC or AC power cables do not extend adjacent to or in close proximity to the DC power cables in the array as shown in Almy FIG. 6. Thus, a POSITA would understand that Almy does not disclose AC power cables within the solar field array that would risk any kind of cross induction effect with the DC cables.

161. Further, nothing in Almy discloses or even suggests the use of data carrier cables. This is not surprising given the date of Almy's application in 2009.

162. Therefore, a POSITA would understand that Almy discloses only DC power cables and that Almy's wire-way system supports exclusively bundles of DC power cables between photovoltaic modules or module groups. Indeed, Dr. Beik acknowledged that it "would not be normal practice" to bundle different kinds of cables in Almy's wire loops. EX2004, 150:4-7.

163. Of primary significance, a POSITA would understand that Almy's bundles of DC power cables ***do not raise the cross-induction concerns*** such as disclosed by Carr. As Dr. Beik has acknowledged, there is no cross-induction effect between only DC cables that are bundled together as in Almy. EX2004,

84:25-85:2; 154:12-19. As Dr. Beik has further acknowledged, cross induction occurs when current-carrying cables have a “significantly stronger magnetic field due to the higher current *than data or controls or sensors and so on.*” EX2004, 85:23-86:2. There would not be any disparity of current that would result in stronger magnetic fields between Almy’s DC cables.

164. I note that Dr. Beik refers to “transients,” what I would refer to as harmonics, from power electronic devices such as inverters when converting DC current to AC current. EX2004, 81:13-82:7. Dr. Beik states that these transients that could be “seen” by the DC cables and induce cross induction. *Id.*, 81:16-19.

165. First, Dr. Beik’s discussion of the possibility of transients in the DC cables is a theoretical discussion, but not a practical one. As a POSITA would appreciate, power inverters in solar arrays are designed and constructed in such a way as to ensure that there are no harmonics that would affect the DC cables, for example, by using electrical power filters. Indeed, in his deposition, Dr. Beik acknowledged that such filters “remove harmonics unwanted harmonics from distribution grids, transmission grids, generation, end users and so on.” EX2004, 30:3-7. A POSITA would readily understand that the inverter in Almy is of a typical type in a solar power system, properly constructed with the use of filters that would protect against any harmonics affecting the operation of DC cables.

166. In addition, separate and apart from the fact that filters would protect against transients or harmonics, Dr. Beik made clear later in his deposition that even if there was a potential cross induction effect because of transients or harmonics, the cross induction effect would not be between the DC cables themselves, but only *between DC cables and data cables*. EX2004, 153:22-154:3. As such, Dr. Beik's entire hypothetical discussion of transients is still only relevant to the separation of DC cables from data cables, not the separation of DC cables only. Ultimately, Dr. Beik has confirmed, consistent with my opinion, that if the cables in Almy's wire loops are only DC cables, there is no need to separate them to prevent cross induction. EX2004, 154:4-19; *see also id.*, 65:3-20.

167. Thus, contrary to Dr. Beik's assertion at ¶ 98 of his declaration, a POSITA would have had no motivation to replace Almy's wire loop with Carr's hanger to reduce cross induction, since there would be no cross induction between Almy's DC cables.

168. In addition to issues relating to cross-induction, Dr. Beik's testimony regarding separation of cables for maintenance purposes is equally irrelevant. As Dr. Beik testified, any such maintenance issues would relate to the separation of different types of cables, for ease of installation and maintenance *See* EX2004, 63:22-25; 65:12-15. In other words, according to Dr. Beik, separating the different types of cables would allow for easier installation and maintenance by having the

cables segregated and being able to more readily identify the different types of cables.

169. However, because Almy discloses only DC cables, any such ease of installation and maintenance issues are also not relevant to Almy, just as preventing or minimizing cross-induction effect is irrelevant.

2. A POSITA Would Understand That Replacing Almy's Wire Loop With Carr's Hanger Would Not Result In a More Robust Hanger

170. In addition, I also disagree with Dr. Beik's opinion that a POSITA would have been motivated to replace Almy's "wire loops" with Carr's "more robust hanger." According to Dr. Beik, "[a] POSITA would have recognized the disadvantages of using wire loops to suspend conductors from a messenger wire . . . [as] [b]undling cables with zip-ties, cable-ties, or other lashings *such as wire loops* provide temporary solutions but cannot be used permanently in power systems . . . [and because] [a] POSITA would have known that the ties, if plastic may melt during high short circuit currents or fires, have limited capacity for supporting weight, and will deflect over time even if they are made of metal." EX1002 at ¶ 98; *see also* Institution Decision at 31-32.

171. First, contrary to Dr. Beik's assertion that Almy's wire loops are in the same category as zip-ties and cable-ties, Almy teaches that its wire loops are an improvement over zip-ties and cable-ties, and are intended to replace the use of

“wire-ties” for bundling DC power cables. *See, e.g.*, EX1004, [0003] (background discussion of the 2007 Nellis Air Force Base photovoltaic system in which “a rigid bar drive strut was used to support bundled electrical cables with wire-ties attached to the rigid bar drive strut”); 9, [0015] (“In accordance with an embodiment of the present invention, a wire-based hanging wire-way is flexible, providing more range of motion and compatibility with on-site customizable support than, say, a rigid bar drive strut having wire-ties coupled thereto.”)

172. Moreover, a POSITA would have no reason to replace Almy’s wire loops that support bundles of DC power cables with Carr’s hanger device made of “a simple and cheap construction” for “supporting two aerial conducting cables” i.e., two telecommunication cables, so as to provide a more robust hanger.

EX1005, 1:27-30. A POSITA would understand that Carr, which was assigned to Bell Telephone Laboratories, discloses a hanger for the purpose of supporting a single pair of telecommunications cables., *See* EX1005, 1:4-6. Further, Carr’s hanger device is made of “a simple and cheap construction which is capable of supporting two aerial conducting cables . . .” (*id.*, 1:28-30) (i.e., telecommunication cables). A POSITA would understand that such telecommunication cables are much lighter than the bundles of DC power cables in Almy. In my opinion, given the use of Almy’s wire-based hanging wire-way for bundling and supporting much heavier

DC power cables, a POSITA would have realized that Almy's wire loops are more robust than Carr's hanger.

173. I disagree with Dr. Beik's conclusory statement that "[c]ombining the teachings of Carr and Almy would have involved routine implementation, would have posed no technical risk given their complementary teachings, and would have achieved predictable benefits" EX1002 at ¶ 98. Dr. Beik provides no explanation with any rational underpinnings how Carr's hanger could be routinely implemented to bundle and support Almy's much heavier DC cables.

174. Accordingly, in my opinion, Dr. Beik has not provided any rational reason as to why a POSITA would have been motivated to combine Almy and Carr to arrive at the invention recited in claims 1-10, 14-22, and 24-25 of the '291 patent, let alone with a reasonable expectation of success in doing so.

IX. SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

175. I have been advised that any objective evidence of non-obviousness ("secondary considerations") must be considered in assessing whether the claimed invention of the '291 patent would have been obvious at the time that the claimed invention was made. I also understand that the purpose of secondary considerations is to prevent a hindsight analysis of the obviousness of the claims.

176. I have been advised that there are several factors that may be considered as secondary considerations of non-obviousness. These factors include

the commercial success of the invention, industry praise for the invention, copying of the invention, skepticism of the invention, and any long-felt need that the invention solved.

177. Dr. Beik states that he is not aware of any secondary considerations that would weigh against the alleged obviousness of the '291 patent claims. EX1002, ¶¶172-173. I disagree.

178. As I explain in further detail below, CAB's Standard System for solar cable management satisfied a long-felt, but unresolved, need in the industry. Further, CAB's Standard System overcame industry skepticism, achieved commercial success, received widespread industry praise, and has been the subject of copying. In my opinion all of these secondary considerations are directly attributable to the features of the invention claimed in the '291 patent.

179. Therefore, in my opinion, secondary considerations demonstrate the non-obviousness of the challenged claims of the '291 patent.

A. CAB IS ENTITLED TO A PRESUMPTION OF NEXUS SINCE ITS COMMERCIAL PRODUCTS AND SYSTEMS ARE COEXTENSIVE WITH THE CLAIMS OF THE '291 PATENT

180. I have been informed that in order for evidence of secondary considerations to be significant, there must be a nexus between the claimed invention and the evidence of secondary considerations. I also understand that nexus is presumed upon a showing that CAB's commercial products and systems

are embodiments of the invention claimed in the '291 patent and are coextensive with the claimed features.

181. I understand that, for solar power plant installations, CAB sells its Standard System for solar cable management, which includes mid-pier kits, end-pier kits, galvanized steel messenger wire, and cable hangers of various configurations for supporting and separating various electrical cables within a PV array.

182. I have analyzed CAB's Standard System and, in my opinion, CAB's Standard System is coextensive with at least independent claims 1 and 6 of the '291 patent. I have prepared and appended to this declaration as Appendix A a claim chart mapping the limitations of independent claims 1 and 6 of the '291 patent to CAB's Standard System.

183. In preparing EX2040, I personally accessed the CAB Solar website and pulled various photographs of CAB's Standard System from the photo gallery. All photos obtained from CAB's website and included in EX2040 are true and accurate copies of the photos as they appear on CAB's website as of the date of last access as indicated in EX2040.

