

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT & BMW
OF NORTH AMERICA, LLC,

Petitioner,

v.

PAICE LLC & THE ABELL FOUNDATION, INC.,

Patent Owner.

IPR2020-01299
Patent 8,630,761 B2

Before SALLY C. MEDLEY, KALYAN K. DESHPANDE, and
ARTHUR M. PESLAK, *Administrative Patent Judges*.

PESLAK, *Administrative Patent Judge*

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Bayerische Motoren Werke Aktiengesellschaft and BMW of North America, LLC, (collectively “Petitioner” or “BMW”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–12 (the “challenged claims”) of U.S. Patent No. 8,630,761 B2 (Ex. 1001, “the ’761 patent”). Petitioner submitted the Declaration of Dr. Gregory W. Davis in support of the Petition. Ex. 1008. Patent Owner, Paice LLC and the Abell Foundation, Inc., timely filed a Preliminary Response (Paper 8, “Prelim. Resp.”). Taking into account the arguments presented in Patent Owner’s Preliminary Response, we determined there was a reasonable likelihood Petitioner would prevail in its contention that at least one of the challenged claims of the ’761 patent is unpatentable under 35 U.S.C. § 103(a). On January 15, 2021, we instituted this *inter partes* review as to the challenged claims and all grounds presented in the Petition. Paper 10 (“Dec.”).

During the course of trial, Patent Owner filed a Patent Owner Response. Paper 18 (“PO Resp.”). Patent Owner also filed a Declaration of Dr. Mahdi Shahbakhti in support of its response. Ex. 2016. Petitioner filed a Reply to Patent Owner’s Response. Paper 23 (“Pet. Reply”). Petitioner filed a Reply Declaration of Dr. Gregory W. Davis with its Reply. Ex. 1088. Patent Owner filed a Sur-reply. Paper 27 (“Sur-reply”). An oral hearing was held on October 19, 2021 and a transcript of the hearing has been entered into the record. Paper 33 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims of the ’761 patent. For the reasons discussed below, we determine

Petitioner establishes by a preponderance of the evidence that claims 1–12 of the '761 patent are unpatentable.

A. Related Matters

The parties state the '761 patent is asserted in *Paice LLC et al. v. Bayerische Motoren Werke Aktiengesellschaft*, 1:19-cv-03348-SAG (D. Md.). Pet. 74; Paper 5, 2.

B. Real Parties in Interest

Petitioner and Patent Owner each identifies itself as the only real party in interest. Pet. 74; Paper 5, 2.

C. The '761 Patent (Ex. 1001)

The '761 patent issued on January 14, 2014, and is titled “Hybrid Vehicles.” Ex. 1001, codes (45), (54). The '761 patent issued from U.S. Patent Application 13/573,728 filed on October 5, 2012 and claims priority through a series of applications to U.S. Provisional Patent Applications 60/100,095, filed on September 14, 1998 and 60/122,296, filed on March 1, 1999. *Id.* at codes (21), (22), (60).

The '761 patent generally relates to hybrid vehicles “in which both an internal combustion engine and one or more electric motors are provided to supply torque to the driving wheels of the vehicle ... [for] achieving substantially improved fuel economy and reduced pollutant emissions.” Ex. 1001, 1:16–24. The '761 patent describes various modes of operation of the hybrid vehicle powertrain that are “controlled by microprocessor 48 [as] a function of the state of charge of the battery bank, the instantaneous road load, and time.” *Id.* at 35:61–66. The '761 patent further describes that “microprocessor 48 controls the vehicle's mode of operation at any given

time in dependence on ‘recent history,’ as well as on the instantaneous road load and battery charge state.” *Id.* at 36:23–26.

Figure 6 of the ’761 patent, reproduced below, schematically illustrates an embodiment of the claimed invention.

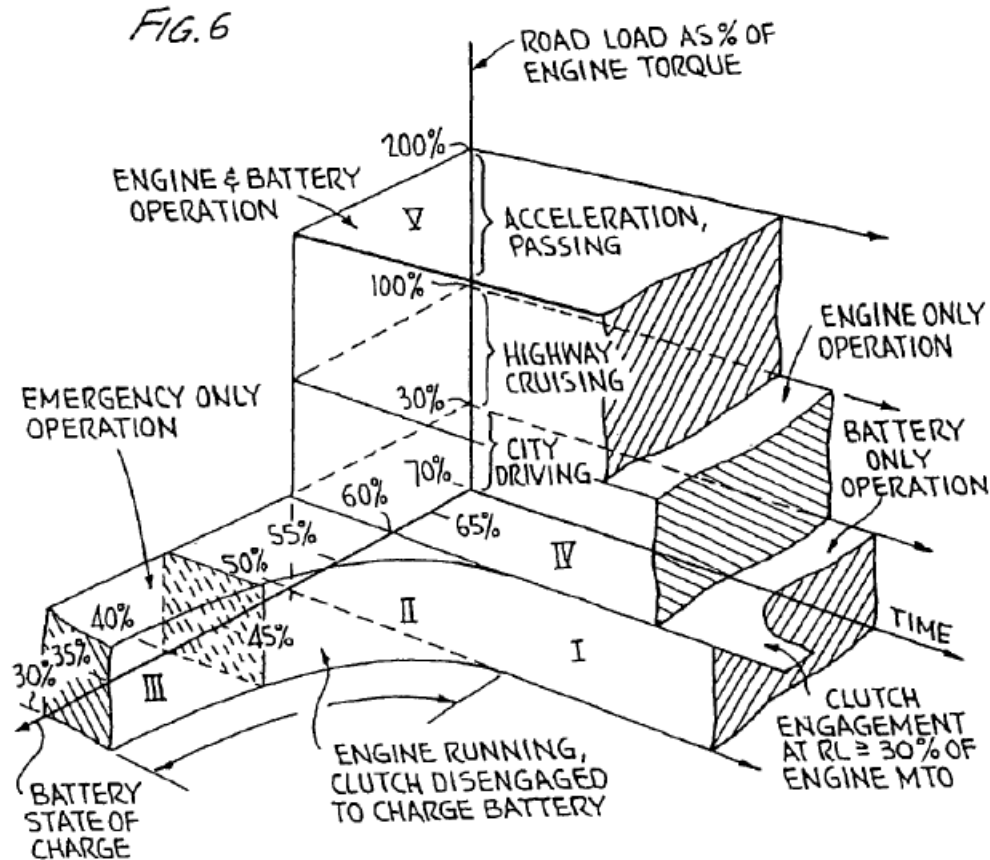


Figure 6 is a three-axis schematic with time on one axis, road load on a second axis, and battery state of charge on the third axis, illustrating that the mode of vehicle operation is a function of the state of charge of the battery bank, the instantaneous road load, and time. *Id.* 21:53–57.

As shown in Figure 6, “during city driving (mode I), defined in this example as driving where the vehicle’s instantaneous torque requirements, or ‘road load,’ is up to 30% of the engine's maximum torque, the vehicle is

operated as a ‘straight electric’ car.” *Id.* at 36:27–31. In mode I, “the clutch [is] disengaged and energy from the battery bank 22 [is] used to power traction motor 25 to propel the vehicle, as long as the battery remains charged to between 50 and 70% of its full charge.” *Id.* at 36:31–34. “If the charge falls to below a given value ... mode II is entered as indicated, the engine is started, and the starter motor 21 is operated as a generator to charge the battery to substantially full charge.” *Id.* at 36:34–39. Mode III permits operation of the vehicle as an electric car “when the battery falls to below 40% of full charge, for example, if there is a fault in the engine or charging system, but only on an emergency basis; such deep discharge is harmful to battery life.” *Id.* at 36:39–44. “During highway cruising, region IV, where the road load is between about 30% and 100% of the engine’s maximum torque output, the engine alone is used to propel the vehicle.” *Id.* at 36:45–47. “If the operator then calls for additional power, e.g. for acceleration or passing, region V is entered.” *Id.* at 37:3–4. There, “the microprocessor detects that the road load exceeds 100% of the engine’s maximum torque output, it controls inverter/charger 27 so that energy flows from battery bank 22 to traction motor 25, providing torque propelling the vehicle in addition to that provided by engine 40.” *Id.* at 37:3–9.

The above embodiment includes a controlled transition from low-speed operation to highway cruising at a transition point or set point (i.e., between operation in modes I and IV). *Id.* at 39:41–46. Using a constant set point, however, can sometimes lead to undesirable engine starting and shut-off, until extended highway cruising is attained. *Id.* at 39:63–66. To address this potential undesirable effect, the ’761 patent uses the microprocessor to monitor the vehicle’s operation over a period of days or weeks and adjust the

set point in response to a repetitive driving pattern. *Id.* at 39:48–66. The ’761 patent describes such a pattern as “the operator drives the same route from a congested suburban development to a workplace about the same time every morning.” *Id.* at 39:51–53. The ’761 patent explains that by the microprocessor “monitoring the road load over time, and comparing it to different set points accordingly, much of this undesirable repetitive sequence of engine starting and shut-off can be eliminated.” *Id.* at 40:26–29.

D. Challenged Claims

Claims 1 and 7 are independent. Ex. 1001, 56:33–57:37. Claim 1, reproduced below, illustrates the subject matter of the challenged claims.

1. A method of operation of a hybrid vehicle, comprising steps of: storing and supplying electrical power from a battery bank, applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor, and controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels, and controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller, and wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle; and controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.

E. Asserted Grounds of Unpatentability

Petitioner challenges claims 1–12 of the ’761 patent based on the asserted grounds of unpatentability set forth below (Pet. 14)¹:

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103. Because the ’761

Claims(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–12	§ 103(a)	Severinsky ² , Quigley ³
1–12	§ 103(a)	Severinsky, Nii ⁴
1, 2, 5–8, 11, and 12	§ 103(a)	Severinsky, Graf ⁵

II. ANALYSIS

A. Overview

Petitioner bears the burden of establishing the unpatentability of the challenged claims by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d) (2020). This burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences

patent was filed before the effective date of the relevant amendment, the pre-AIA version of § 103 applies.

² U.S. Pat. No. 5,343,970, issued Sept. 6, 1994 (Ex. 1013, “Severinsky”).

³ C. P. Quigley et al., *Predicting the Use of a Hybrid Electric Vehicle*, IFAC Proceedings Volumes, 1996 (Ex. 1054, “Quigley”).

⁴ U.S. Pat. No. 5,650,931, issued July 22, 1997 (Ex. 1022, “Nii”).

⁵ U.S. Pat. No. 6,188,945 B1, issued Feb. 13, 2001 (Ex. 1020, “Graf”).

between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations).⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

Petitioner contends a person of ordinary skill in the art would have “a graduate degree in mechanical, electrical or automotive engineering with at least some experience in the design and control of combustion engines, electric or hybrid electric vehicle propulsion systems, or design and control of automotive transmissions” or alternatively “a bachelor’s degree in mechanical, electrical or automotive engineering and at least five years of experience in the design of combustion engines, electric vehicle propulsion systems, or automotive transmissions.” Pet. 10 (citing Ex. 1008 ¶¶ 43–46). Patent Owner does not address the level of ordinary skill in the art in the Patent Owner Response. *See generally* PO Resp.

We agree with Petitioner’s level of ordinary skill in the art because it appears consistent with the problems addressed in the ’761 patent and the prior art of record.