184. I also obtained directly from CAB a copy of CAB's Installation Guide, revised 01-28-2022. EX2041. The Installation Guide includes instructions for the installation of CAB's Standard System as well as various photographs of

CAB's installed systems. All content, including photographs, taken from CAB's Installation Guide and included in EX2040 are true and accurate copies as they appear in the Installation Guide.

185. I also have consulted and reviewed a CAB customer bid request for a Standard System and CAB's quote for a Standard System. EX2042. I have included component part numbers for CAB's Standard System in my claim chart.

186. I have also consulted and reviewed an Authorization to Mark from Intertek issued August 4, 2023. EX2043.

187. My claim chart, EX2040, is all based on information derived directly from the CAB website and from EXs2041-2043.

188. Exemplary CAB product part numbers that constitute its Standard System include [REDACTED] (messenger wire); [REDACTED] (end-pier attachment kit); [REDACTED] (mid-pier attachment kit); [REDACTED] and CAB-9303 (cable hangers). EX2042.

189. Specifically in connection with claim 1 of the '291 patent, as shown in the claim chart, CAB's Standard System comprises a system for organizing a plurality of electrical cables extending from a plurality of solar panels. The annotated photographs in the claim chart shows an exemplary CAB Standard System that organizes a plurality of electrical cables extending from a plurality of solar panels, with the plurality of electrical cables supported and organized by a

plurality of solar cable hangers disposed along and suspended from a messenger cable that is supported a distance above the ground and that runs parallel to the plurality of electrical cables. App. A, at A1-A2.

190. The annotated photographs show a messenger cable in the CAB Standard System that is structured to extend parallel to the electrical cables, and further structured to be supported a distance above the ground, together with a plurality of cable hangers that support a plurality of the electrical cables extending from the plurality of solar panels and that are suspended from the messenger cable. *Id.*

191. The messenger cable in CAB's Standard System is structured to be supported a distance above the ground by using end-pier kits and mid-pier kits to couple the messenger cable to a plurality of spaced supporting piles. *Id.*, at 2-4.

192. Further, as shown in the annotated photographs in the claim chart, CAB's Standard System comprises a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire. *Id.*, at 5-6.

193. The hangers in CAB's Standard System have a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one of the plurality of electrical cables extending from the plurality of solar panels in a solar plant. The annotated photographs in the claim chart show examples of CAB's cable hangers having a plurality of cable carrying surfaces, each cable

carrying surface supporting at least one electrical cable of the plurality of electrical cables. Further, as annotated in the photographs in the claim chart, CAB's cable hangers included in its Standard System include cable carrier dividers separating adjacent cable carrying surfaces. *Id.*

194. In connection with claim 6 of the '291 patent, the annotated photographs in the claim chart show exemplary CAB cable hangers in its Standard System likewise disposed along and suspended from a messenger wire and having a plurality of cable carrying surfaces that are structured to support at least one electrical cable of the plurality of electrical cables extending from solar panels in a PV array. *Id.*, at 6-10.

195. Further, the annotated photographs in the claim chart show that the cable hangers are comprised of a high tensile strength wire with opposing ends and forming a plurality of U-shaped configurations and in which the outermost lateral opposing sides form the boundary of the hanger. *Id.*, at 11-14.

196. In addition, the CAB cable hanger includes opposing shoulders extending toward each other, which have an arrangement to engage and securely hold the hanger on the messenger wire. *Id.*

197. Accordingly, in my opinion, CAB's Standard System is coextensive with at least claims 1 and 6 of the '291 patent.

**B. CAB’S STANDARD SYSTEM FOR SOLAR CABLE
MANAGEMENT MET A LONG-FELT INDUSTRY NEED**

198. I have been advised that a long-felt industry need that is resolved by the claimed invention can provide persuasive evidence of non-obviousness. In my opinion, CAB’s Standard System for solar cable management addressed such a long-felt need.

199. As noted above in my overview of the relevant technology (Section IV), the unique nature of power collection and aggregation in solar PV facilities present novel constraints and challenges in wire and cable management and organization that do not exist in other fields. These challenges include, for example, aggregating and collecting power in a PV array “string” of modules, transmitting power output to string combiners and on to inverters in PV output circuits – all utilizing hundreds if not thousands of lengthy electrical cables. In addition, the increased usage of AC-powered solar tracking devices and data wires for collecting information from the array and monitoring the operation of the solar plant only increase the need for proper management and organization of these various types of cables in an economical, safe, and code-compliant manner that does not interfere with the operation of the solar panels.

200. As the size scale, number of solar projects grew exponentially in the 2000-2010 time-period, the high costs of materials, supply chain logistics, installation, and maintenance of using older methods of cable management, such as

trenching and metal wire trays, became increasingly non-viable and called for needed innovation in developing improved and more efficient cable management systems.

201. Trenching and direct burial of cables were the conventional methods of cable management as PV output circuits were added along the path to the inverter. The tradeoff between direct burial (without conduit) and laying conduit often related to site soil conditions, such as the likelihood of sharp rocks abrading the cable. Direct burial was cheaper, but more prone to cable failure and once in place could not be easily maintained or replaced. In addition to being labor intensive, trenching also presented logistical issues and delays as open trenches impeded access of construction vehicles within the array.

202. Cable trays were not considered a viable long-term solution as they were expensive and cumbersome to build and were difficult to utilize in a manner that matched the geography and necessary flexibility in large PV arrays.

203. Many of the unique challenges in solar PV array cable management at the time of the invention claimed in the '291 patent were discussed in an article from early 2013 in a leading trade industry publication, SolarPro Magazine, entitled "PV Array Wire Management." EX1011.

204. According to the article, in 2013, "designers and installers face[d] persistent challenges to managing free-air conductors within the PV array," and

“[i]mplementing a safe, reliable and *Code*-compliant wire management system for exposed PV conductors [was] not an easy task.” *Id.*, at 1-2.

205. The author of the article further stated that “[w]hile securing array wiring seems like it should be a straightforward exercise, the reality is that integrators continue to face numerous challenges.” *Id.*, at 2.

206. Further “[c]oupled with the harsh environmental conditions that PV array conductors are exposed to – UV radiation, high winds and extreme ambient temperatures, and ice, snow and other debris – wire management continue[d] to be the *Achilles heel* of the majority of PV installations” as late as 2013. *Id.* (emphasis added).

207. The SolarPro article further expressed the need for solar wire management techniques that complied with NEC requirements. For example, one industry expert complained that “[b]esides squirrels, the biggest issue we face is a “recreate the wheel” approach at every site as we strive to meet *NEC* requirements while installing systems that will last 25 years.” EX1011, at 4.

208. The solar industry’s long-felt need for improved cable management is also reflected in the declaration of Allen Smith submitted in support of CAB’s Patent Owner Response. For example, in his declaration, Mr. Smith recounts his discussions with a leading solar company in 2012 about the possibility of

expanding CAB's cable hanger product line for application in the solar industry.

EX2006, ¶ 13.

209. Consistent with my knowledge of the evolution of cable management in the solar industry, Mr. Smith likewise explains that prior to CAB's above-ground messenger wire-supported cable management system, the solar industry's primary method of cable management was burying electrical cables underground in trenches, which was expensive and labor intensive, and to a lesser extent, the usage of cable trays, which were also expensive and did not provide the necessary flexibility to meet the needs of utility-scale solar installations. EX2006, ¶¶ 28-30.

210. Likewise, Bill Brooks, in his declaration in support of CAB's Patent Owner Response, recounts the evolution of the solar industry and the significant increase in electrical cables within solar PV arrays. Ex2033 at ¶¶39-40. Mr. Brooks also states that at the time of the invention, there was an industry need to properly manage and organize the various types of electrical cables in a solar array in a cost-effective and code-compliant manner. *Id.* at ¶¶ 41-42.

211. Messrs. Mitchel Bowman and Bill Novak, individuals with knowledge and experience in identifying and implementing alternative and innovative technologies in the solar industry, including cable management systems, have also submitted declarations in support of CAB's Patent Owner Response, noting the

long-felt solar industry need for improved cable management solutions. *See* EX2028 at ¶¶ 27-30, 32; EX2059, ¶¶ 43-49.

212. Thus, it is my opinion that the claimed invention of the ‘291 patent, as commercialized by CAB’s Standard System for cable management in solar installations, satisfied a long-felt, yet previously unmet need in the industry.

C. CAB’S STANDARD SYSTEM FOR SOLAR CABLE MANAGEMENT FACED INDUSTRY SKEPTICISM

213. I also understand that prior to enjoying commercial success and industry praise (as discussed below), CAB faced (and ultimately overcame) significant industry skepticism as to whether its unconventional above-ground cable management system would work and be commercially viable.

214. I have outlined my extensive experience in solar power development since its inception, well over four decades. Prior to the time of the ‘291 invention, I am not aware of any solar installation that has ever used an above-ground cable management system employing multi-surface cable hangers suspended from a messenger wire to manage the various kinds of electrical cables in a solar installation array. Given my extensive experience and involvement in the solar industry, including utility-scale power plants, I believe that if there had been such a cable management system, I would certainly have been aware of it.