C. Claim Construction

We apply the same claim construction standard used by Article III federal courts and the International Trade Commission, both of which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. 37 C.F.R. § 42.100(b). Accordingly, we construe each challenged claim of the ’761 patent to generally be “the ordinary and customary

⁶ The parties have not presented any evidence of objective indicia of non-obviousness.

meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.*

Petitioner requests we construe the claim terms “predicted near-term pattern of operation,” “controls operation ... responsive to said derived near-term predicted pattern,” and “road load.” Pet. 10–15. Patent Owner takes issue with Petitioner’s construction of the term “predicted near-term pattern of operation,” and requests we use the construction adopted by the District Court in the parallel proceeding or apply the plain and ordinary meaning. PO Resp. 15–21. After reviewing the evidence and argument presented by Petitioner and Patent Owner, we determine it is not necessary to construe the claim terms “controls operation ... responsive to said derived near-term predicted pattern” and “road load.” *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that “we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’”) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). Nonetheless, we address the construction of the claim term “predicted near-term pattern of operation.” In our Decision on Institution, we preliminarily adopted the District Court’s construction of this term, which is “an expected pattern of operation.” Dec. 12.

Patent Owner contends we should maintain our preliminary construction. PO Resp. 21.⁷ In the Petitioner Reply, Petitioner does not

⁷ Patent Owner makes additional arguments concerning the “plain meaning of the term ‘pattern’” in connection with its contentions concerning Quigley. PO Resp. 25. We address those arguments in our analysis of the ground based on Severinsky and Quigley.

dispute our preliminary construction and submits that “Dr. Davis has confirmed his analysis under that construction.” Pet. Reply 2 (citing Ex. 1088 ¶ 7; Ex. 2034, 46:14–47:19).

The District Court noted Petitioner “seeks to limit how the controller derives this pattern, basing it solely on the driver’s repeated driving operations,” while Patent Owner “suggests that the question of how the pattern is derived was left open-ended by the claim language and covers vehicle operation in general.” Ex. 2007, 9. The District Court rejected Petitioner’s arguments for a more limited construction that incorporates “monitoring the driver’s repeated driving operations over time” because the construction was not supported by the Specification or prosecution history. *Id.* at 11. In adopting the broader construction proposed by Patent Owner, the District Court provided the following pertinent observations:

It is also worth noting that [Patent Owner], whether in the specification or at oral argument, has provided few examples of other factors that might play into the expected pattern of operation. It seems apparent that driving operations will be the most central factor in ascertaining the pattern of operation. Nevertheless, the plain language does not rule out other inputs. Thus, because [Patent Owner]’s construction hews most closely to the broad language of the claim, the Court will adopt it: “an expected pattern of operation.” *Id.*

We agree with the District Court’s reasoning and adopt its construction of “predicted near-term pattern of operation” as “an expected pattern of operation.” We, thus, maintain our preliminary construction for purposes of this Decision.

D. Ground 1: Obviousness over Severinsky and Quigley

Petitioner contends claims 1–12 are obvious over Severinsky and Quigley. Pet. 19–50. In support, Petitioner asserts Severinsky discloses

most of the limitations of claim 1, and relies on Quigley to disclose, *inter alia*, the last two limitations of claim 1⁸, “wherein said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle,” and “controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle.” *Id.* at 25–30. Petitioner identifies the disclosures in Severinsky and Quigley alleged to describe the subject matter in these limitations. *Id.* Additionally, Petitioner offers declaration testimony from Dr. Gregory W. Davis in support of its position. Ex. 1008 ¶¶ 161–280.

Patent Owner contends “[n]either Severinsky nor Quigley disclose a controller that derives a ‘predicted near-term pattern of operation of said hybrid vehicle’” when that phrase is properly construed. PO Resp. 22. Patent Owner further contends Petitioner “fails to explain how or why these references could be combined in the first place.” *Id.*

We begin our analysis with a brief overview of Severinsky and Quigley. We then address the parties’ respective contentions with respect to the challenged claims.

1. Overview of Severinsky — Ex. 1013

Severinsky is a United States Patent issued on September 6, 1994. Ex. 1013, code (45). Severinsky is titled “Hybrid Electric Vehicle.” *Id.* at

⁸ Independent claim 7 includes limitations similar to claim 1. Petitioner relies on its arguments in support of claim 1 for claim 7. *See* Pet. 49. Patent Owner does not provide separate arguments for claim 7. *See generally* PO Resp. 22–36.

code (54). Severinsky describes a “parallel hybrid electric vehicle wherein an internal combustion engine and an electric motor can separately or simultaneously apply torque to the driving wheels of the vehicle, controlled to realize maximum fuel efficiency at no penalty in convenience, performance, or cost.” *Id.* at 5:31–36. Severinsky discloses “microprocessor 48 is provided with all information relevant to the performance of the system, and appropriately controls torque transfer unit 28, internal combustion engine 40, switching unit 28, and electric motor 20 to ensure that appropriate torque is delivered to the wheels 34 of the vehicle.” *Id.* at 12:64–13:2. Severinsky further discloses “at all times the microprocessor 48 may determine the load (if any) to be provided to the engine by the motor, responsive to the load imposed by the vehicle’s propulsion requirements, so that the engine 40 can be operated in its most fuel efficient operating range.” *Id.* at 17:11–15. Severinsky uses several parameters relevant to the performance of a parallel hybrid vehicle, including maximum power available to drive the vehicle, the ratio of internal combustion engine maximum power versus that of the electric motor, and optimization of the control algorithm. *Id.* at 21:23–38. Severinsky discloses that “these parameters are optimized so as to ensure that the engine is operated at all times at its maximum point of efficiency, and such that the driver need not consider the power source being employed at any given time.” *Id.*

2. Overview of Quigley — Ex. 1054

Quigley is an International Federation of Automatic Control (IFAC) paper titled “Predicting the Use of a Hybrid Electric Vehicle.” Ex. 1054,