215. In their respective declarations, Messrs. Bowman and Novak confirm my observations. They also confirm and explain that, at the time of the ‘291

invention, above-ground cable management systems using messenger wire supported cable hangers to support and separate the various kinds of electrical cables had never been used in the solar industry. *See* EX2028 at ¶¶32; EX2059, ¶41. Mr. Smith’s statements in his declaration that CAB faced a long road in developing products that could meet the needs and exacting demands of the solar industry, and that could gain the industry’s acceptance and trust comport with my experience developing solar photovoltaic power system equipment. EX2006, ¶¶32-33.

216. This skepticism stemmed largely from the fact that persons engaged in designing and constructing PV systems are very cautious in designing balance of systems in PV systems, including mounting structures, foundations, wire and cable management and organization, electrical panels, switching gear, battery storage and other structural features of a typical solar plant. PV system designers and installers are guided and constrained by NEC safety codes as well as structural codes. Non-compliance can result in costly failures to pass electrical inspections and professional liability in the case of injury, accident, or damage.

217. Mr. Bowman states that, while prototyping CAB’s above-ground cable management system, his team of engineers were skeptical about the “installability,” practicality, reliability, NEC code-compliance, and cost of using CAB’s above-ground cable management system in a utility-scale solar power plant. EX2028, ¶¶

34-35. Similarly in his declaration, Mr. Novak also confirmed the industry's initial skepticism and concerns related to CAB's cable management system. EX2059, ¶¶ 48-49. In particular, and echoing my overview of the relevant technology above, Messrs. Bowman and Novak state that the industry was concerned about the harsh environmental conditions that CAB's system would be exposed to and compliance with the NEC. *See* EX2028, ¶¶ 34-35; EX2059, ¶¶ 46-47.

218. Given the industry's skepticism, Mr. Smith explained in his declaration that CAB commissioned the preparation of a white paper by Bill Brooks (by that time already considered a pioneer in the solar industry) to evaluate CAB's solar cable management system and to demonstrate to those in the industry that CAB's system could perform in actual utility-scale solar power plant applications and would be safe and code-compliant. EX2006 at ¶ 22.

219. In my experience, in this industry, it is the norm for new solar technologies to be faced with significant industry skepticism, and such new technologies can only be successfully adopted after significant analysis, testing, and confirmation. Therefore, it is unsurprising to me that, as Mr. Smith states in his declaration, CAB expended significant efforts and financial resources over several years to install mock-ups and work with industry consultants and engineers at various leading solar companies and certification organizations to prototype, test,

assess, and obtain appropriate safety and efficacy listings for its cable management system. EX2006, ¶ 33.

220. In his declaration, Mr. Brooks also shares my knowledge that prior to 2014, trenching was the predominant method of managing the various kinds of cables within a solar installation, and that the only alternative to trenching was the use of metal cable trays, which were employed in far fewer installations. EX2033, ¶¶ 41-42. Mr. Brooks also confirms that both trenching and the use of cable trays presented significant cost and logistical challenges. *Id.*

221. Given Mr. Brooks' reputation and knowledge in the solar industry, it is notable that he has also confirmed that around the time of the invention of the '291 patent, CAB was the first and only company in the solar industry that offered an above-ground cable management system using messenger wire supported cable hangers to support cables in a solar installation array. *Id.*, ¶¶38-39.

222. In my opinion, I agree with Mr. Brooks that the solar industry's unfamiliarity with CAB's cable management system, coupled with the challenges that were already well known related to cable management in solar installations, meant that it took significant efforts to overcome the industry's resistance to CAB's unconventional system. EX2033, ¶ 49.

223. It is my opinion that had CAB not been able to obtain Mr. Brooks' endorsement that CAB's above-ground cable management system utilizing cable

hangers suspended from a messenger wire was compliant with the NEC and other industry-standard installation practices, it's highly unlikely that it would have even gotten off the ground. As Mr. Bowman states, Mr. Brooks' white paper provided a level of comfort and assurances to SunEdison that CAB's system would meet safety and code requirements for utility-scale solar plants. EX2028, ¶ 43.

224. Given the benefits conferred by CAB's cable management system, it is also unsurprising to me that CAB eventually overcame the industry's skepticism. Indeed, as stated by Mr. Novak, CAB's system proved to be simple to and easy to install and portended significant cost savings in solar installations. EX2059, ¶ 54.

225. Evidence of the benefits that CAB's above-ground cable management system bestowed, once it finally overcame significant industry skepticism, includes that Mr. Novak routinely recommended the use of CAB's system on solar projects for which his company was consulting over prior art methods for cable management. EX2059, ¶¶ 54-55, 66.

226. Notably, in both his declaration and at his deposition, Dr. Beik stated that he was not aware of any evidence of secondary considerations of non-obviousness, but even if such evidence were presented to him, he would not change his opinion. EX1002, ¶¶ 172-173; EX2004, 183:21-184:2. In my opinion, the evidence presented in this proceeding of industry skepticism towards above-ground messenger wire supported cable management system, the efforts that CAB

took to overcome that skepticism, and the benefits that CAB's system bestowed on the industry is more than sufficient to change any opinion that the claims of the '291 patent are obvious.

D. CAB'S STANDARD SYSTEM FOR SOLAR CABLE MANAGEMENT ACHIEVED COMMERCIAL SUCCESS

227. As noted above in connection with CAB's success in overcoming the industry's skepticism, CAB's cable management system proved to be safe, effective, code-compliant, and cost-efficient. Thus, as noted by Mr. Smith in his declaration, that as of July 2015, CAB's top customer, SunEdison, was specifying CAB's system in all of its engineering drawings specifying the NT tracker system, and by 2016, was specifying CAB's system in all engineering drawings for all solar power plant projects. EX2006, ¶¶ 43-44, 55. Many other companies subsequently followed suit and likewise specified CAB's above-ground cable management system in their engineering drawings.

228. By the end of 2016, CAB's system was rapidly becoming the industry-standard for cable management. EX2006, ¶ 62; EX2028 at ¶ 48. In my experience in the solar industry, proven successful technologies are typically quickly incorporated by competitors seeking to duplicate cost savings and efficiencies in their solar installations.

229. In his declaration submitted in support of CAB's Patent Owner Response, Jon Putnam has analyzed how CAB's Standard System for cable

management in PV solar plants achieved commercial success since its initial sales in 2015. EX2044. Significantly, as analyzed by Dr. Putnam, CAB's commercial success and growth have outpaced the growth of the solar industry. *Id.*, ¶¶ 45-51 56-63.

230. In my opinion, the commercial success achieved by CAB's Standard System for solar cable management was a direct result of the breakthrough benefits provided by CAB's patented system, including increased efficiencies and cost-savings as described above thus avoiding the drawbacks of prior art solar cable management methods.

E. CAB'S STANDARD SYSTEM FOR SOLAR CABLE MANAGEMENT HAS RECEIVED INDUSTRY PRAISE

231. In his declaration, Mr. Smith discusses numerous prestigious solar industry awards and recognitions that CAB has received for its innovative and unconventional solar cable management system. EX2006, ¶¶ 40, 54. CAB's above-ground messenger wire supported cable management system was also featured in leading solar industry publications, including SolarPro Magazine, discussing industry best practices. *Id.* at ¶ 59.

232. In my opinion, these awards and recognitions are only presented in recognition of truly innovative technologies that significantly impact and support the solar industry. It is also notable that CAB received those awards and recognitions shortly after introducing and commercializing its cable management

technology, signifying that the industry quickly recognized the innovative nature and import of CAB's system and its positive impact on the design and installation of utility-scale PV solar plants.

233. The repeated praise and acknowledgement of CAB's cable management system, as demonstrated by the industry awards and significant positive feedback from customers that it received, shows the significant advancement to cable management in the solar industry contributed by the inventions claimed in the '291 patent.

F. CAB'S STANDARD SYSTEM FOR SOLAR CABLE MANAGEMENT HAS BEEN COPIED BY OTHERS IN THE INDUSTRY

234. In my opinion, other objective evidence of non-obviousness of the '291 patent is especially demonstrated by evidence of copying of CAB's hanger system.

235. As explained in Mr. Smith's declaration, CAB first learned of this copying in the Spring of 2015, shortly after it began working with First Solar, a leading American solar technology company. EX2006, ¶¶ 48-53.

236. Specifically, in March of 2015, CAB met with a First Solar manager and team of First Solar engineers, including a Mr. Dan R. Smith, who eventually left First Solar and became one of the founders and chief technology officer of AWM, the Petitioner in this IPR proceeding. During that meeting, CAB shared

dozens of samples of its hanger products, including its two-carrier solar hanger for its above-ground messenger wire supported cable management system. CAB further shared proprietary drawings, designs, and product features. *Id.*, ¶ 49.

237. As shown by the evidence offered by Mr. Smith, in September 2015, CAB received a quote from a supplier in the solar industry, asking for a quote for approximately two million hangers for a two-carrier solar hanger for a First Solar project that specified above-ground cable management for a solar power plant project. Attached to the request for quote was an engineering drawing dated April 9, 2015, three weeks after the meeting with Dan R. Smith and others at First Solar at which CAB shared solar hanger product samples, drawings and designs. The engineering drawing identifies that it was drawn by DRS, who is also identified as the engineer on the drawing. *Id.*, ¶51.