129.⁹ Quigley describes an intelligent controller that “relies on the idea that many cars will have *habitual usage characteristics* for a high percentage of their journeys, and hence *the ability to predict the occurrence of a journey* and its associated characteristics will be quite high.” *Id.* at 130¹⁰ (emphasis added). Quigley’s proposed controller uses signals already present in vehicles including: “a) Drivers Operational Inputs: Throttle Brake etc. b) Time of day/year c) Engine Management Data: Engine speed etc. d) Road speed” which are collectively referred to as “1st Generation Control.” *Id.* Quigley discloses that its “2nd Generation Control . . . would employ the use of 1st generation control information but also would have the additional advantage of vehicle location information relayed into the vehicle from external sources.” *Id.* (emphasis omitted). Quigley discloses a data logger records control parameters, which include “Time of departure, Journey time elapsed, Speed over ground, derived from latitude and longitude.” *Id.* at 131. Using this data, different types of a driver’s journeys can be classified. *Id.* at 132. Then, the controller can determine, for example, “[i]f it is a weekday, and the time is between 07.00–08.00 a.m. then there is a high expectation of a journey of 1000 to 1300 seconds duration, with a distance around 14km.” *Id.* at 133 (emphasis omitted). GPS data can also be used to provide position data. *Id.* at 133–134.

⁹ Petitioner submits a Declaration of Sylvia Hall-Ellis, Ph.D to establish “the authenticity and public availability” of Quigley. *See* Ex. 1055. Patent Owner does not dispute the authenticity or public availability of Quigley. *See generally* PO Resp.

¹⁰ We refer to the original page numbers in Quigley in this Decision.

3. *Claim 1 (A method of operating a hybrid vehicle)*

a. *storing and supplying electrical power from a battery bank*¹¹

Petitioner contends Severinsky's method of operating a hybrid vehicle includes storing and supplying electrical power from battery pack 22. Pet. 20. Petitioner asserts Severinsky discloses battery pack 22 "is charged by power generated by the motor 20 when operated as a generator," and electric motor 20 is "powered by energy stored in a relatively large, high voltage battery pack 22." *Id.* (citing Ex. 1013, 9:65–10:14, 10:53–58).

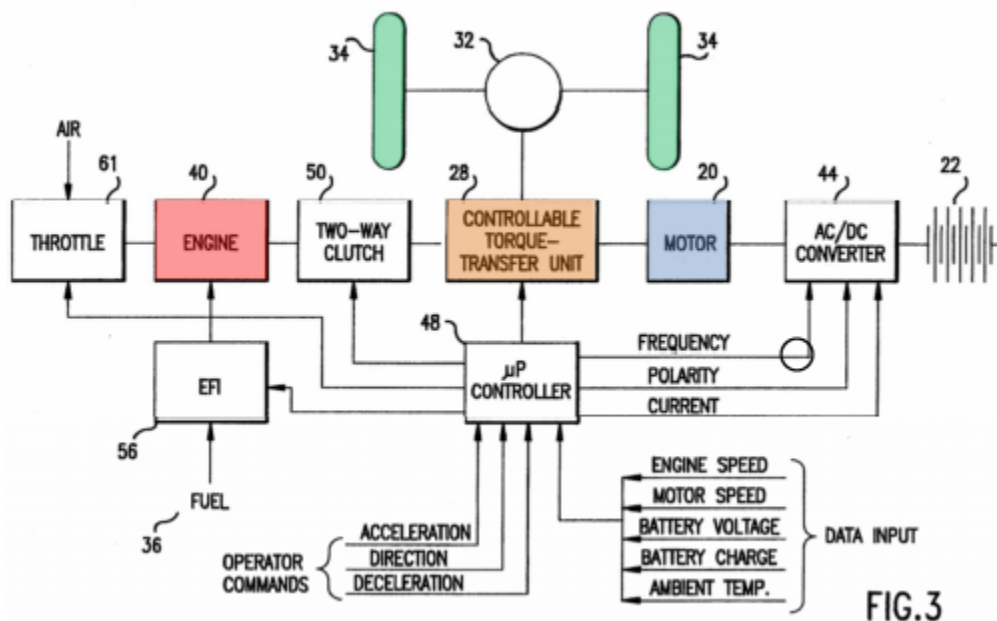
Patent Owner does not directly address Petitioner's contentions. *See* PO Resp. 22–36.

Based on the evidence discussed above, we find Severinsky discloses this limitation.

b. *applying torque to road wheels of said hybrid vehicle from one or both of an internal combustion engine and at least one traction motor*

Petitioner contends Severinsky discloses this limitation because "both the engine 40 . . . and the motor 20 . . . provide torque to the drive wheels 34 . . . by way of the controllable torque transfer unit 28." Pet. 20–21 (citing Ex. 1013, 10:24–26; Fig. 3). Petitioner provides the following annotated version of Severinsky's Figure 3:

¹¹ Here and throughout we use Petitioner's claim element annotations such as "a" for ease of reference.



Pet. 21. Figure 3 is a block diagram of Severinsky's parallel hybrid drive system. Ex. 1013, 7:45–46. Petitioner adds red highlighting to engine 40, orange highlighting to torque transfer unit 28, blue highlighting to motor 20, and green highlighting to wheels 34. Pet. 21. Figure 3 also shows engine speed and motor speed are input to microprocessor 48 which controls torque transfer unit 28. Ex. 1013, Fig. 3.

Patent Owner does not directly address Petitioner's contentions. See PO Resp. 22–36.

Based on the evidence discussed above, we find Severinsky discloses this limitation.

c. controlling flow of torque between said internal combustion engine, said at least one traction motor, and said road wheels

Petitioner contends Severinsky discloses this limitation because “microprocessor 48 . . . controls the flow of torque between the motor 20 . . . the engine 40 . . . and the wheels 34 . . . responsive to the mode of operation of the vehicle.” Pet. 22 (citing Ex. 1013, 10:26–30, Fig. 3).