238. Although the drawing was presented as a First Solar drawing, the drawing itself depicted a hanger that was virtually identical to CAB's two-carrier hanger that CAB had disclosed to First Solar at the meeting three weeks earlier. *Id.*

239. In my opinion, the copying of CAB's hanger device for a project requiring 2 million hangers is a strong indication that the inventions claimed in the '291 patent are not obvious.

X. CONCLUSION

240. For all the reasons set forth above, it is my opinion that Petitioner has not shown, and Dr. Beik has not supported any showing, that claims 1-23 of the '291 Patent are unpatentable over the references cited by Petitioner.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

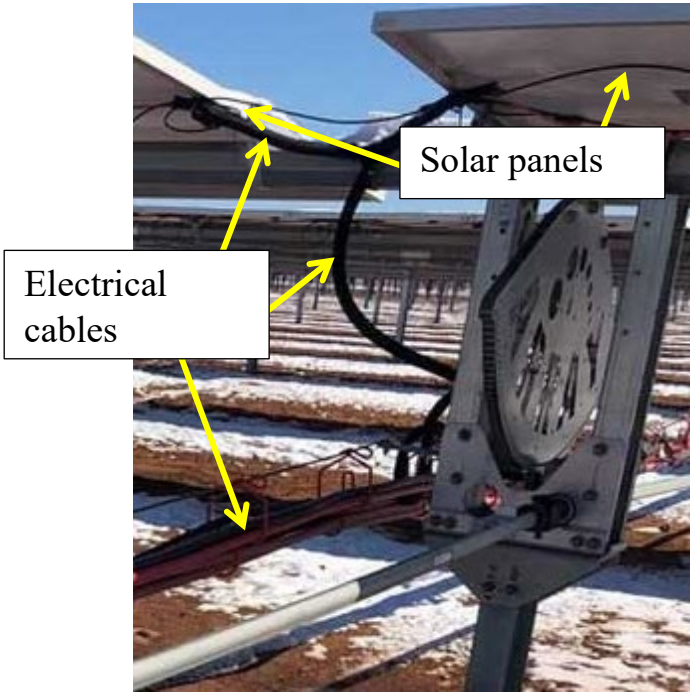
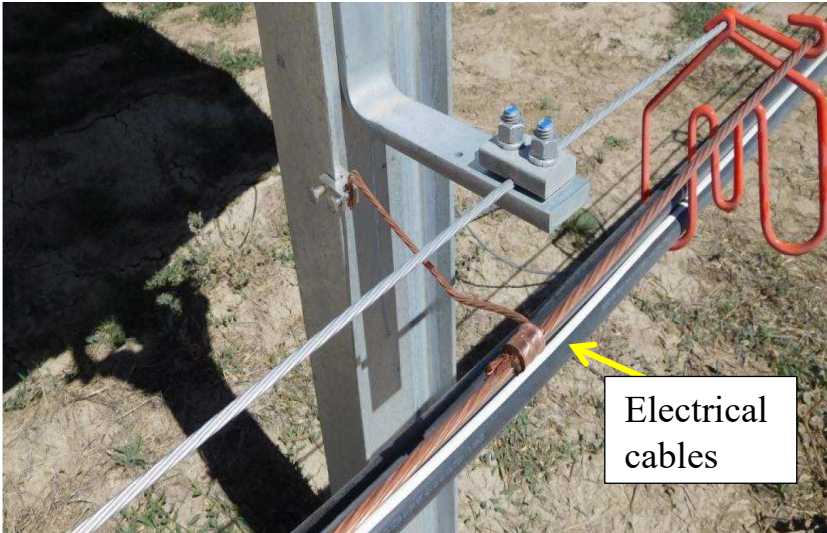
A handwritten signature in blue ink, appearing to read "Edward C. Kern, Jr.", written over a horizontal line.

Edward C. Kern, Jr., Ph.D.

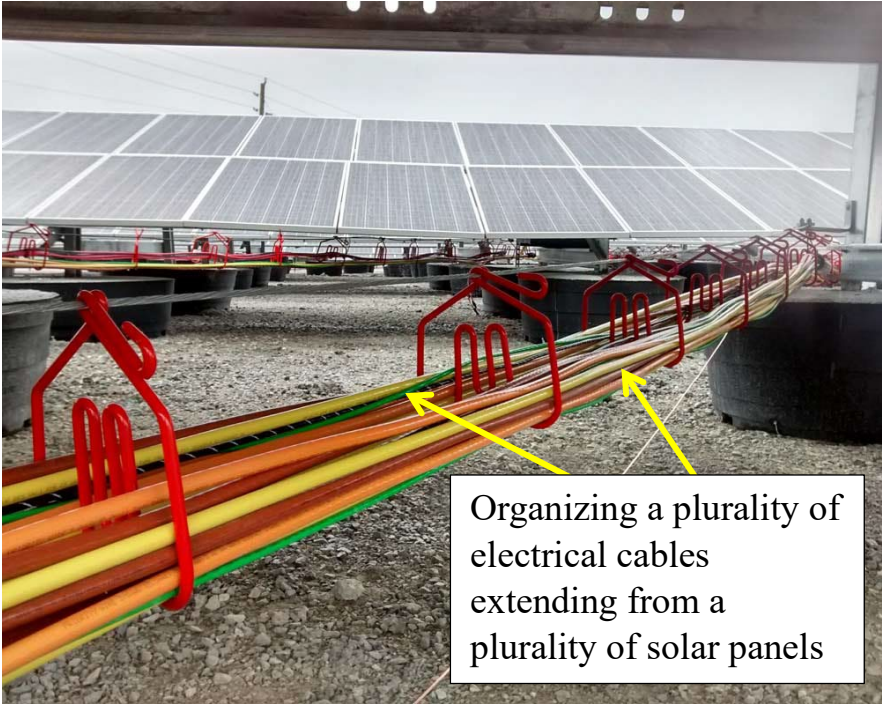
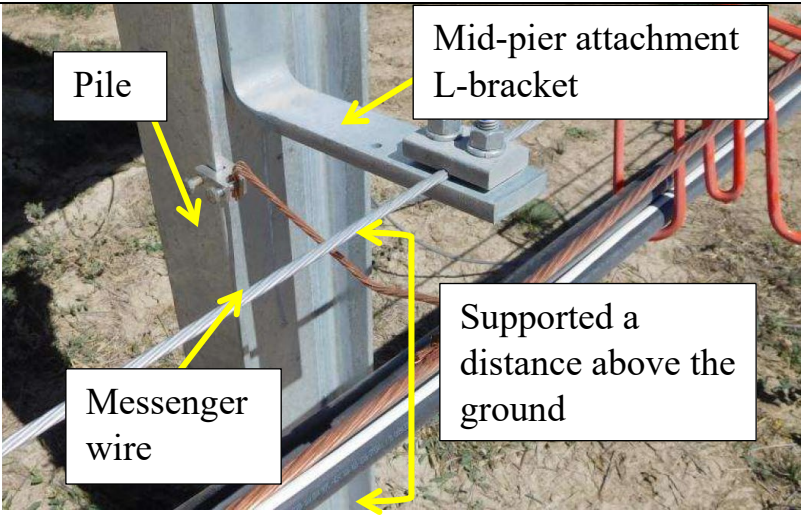
Dated: *July 25, 2024*

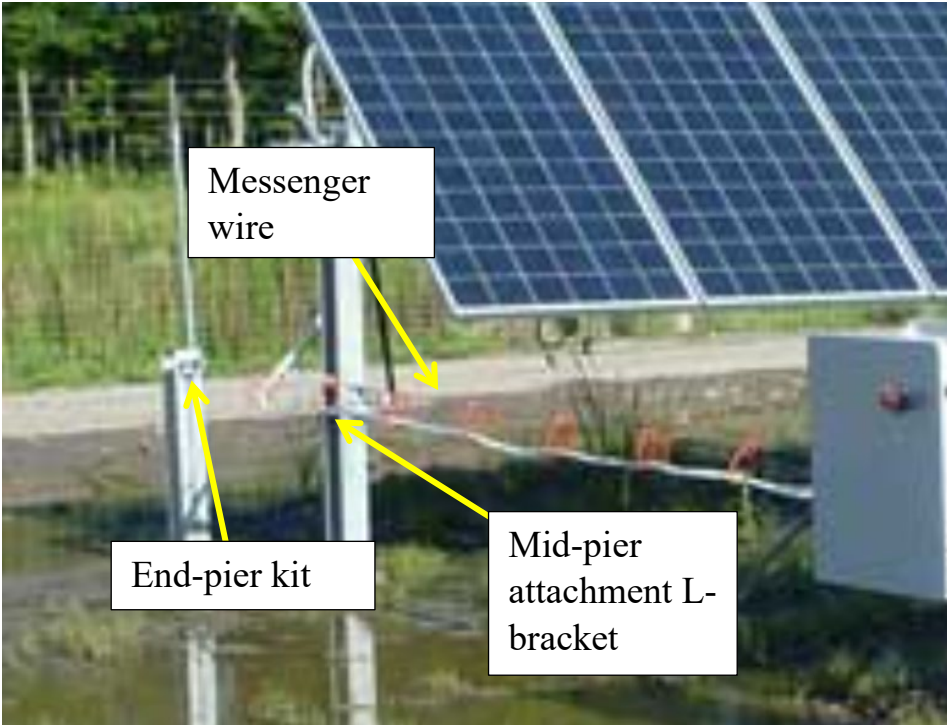
Appendix A

CLAIM CHART FOR CAB'S COMMERCIAL EMBODIMENT OF THE '291 PATENT

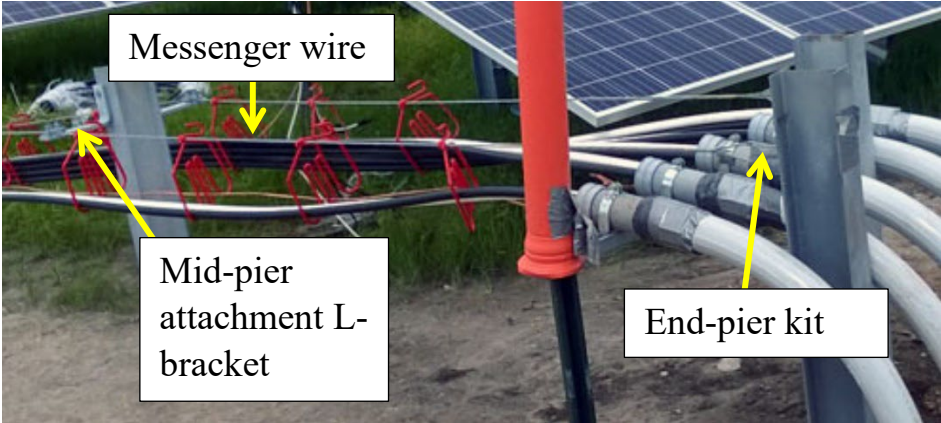
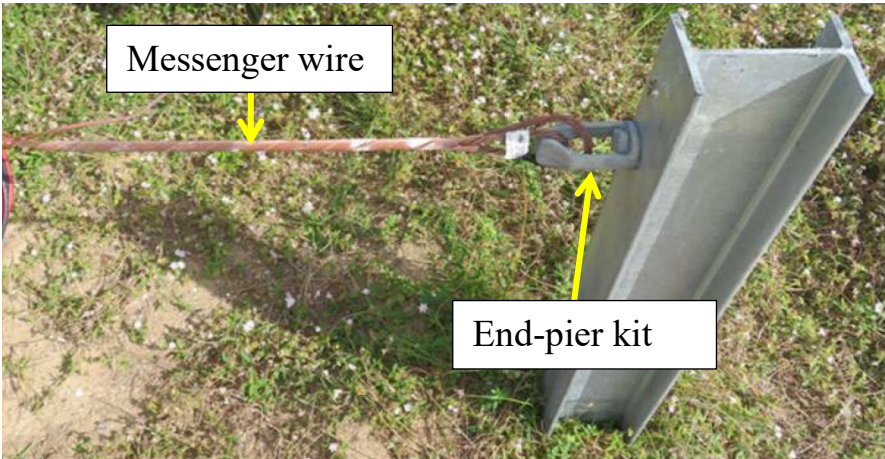
Claim Language	CAB's Standard System
[1.Preamble] A system for organizing a plurality of electrical cables extending from a plurality of solar panels, the system comprising:	 See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/1 (last visited on July 20, 2024). 

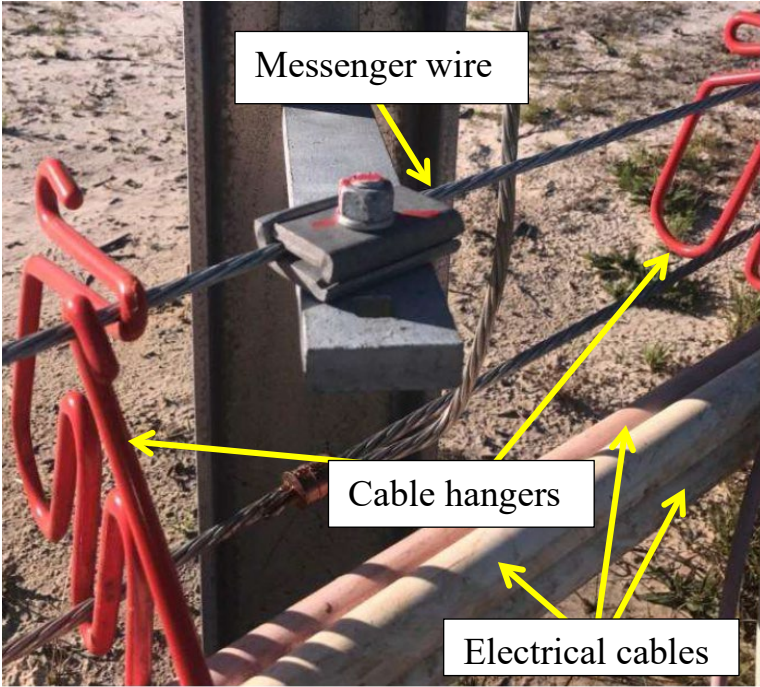
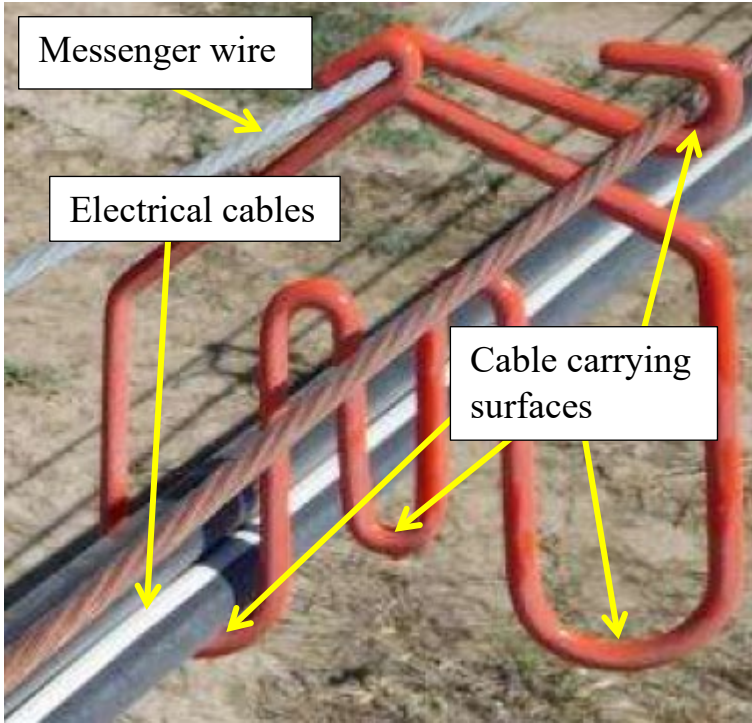
A1

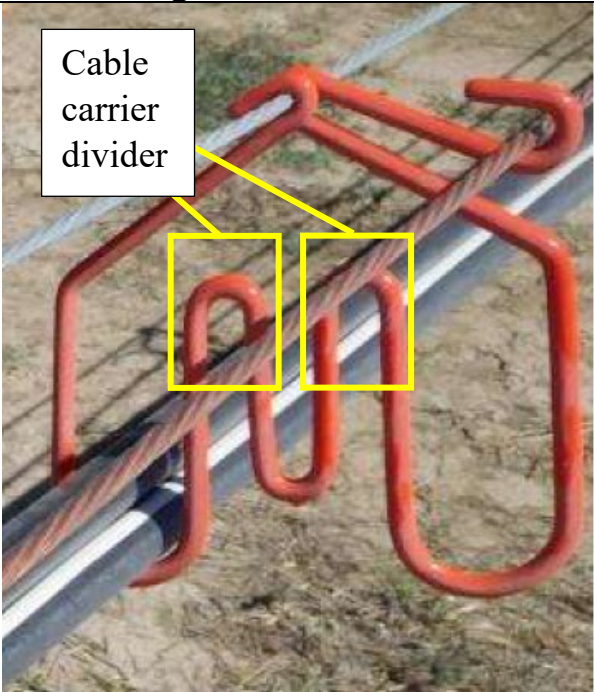
Claim Language	CAB's Standard System
	EX. 2041 (CAB Solar Installation Guide) at 2.  Organizing a plurality of electrical cables extending from a plurality of solar panels See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/19 (last visited on July 22, 2024).
[1.a] a messenger wire structured to be supported a distance above the ground; and	 Pile Mid-pier attachment L-bracket Messenger wire Supported a distance above the ground