Patent Owner does not directly address Petitioner's contentions. *See* PO Resp. 22–36.

Based on the evidence discussed above, we find Severinsky discloses this limitation.

d. controlling flow of electrical power between said battery bank and said at least one traction motor employing a controller

Petitioner contends Severinsky discloses this limitation because microprocessor controller 48 controls “the bi-directional flow of power between the battery 22 . . . and the motor 20.” Pet. 23 (citing Ex. 1013, 10:4–23, Fig. 3).

Patent Owner does not directly address Petitioner's contentions. *See* PO Resp. 22–36.

Based on the evidence discussed above, we find Severinsky discloses this limitation.

e. said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle

Petitioner contends that although “this claim language was added by Applicants specifically to avoid Severinsky ... [this] functionality, however, was well known in the prior art,” as evidenced by Quigley. Pet. 25.

Specifically, Petitioner contends Quigley discloses an “‘intelligent controller for hybrid electric vehicles’ that is ‘required to manage energy flow through the hybrid drive train and for optimum control.’” *Id.* (citing Ex. 1054, 129). According to Petitioner, “Quigley ‘predict[s]’ certain ‘parameters at the start of the journey using intelligent classification techniques and a knowledge base of previous journey histories.’” *Id.* (quoting Ex. 1054, 129) (alteration in original). Petitioner contends “Quigley discloses that ‘many cars will have *habitual usage characteristics* for a high percentage of their journeys,

and hence the ability *to predict the occurrence of a journey and its associated characteristics* will be quite high.” *Id.* (citing Ex. 1054, 130). Petitioner further contends “Quigley’s method determines the expected upcoming vehicle operation based on past repetitive driver behavior (i.e., during commuting times).” *Id.* at 27–28. According to Petitioner, “Quigley’s disclosure is consistent with the example provided in the ’761 patent, which refers to detecting patterns based on an operator’s daily commute.” *Id.* at 28 (citing Ex. 1001, 39:51–61).

Patent Owner counters “Quigley does not derive a ‘predicted near-term’ or ‘expected pattern of operation.’” PO Resp. 22–23. Patent Owner contends Quigley predicts certain parameters but “Quigley’s ‘parameters’ are not a pattern of any kind,” and do “not establish an ‘expected pattern of operation.’” *Id.* at 23 (citing Pet. 25; Ex. 1054,¹² 1; Ex. 2016 ¶¶ 47–50); *see also* Sur-reply, 3–4 (arguing the same). Patent Owner further contends “Quigley . . . does not predict a ‘journey’” but “only predicts parameters consisting of ‘[j]ourney duration, journey distance, time of departure, [and] journey destination.” *Id.* at 24 (citing Ex. 1054, 2; Ex. 2016 ¶ 50); *see also* Sur-reply 5 (arguing the same (citing Ex. 2016 ¶¶ 50–53)). According to Patent Owner, “[n]one of these ‘parameters’ — whether together or in isolation — constitutes a pattern of operation of the hybrid vehicle.” *Id.* (citing Ex. 2016 ¶ 50). Patent Owner further contends that “while Quigley states that the controller could monitor ‘Drivers Operation Inputs’ (including the throttle and brake), Quigley actually does not monitor these variables when conducting experiments or disclose any other use for this

¹² Patent Owner refers to the page numbers added by Petitioner to Quigley.

information.” *Id.* at 23 n. 11 (citing Ex. 1054, 2; Ex. 2016 ¶ 64) (emphasis omitted). Patent Owner further contends the plain meaning of “‘pattern’ is not so broad as to capture simple parameters such as isolated values representing distance or duration” and a skilled artisan “would understand a ‘pattern of operation of said hybrid vehicle’ to require an order or sequence of driving operations.” *Id.* at 25 (citing Ex. 2016 ¶¶ 51–53).¹³ Patent Owner continues “[t]here is neither a sequence or order to a single measurement of time or distance” which Patent Owner contrasts with a disclosed embodiment in the ’761 patent which “describes a pattern consisting of road load remaining under 20% MTO¹⁴ followed by road load varying between 0 and 50% MTO followed by road load increasing to 150% MTO.” *Id.* at 26–28 (citing Ex. 1001, 39:51–58; Ex. 2016, ¶¶ 52–53).

Petitioner, in turn, contends Patent Owner distinguished Severinsky during prosecution of the ’761 patent by arguing “in contrast to a vehicle that determines its mode of operation ‘strictly in real time’ based on a ‘vehicle designer’s’ anticipated mode of operation,” the claims of the ’761 patent “require that the vehicle’s controller monitor operation of the particular vehicle and use that data to predict future operational patterns and alter the vehicle operation accordingly.” Pet. Reply 3 (citing Ex. 1052, 58–59). Petitioner provides an annotated version of Quigley’s Figure 2 reproduced below, which according to Petitioner, shows that the purportedly

¹³ Patent Owner cites to several dictionary definitions of “pattern” to support this construction of “pattern.” PO Resp. 25 (citing Ex. 2029, 3; Ex. 2030, 3; Ex. 2031, 3).

¹⁴ “MTO” refers to maximum torque output.

novel feature of the '761 patent “was described *precisely* by Quigley.” *Id.* at 3–4.