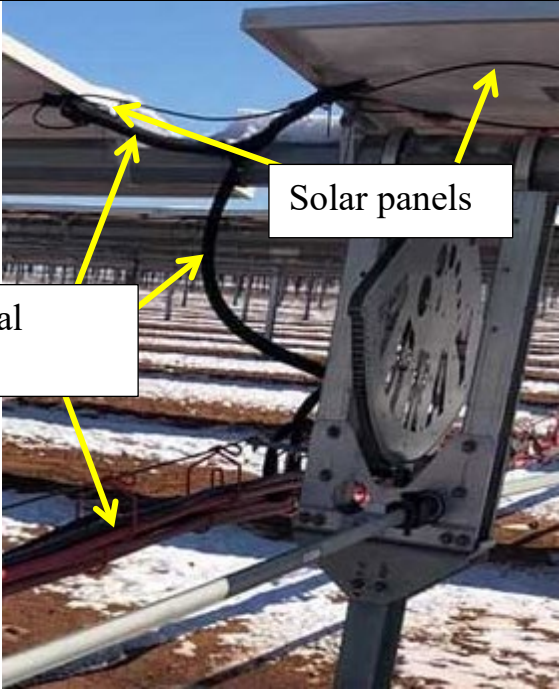
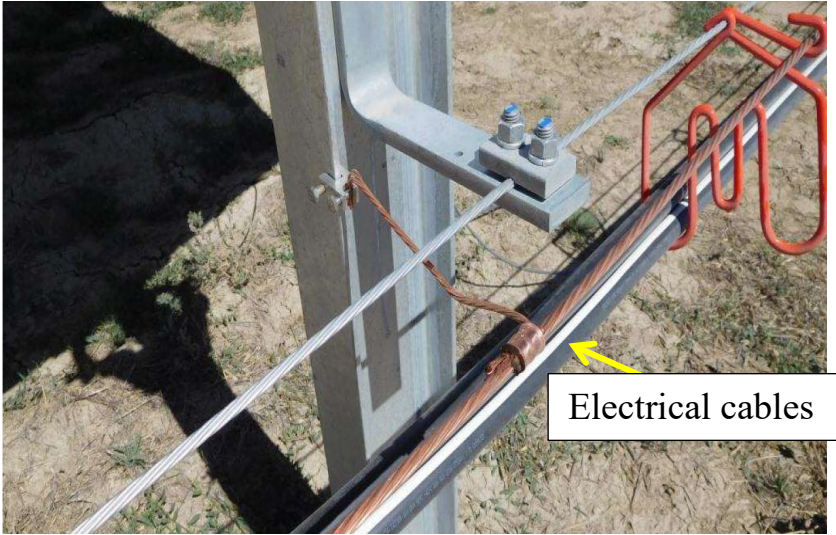
Claim Language	CAB's Standard System
	EX. 2041 at Page 2.¹ “For standard CAB System: Extra High Strength (EHS) [REDACTED] class A galvanized messenger wire is recommended for most applications. Confirm with EOR that this will accommodate all anticipated loads and class A galvanization is adequate for anticipated corrosion level.” EX. 2041 at 4, 3.1.1. Part No. [REDACTED], corresponding to [REDACTED] diameter EHS messenger wire is representative of the messenger wire in CAB's Standard System. EX. 2042.  The photograph shows a solar panel array with a steel messenger wire and a copper equipment grounding conductor (EGC) running parallel to it. Yellow arrows point to the messenger wire, the end-pier kit, and the mid-pier attachment L-bracket.

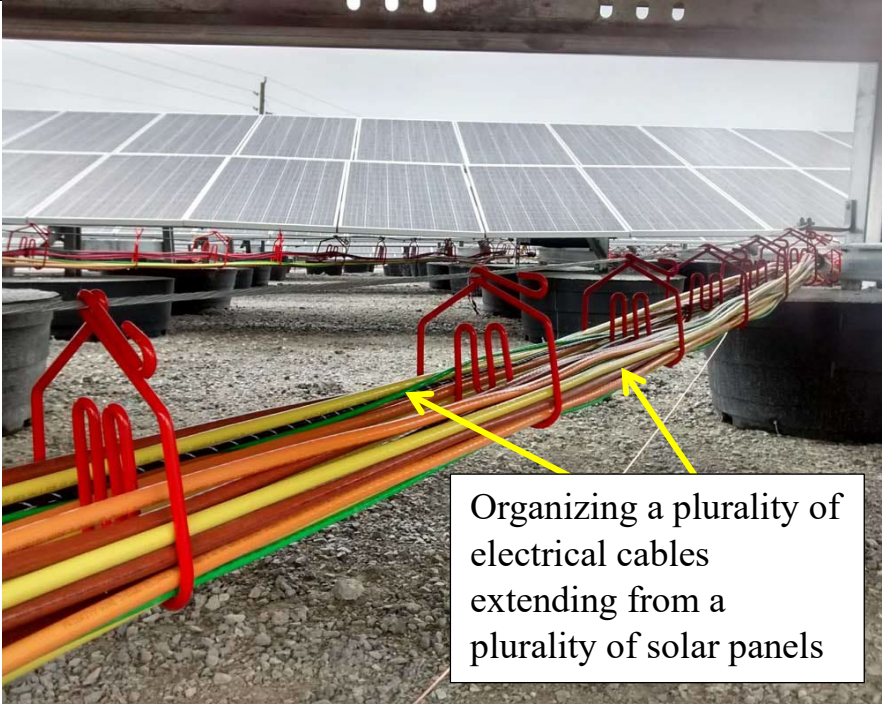
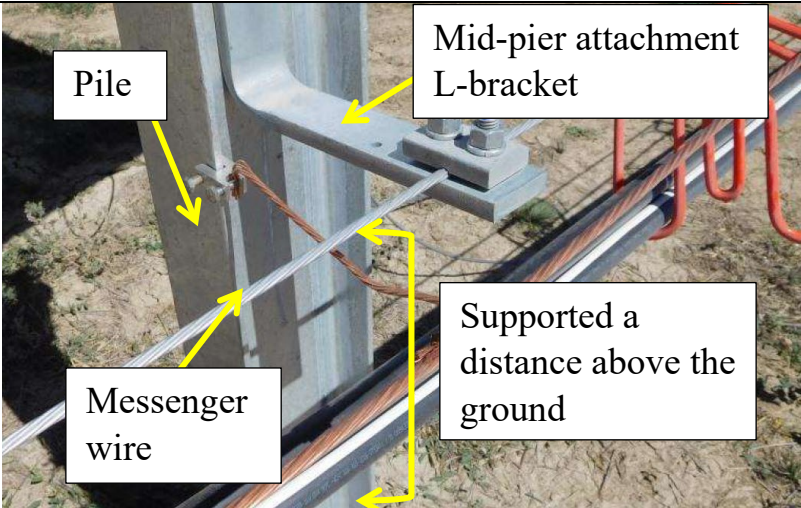
¹ The images above show a copper equipment grounding conductor (EGC) that runs adjacent and parallel to the steel messenger wire (upon which the CAB cable hangers are disposed and suspended) as well as a copper jumper from the EGC to the steel pile. The EGC and jumper splices are not part of the CAB Standard System and are separately purchased and installed by CAB customers to electrically ground the system.

Claim Language	CAB's Standard System
	See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/16, (last visited on July 22, 2024).  See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/8 (last visited on July 24, 2024).  EX. 2041 at Page 1. Part No. [REDACTED] is representative of an end-pier attachment kit and Part No. [REDACTED] is representative of the mid-pier attachment L-bracket, which support the messenger wire at a distance above the ground. EX. 2042.

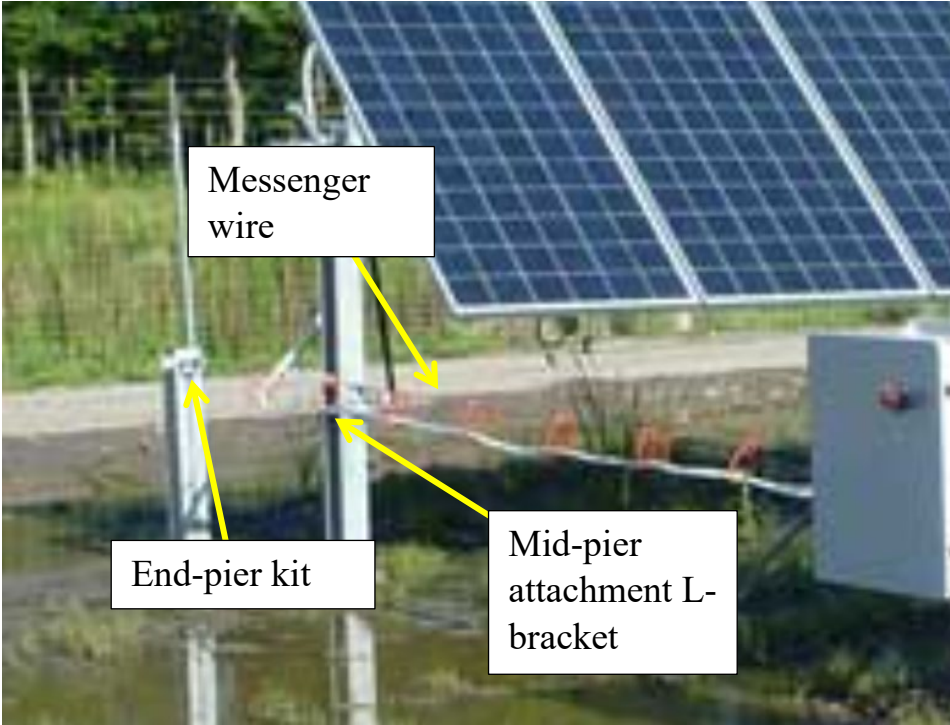
Claim Language	CAB's Standard System
[1.b] a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables,	 This photograph shows a close-up of the CAB's Standard System. A grey metal messenger wire is attached to a vertical post with a grey metal bracket. Several red, U-shaped cable hangers are suspended from the messenger wire. Yellow arrows point from labels to the messenger wire, the cable hangers, and the electrical cables passing through the hangers. EX. 2041 at 2.  This photograph shows a close-up of the cable carrying surfaces of the cable hangers. The red, U-shaped hangers are suspended from a grey metal messenger wire. Yellow arrows point from labels to the messenger wire, the electrical cables, and the cable carrying surfaces of the hangers.