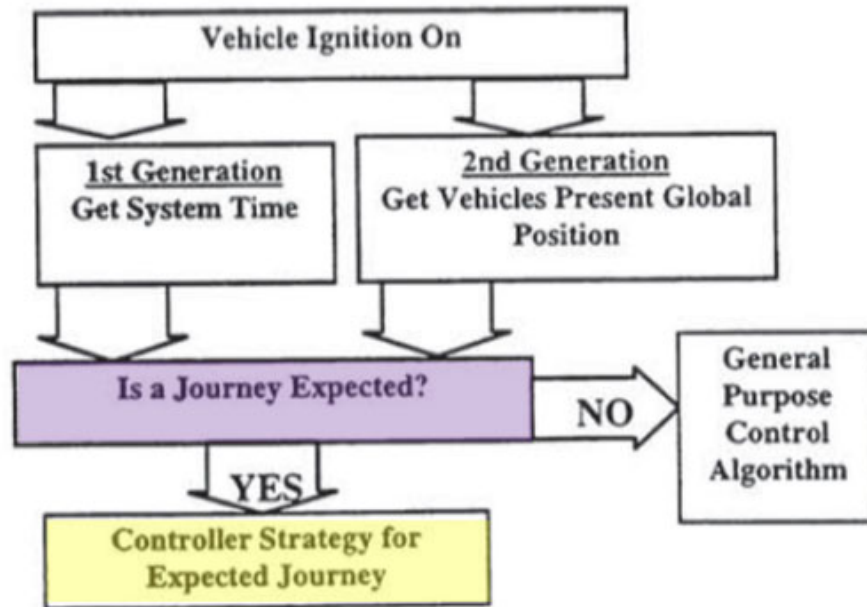


Figure 2. Decision Process of Where Am I Going?

Figure 2 of Quigley is a block diagram of a decision process including a block shaded in purple by Petitioner with the text “Is a Journey Expected?” and a block shaded in yellow by Petitioner with the text “Controller Strategy for Expected Journey.” *Id.* at 3–4 (citing Ex. 1054, 131, Fig. 2). The purple block indicates two possible steps for the controller. *Id.* If a journey is not expected, the vehicle will utilize a “General Purpose Control Algorithm,” but if the journey is expected then the vehicle will utilize a “Controller Strategy for Expected Journey.” *Id.*

For the following reasons, Patent Owner’s contentions are unavailing.

During prosecution of the '761 patent, the Examiner rejected the pending claims under 35 U.S.C. § 102 based on the same Severinsky reference upon which Petitioner relies. Ex. 1052, 91 (June 12, 2013 Office

Action). The applicant traversed the rejection over Severinsky with the following comments:

Independent claims 17 and 23 have both been amended hereby to recite that the controller performs the separate steps of monitoring vehicle operation to derive a predicted pattern of operation and then controlling vehicle operation accordingly . . .

Further, the '970 patent [Severinsky] says nothing about the **controller** performing the step of monitoring vehicle operations in order to derive a predicted pattern of operation or anticipate a pattern of operation of the vehicle. . . .

[In Severinsky] it is the vehicle designer who anticipates highway and low-speed driving, and incorporates the necessary components into the vehicle to permit the vehicle to perform both modes . . . This is very different from the vehicle's controller monitoring operation of the particular vehicle and using the data to predict future operations patterns accordingly as claimed. . .

For example, the '970 patent fails to disclose that the controller monitors variation in road load experienced by the hybrid vehicle and compares patterns of variation in said road load experienced from day to day in order to identify said repetitive patterns of vehicle operation.

Id. at 58–59.

The applicant, thus, distinguished Severinsky because its controller does not monitor operation of the vehicle and use data derived from the monitoring to adjust the set point for mode switching. Essentially, applicant argued that Severinsky discloses operating only under an analog to the “General Purpose Control Algorithm” shown in Figure 2 of Quigley as opposed to optionally operating under “Controller Strategy for Expected Journey.”

We agree with Petitioner that Quigley discloses “exactly what the Applicants believed was novel in the '761 patent over Severinsky. In short,

predicting a pattern of operation and altering vehicle control accordingly.”

Tr. 10:9–12. Petitioner’s contention is supported by the disclosure of Quigley discussed below and the testimony of Dr. Davis, which we credit. Ex. 1088 ¶ 13; Ex. 1008 ¶ 194.

We start with Quigley’s disclosure. Quigley discloses “means of intelligently estimating [] parameters, based on the controller’s past experience is needed.” Ex. 1054, 130. Quigley describes “an intelligent controller” that “will allow journey parameters to be reliably estimated upon journey departure, and therefore allow for optimal operation with respect to exhaust emissions and fuel consumption.” *Id.* According to Quigley, this type of control can be implemented because the “controller relies on the idea that many cars will have habitual usage characteristics for a high percentage of their journeys, and hence the ability to predict the occurrence of a journey and its associated characteristics will be quite high.” *Id.* Quigley discloses the controller uses “technology already present in modern day vehicles (e.g. electronic tachometer, engine management system),” and derives signal information including driver inputs such as throttle and brake usage, time of day and year, as well as engine speed data and road speed. *Id.*

Patent Owner’s contention that Quigley “only predicts parameters consisting of ‘[j]ourney duration, journey distance, time of departure, [and] journey destination’ and “[n]one of these ‘parameters’ . . . constitutes a pattern of operation of the hybrid vehicle” (PO Resp. 24) is based on an improperly narrow reading of Quigley. Patent Owner argues Quigley discloses “the controller *could* monitor” the Drivers Operational Inputs “but actually does not monitor these variables when conducting the experiments

or disclose any other use for this information.” *Id.* at 23 n11 (citing Ex. 1054, 2; Ex. 2016 ¶ 64). We disagree.

Regardless of what Quigley chose to monitor during the experiments, Quigley discloses the 2nd Generation Control “*would* employ the use of 1st generation control information” and the 1st Generation Control “*would use* signals derived from”, *inter alia*, “Driver’s Operational Inputs.” Ex. 1054, 130 (emphasis added).