Claim Language	CAB's Standard System
	EX. 2041 at 2. “Place cabling in hangers.” EX. 2041 (CAB Solar Installation Guide) at 5. 4.5. Part Nos. [REDACTED] and [REDACTED] are representative of the cable hangers in CAB's Standard System. EX. 2042. Part Nos. [REDACTED] and [REDACTED] are ETL Listed by Intertek Testing Laboratories as compliant with the UL 2239 Standard for Hardware for the Support of Conduit, Tubing, and Cable and with the UL 1565 Standard for Positioning Devices. EX. 2043.
[1.c] wherein adjacent cable carrying surfaces of the plurality of cable carrying surfaces are separated by a cable carrier divider.	 EX. 2041 at 2.
[6.Preamble] A system for organizing a plurality of electrical cables extending from a plurality of solar panels,	

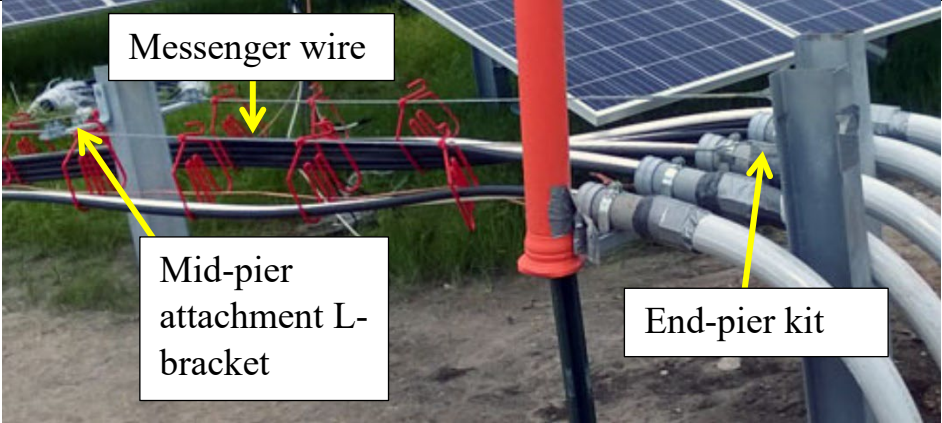
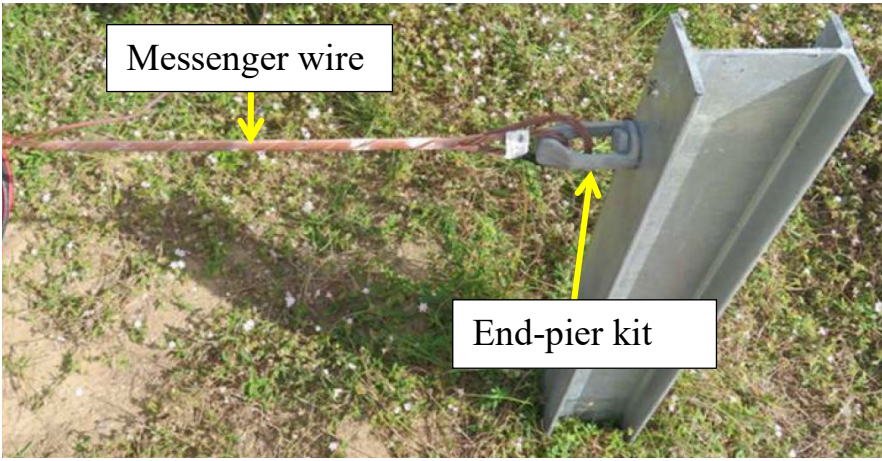
Claim Language	CAB's Standard System
the system comprising:	 Solar panels Electrical cables <i>See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/1 (last visited on July 20, 2024).</i>  Electrical cables EX. 2041 at 2.

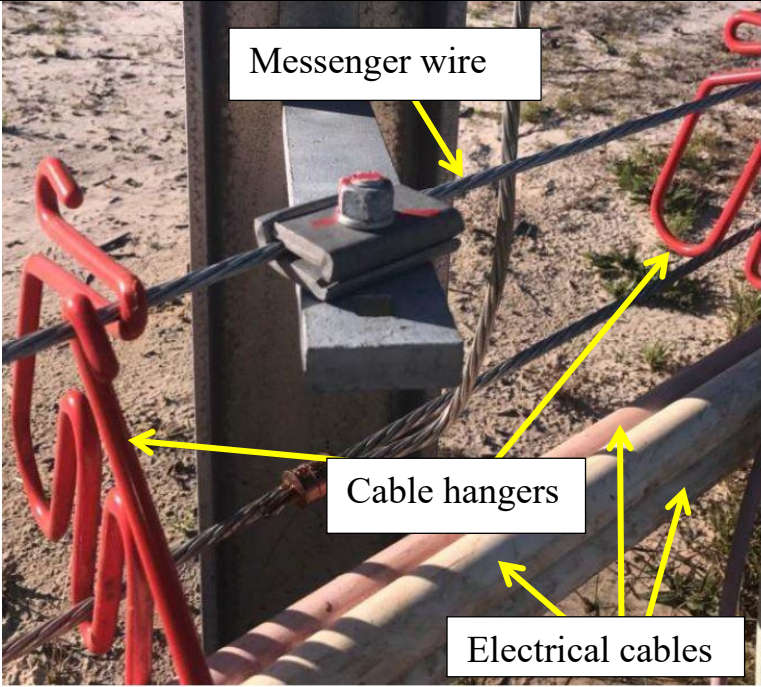
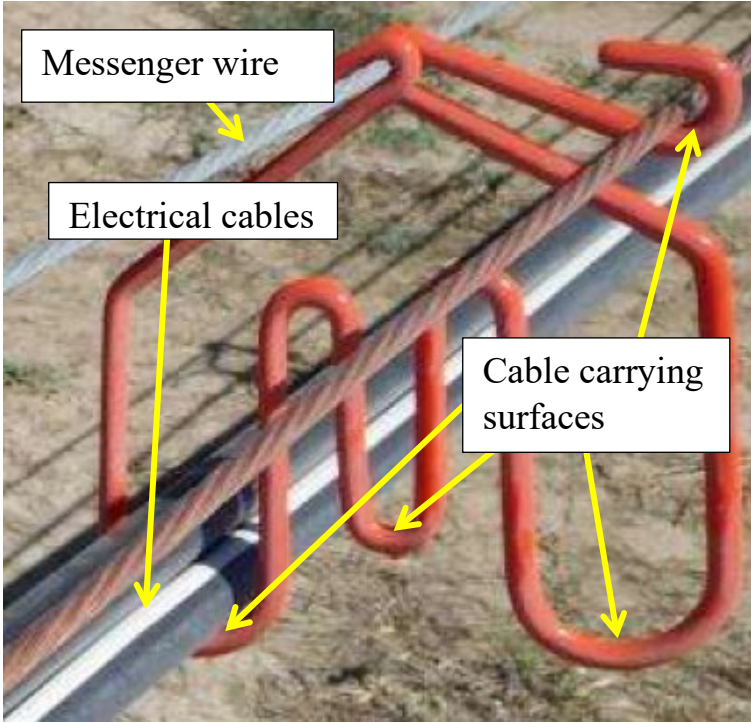
Claim Language	CAB's Standard System
	 Organizing a plurality of electrical cables extending from a plurality of solar panels <i>See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/19 (last visited on July 22, 2024).</i>
[6.a] a messenger wire structured to be supported a distance above the ground; and	 Pile Mid-pier attachment L-bracket Messenger wire Supported a distance above the ground EX. 2041 at 2.²

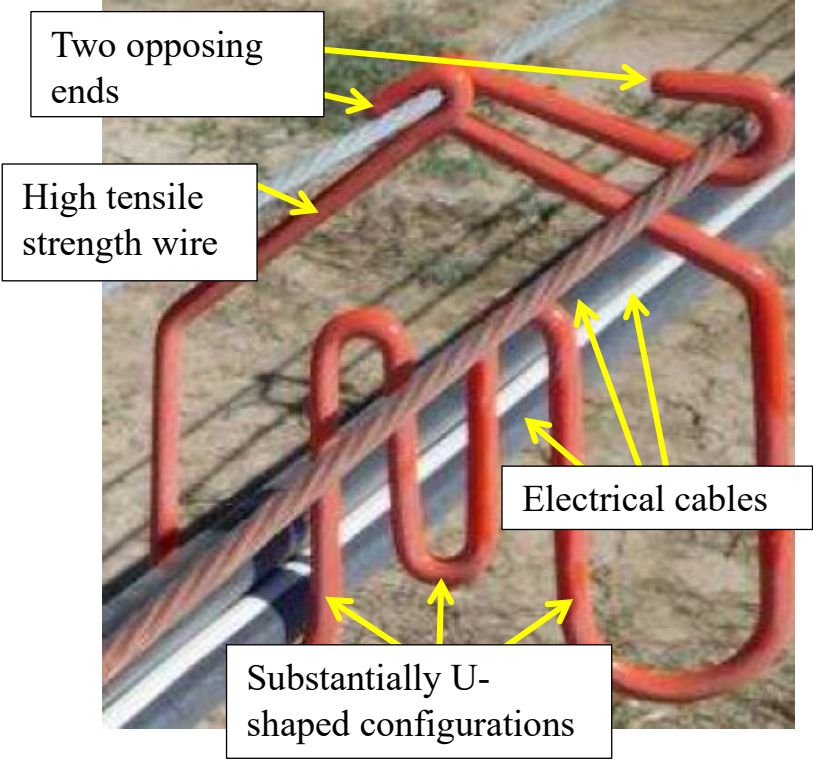
² The images above show a copper equipment grounding conductor (EGC) that runs adjacent and parallel to the steel messenger wire (upon which the CAB cable

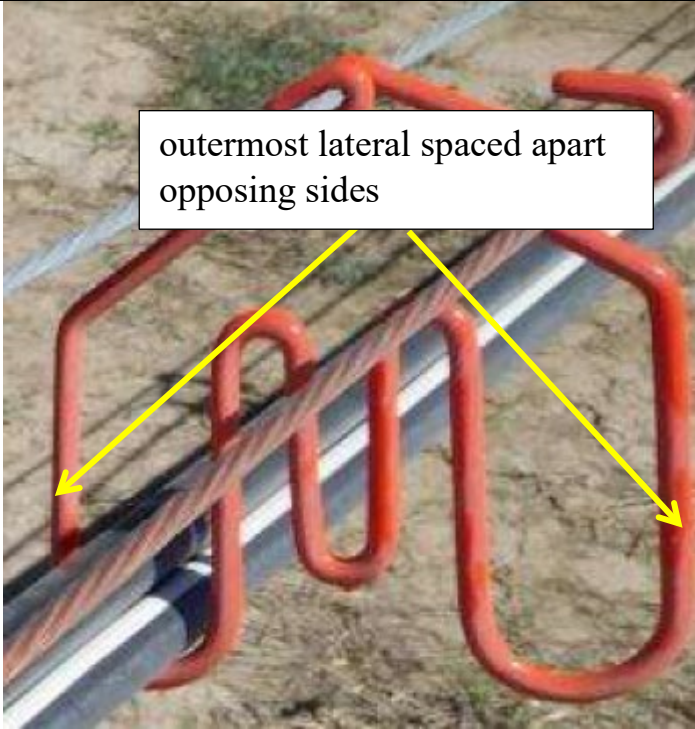
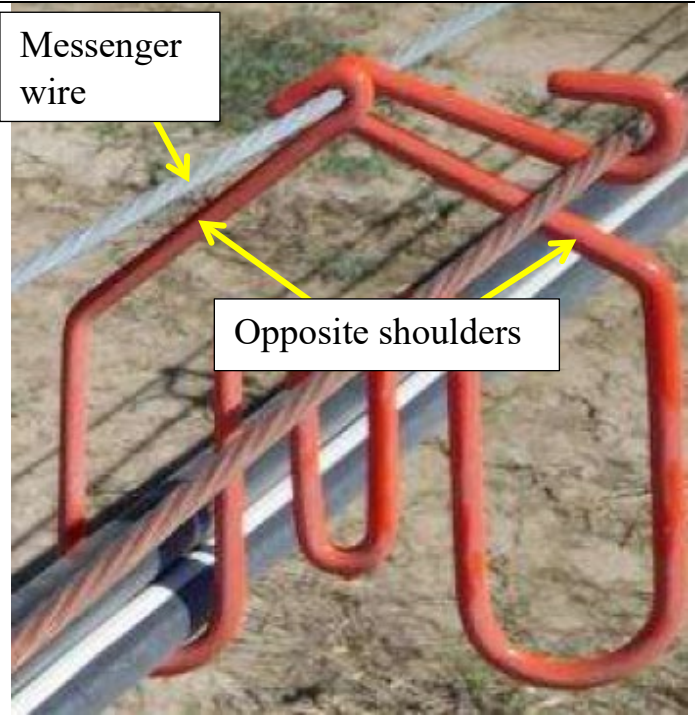
Claim Language	CAB's Standard System
	“For standard CAB System: Extra High Strength (EHS) [REDACTED] class A galvanized messenger wire is recommended for most applications. Confirm with EOR that this will accommodate all anticipated loads and class A galvanization is adequate for anticipated corrosion level.” Ex. 2041 at 4, 3.1.1. Part No. [REDACTED], corresponding to [REDACTED] diameter EHS messenger wire is representative of the messenger wire in the Standard System Commercial Embodiment. EX. 2042.  <i>See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/16, (last visited on July 22, 2024).</i>

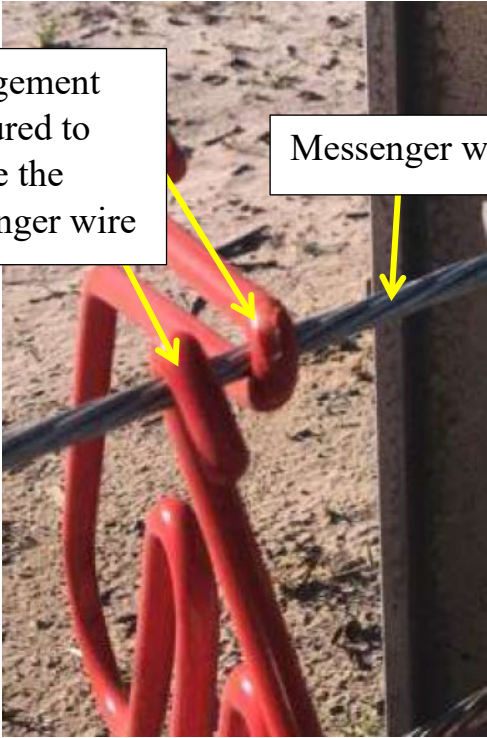
hangers are disposed and suspended) as well as a copper jumper from the EGC to the steel pile. The EGC and jumper splices are not part of the CAB Standard System and are separately purchased and installed by CAB customers to electrically ground the system.

Claim Language	CAB's Standard System
	 Messenger wire Mid-pier attachment L-bracket End-pier kit See https://www.cabproducts.com/solar-gallery/#iLightbox[gallery_image_1]/8 (last visited on July 24, 2024).  Messenger wire End-pier kit EX. 2041 at Page 1. Part No. [REDACTED] is representative of an end-pier attachment kit and Part No. [REDACTED] is representative of the mid-pier attachment L-bracket, which support the messenger wire at a distance above the ground. EX. 2042.

Claim Language	CAB's Standard System
[6.b] a plurality of cable hangers structured to be disposed along, and suspended from, the messenger wire, each cable hanger having a plurality of cable carrying surfaces, each cable carrying surface being structured to support at least one electrical cable of the plurality of electrical cables,	 This photograph shows a close-up of a cable hanger assembly. A thick, dark messenger wire runs horizontally across the frame. A metal cable hanger is attached to the messenger wire via a bolt and nut. The cable hanger has a series of red, U-shaped loops. Several electrical cables are shown passing through these loops. Yellow arrows point from the labels to the corresponding parts: 'Messenger wire' points to the top wire, 'Cable hangers' points to the metal bracket, and 'Electrical cables' points to the cables within the red loops. EX. 2041 at 2.  This photograph provides a closer view of the red, U-shaped loops of the cable hanger. A messenger wire is visible at the top. Electrical cables are shown passing through the loops. Yellow arrows point from the labels to the corresponding parts: 'Messenger wire' points to the top wire, 'Electrical cables' points to the cables within the loops, and 'Cable carrying surfaces' points to the red U-shaped loops themselves. EX. 2041 at 2.

Claim Language	CAB's Standard System
	“Place cabling in hangers.” EX. 2041 at 5, 4.5. Part Nos. [REDACTED] and [REDACTED] are representative of the cable hangers in CAB's Standard System. EX. 2042. Part Nos. [REDACTED] and [REDACTED] are ETL Listed by Intertek Testing Laboratories as compliant with the UL 2239 Standard for Hardware for the Support of Conduit, Tubing, and Cable and with the UL 1565 Standard for Positioning Devices. EX. 2043.
[6.c] wherein each cable hanger of the plurality of cable hangers comprises: a high tensile strength wire with two opposing ends and configured intermediate of said ends to form a plurality of substantially U-shaped configurations each having a cable carrying surface of the plurality of cable carrying surfaces located thereon;	 EX. 2041 at 2.
[6.d] outermost lateral spaced	

Claim Language	CAB's Standard System
apart opposing sides forming the boundary of said hanger;	 outermost lateral spaced apart opposing sides EX. 2041 at 2.
[6.e] opposite shoulders extending toward each other from said spaced apart opposite sides, each of said shoulders having an arrangement structured to engage the messenger wire so as to securely hold the hanger on the messenger wire.	 Messenger wire Opposite shoulders EX. 2041 at 2.

Claim Language	CAB's Standard System
	 Arrangement structured to engage the messenger wire Messenger wire EX. 2041 at 2.