Patent Owner bases its contentions on Dr. Shahbakhti’s testimony that “Quigley simply calculates journey parameters such as duration and distance.” Ex. 2016 ¶ 48. Dr. Davis testifies that a skilled artisan would understand that Quigley’s reference to “associated characteristics” of a journey “are determined from signals from operational driver inputs.” Ex. 1088 ¶ 16 (citing Ex. 1008 ¶ 188; Ex. 1054, 130). We credit Dr. Davis’s testimony that a skilled artisan would have understood Quigley discloses monitoring more than simple journey parameters because it is consistent with the actual disclosure of Quigley.

We find Quigley teaches a controller that is not limited to monitoring journey duration, journey distance, time of departure, and journey destination because it discloses the 2nd Generation Control includes monitoring the data Quigley describes as included in 1st Generation Control. Ex. 1054, 130 (2nd Generation Control “*would* employ the use of 1st generation control information.”).

Further, we find Quigley discloses “monitoring operation of the vehicle” as required by claim 1 because it discloses deriving signal information about how the vehicle is operating using, for example, throttle and brake usage, and engine speed data. Ex. 1054, 130 (1st Generation

Control “would use signals derived from technology already present in modern day vehicles.”).

We now turn to the question of whether Quigley discloses “deriving a predicted near-term pattern of operation”¹⁵ based on monitoring the operation of the vehicle.

Quigley discloses its controller gathers signal information to develop a pattern based on “habitual usage characteristics.” Ex. 1054, 130. Quigley further discloses “[a] commuter journey is a particularly good example of a journey that exhibits habitual characteristics.” *Id.* A commuter journey starts on a weekday between 7 and 8 a.m. *Id.* at 133. Quigley further discloses that if its controller “decides a journey is expected it can make an estimation of the expected journey parameters, and an appropriate optimized control strategy can be referenced from the controller’s memory.” *Id.* at 131.

Quigley, thus, discloses predicting a near-term pattern of operation, *i.e.*, a commuter journey, when the journey starts on a weekday between 7 and 8 a.m. This prediction is based on monitoring previous vehicle activity derived from time of departure and from driver inputs such as throttle and brake usage, as well as engine speed data and road speed. *See* Ex. 1008 ¶¶ 189–193.

Patent Owner’s contention that Quigley’s journey parameters are not a pattern of operation of the vehicle is based on its premise that a skilled artisan “would understand a ‘pattern of operation of said hybrid vehicle’ to require an order or sequence of driving operations.” PO Resp. 25. Patent

¹⁵ We use our construction of this phrase, “an expected pattern of operation,” interchangeably in our analysis.

Owner does not direct us to any claim language or portions of the Specification of the '761 patent or its prosecution history to support this construction. *Id.*

Patent Owner relies exclusively upon extrinsic evidence, namely, Dr. Shahbakhti's testimony and several dictionary definitions. *See* PO Resp. 25. Dr. Shahbakhti relies on the same dictionary definitions. *See* Ex. 2016 ¶ 52. Dr. Shahbakhti testifies the "'761 patent describes such a 'near-term pattern' consisting of road load remaining under 20% MTO followed by road load varying between 0 and 50% followed by road load increasing to 150% MTO" which Dr. Shahbakhti asserts "stands in stark contrast to a single parameter for the journey as a whole." *Id.* at ¶ 53 (citing Ex. 1001, 39:51–58). However, this testimony is undermined by the succeeding portions of the paragraph from the '761 patent to which Dr. Shahbakhti cites. The '761 patent explains that in response to varying loads "the transition point might be adjusted to 60% of MTO" to "prevent repetitive engine starts" or "the engine starting routine might be initiated after the *same total distance* had been covered each day." Ex. 1001, 39:61–68 (emphasis added). Thus, contrary to Patent Owner's contention and Dr. Shahbakhti's testimony, the '761 patent explicitly discloses that the pattern information can indeed be the singular data point of total distance travelled. Thus, we assign little weight to Dr. Shahbakhti's claim construction testimony as well as his testimony that Quigley's disclosure of journey parameters including a vehicle's travel duration/distance are not a "pattern of vehicle operation." Ex. 2016 ¶¶ 49–50.

Based on the evidence cited by Petitioner and after considering Patent Owner's contentions, we find the combined teachings of Severinsky and Quigley disclose this claim limitation.

f. said controller ... controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation of said hybrid vehicle

Petitioner contends Figure 2 of Quigley teaches using a “controller strategy for [the] expected journey.” Pet. 28 (alteration in original). According to Petitioner, “Quigley’s intelligent controller . . . predicts the occurrence of a trip based on habitual usage (pattern of operation) by the driver of a vehicle (discussed in Part e), and implements an appropriate optimized control strategy responsive to the predicted trip.” *Id.* at 29 (citing Ex. 1054, 130–31; Fig. 2). Petitioner further contends Quigley’s “intelligent controller optimally controls the various modes of operation, i.e., electric motor only, engine only, motor and engine combination, which govern the exhaust emissions and fuel consumption in a hybrid vehicle.” *Id.* at 29–30 (citing Ex. 1054, 129–130).

Patent Owner does not directly address Petitioner’s contentions. *See* PO Resp. 22–36.

Based on the evidence cited by Petitioner, we find the combined teachings of Severinsky and Quigley disclose this limitation.

g. Motivation to Combine

Petitioner contends a skilled artisan “would have been motivated to incorporate Quigley’s teachings of using predictive travel patterns into Severinsky’s control scheme to further optimize parameters based on how a particular vehicle is being used in order to increase engine efficiency and reduce emissions.” Pet. 30 (citing Ex. 1008 ¶¶ 197–198). In support,

Petitioner points to Severinsky’s “express goal . . . to optimize parameters, such as those of the control algorithm and the distribution of power between the motor and engine, etc., to ‘ensure that the engine is operated at all times at its maximum point of efficiency.’” *Id.* at 31 (citing Ex. 1013, 21:21–38). Petitioner further contends Quigley “recognized the benefits of, and taught optimizing the hybrid control strategy based on, predicted actual vehicle usage.” *Id.* (citing Ex. 1054, 129–130). In particular, Petitioner points to the statement in Quigley “that ‘many cars will have habitual usage characteristics for a high percentage of their journeys,’ and that the estimation of upcoming journey parameters can allow ‘optimal operation with respect to exhaust emissions and fuel consumption.’” *Id.* at 32 (citing Ex. 1054, 130). Petitioner contends because “Severinsky’s control scheme selects the mode of operation (i.e., motor only, engine only, motor plus engine) for maximum efficiency,” a skilled artisan “would have modified [Severinsky’s] controller to similarly employ a ‘control strategy’ that determines the optimal mode of operation based on expected upcoming journeys (e.g., near-term predicted pattern of operation).” *Id.* (citing Ex. 1008 ¶ 200). According to Petitioner, “the modification of Severinsky with Quigley would better adapt Severinsky’s controller for a wider variety of vehicle operations . . . in order to increase the vehicle’s efficiency (exhaust emissions and fuel consumption).” *Id.* at 33 (citing Ex. 1008 ¶¶ 197–200).

Petitioner next contends a skilled artisan “would have had a reasonable expectation of success in implementing Quigley’s teachings into Severinsky’s controller” for several reasons. Pet. 33 (citing Ex. 1008 ¶ 200). First, Petitioner contends a skilled artisan “would have looked to Quigley, which discloses how to further optimize hybrid operation based on actual

patterns of vehicle usage” and “addresses inefficiencies of using general-purpose or standard parameters.” *Id.* Second, Petitioner contends a skilled artisan “would only need to modify Severinsky’s controller logic to use the information reflecting the estimated journey parameters taught by Quigley, rather than simply using general-purpose parameters independent of actual predicted usage.” *Id.* at 34 (citing Ex. 1008 ¶ 200). Third, Petitioner contends the ’761 patent discloses “that it was ‘within the skill of the art to program a microprocessor to record and analyze such daily patterns, and to adapt the control strategy accordingly.’” *Id.* (citing Ex. 1001, 39:58–61).

Patent Owner, in turn, contends Petitioner “fails to explain how modifying Severinsky with Quigley’s disclosure could possibly result in the claimed invention or achieve any benefit whatsoever.” PO Resp. 30. Patent Owner further contends Petitioner “fails to explain why a POSA would look to Quigley — a reference that expressly does **not** use its ‘intelligent controller’ for selecting between electric motor operation and engine operation — to improve Severinsky.” *Id.* at 30–31. According to Patent Owner, “Quigley **only** uses the ‘intelligent controller’ for determining how to balance use of the engine and electric motor . . . in what Quigley calls ‘mode 3’” and “relies on **the driver** to decide manually regarding when to use the electric motor or engine (modes 1 and 2).” *Id.* at 31–32 (citing Ex. 1054, 1–2; Ex. 2016 ¶¶ 78–79).

Patent Owner next contends Petitioner “fails to explain how or why a [skilled artisan] could improve Severinsky’s control system using Quigley’s . . . ‘journey parameters’ consisting of ‘[j]ourney duration, journey distance, time of departure, journey destination.’” PO Resp. 32 (citing Pet. 32; Ex. 1054, 2). According to Patent Owner, Quigley’s “parameters have nothing

to do with switching between operating modes.” *Id.* (citing Ex. 2016 ¶¶ 79–81). Patent Owner further contends these parameters could only be used to calculate average speed which “does not provide any information about instantaneous vehicle operation including instantaneous torque required to propel the vehicle” and averages in general “are not useful for ‘energy management’ in ‘complex propulsion systems’ such as Severinsky’s parallel hybrid vehicles.” *Id.* at 34 (citing Ex. 2016 ¶¶ 81–83; Ex. 2033, 38).

Patent Owner next disputes Petitioner’s contention that a skilled artisan would have a reasonable expectation of success because Petitioner “fails to identify one ‘journey parameter’ that Severinsky would use” and faults Petitioner for failing to “explain how Severinsky would use one of Quigley’s ‘journey parameters’ to improve efficiency or emissions.” *Id.* at 35–36.

Petitioner counters that Patent Owner improperly attacks Quigley’s teachings in isolation because Petitioner’s “proposed combination *begins* with Severinsky’s controller, whose control strategy a [skilled artisan] would improve based on Quigley’s pattern recognition and control-related teachings” and that Quigley itself provides the motivation for a skilled artisan to do so, *i.e.*, “for optimum control.” Pet. Reply 5 (citing Ex. 1054, 129). Petitioner next contends Patent Owner’s assertion that Quigley only predicts single data points is based on “a narrow view of one aspect of the disclosure but ignores the rest.” *Id.* at 6. Petitioner directs us to Quigley’s 1st Generation Control that estimates journey parameters such as throttle, brake engine speed, and road speed. *Id.* at 6–7 (citing Ex. 1054, 130; Ex. 1088 ¶ 16). Petitioner also takes issue with Patent Owner’s implied construction of “pattern” as “an order or sequence of driving operations”

which according to Petitioner is based only on extrinsic evidence and “adds numerous limitations not found in the Board’s construction (or PO’s own proposed construction).” *Id.* at 9–10 (emphasis omitted).

Petitioner contends Quigley’s controller “would have tracked information such as speed, engine speed, road speed and road load” in order “to manage the energy flow through the hybrid drive train.” Pet. Reply 14 (citing Ex. 1054, 130; Ex. 1088 ¶ 16; Ex. 2034, 7:8–8:5, 12:5–13:8, 26:7–27:25). According to Petitioner, because “these are the same parameters Severinsky relied on for optimizing control,” the proposed combination of Severinsky and Quigley “would merely involve using the same signals that Severinsky is already utilizing but with an ‘intelligent’ control that employs a ‘controller strategy’ for an expected journey.” *Id.* (citing Ex. 1088 ¶¶ 32–33).

In the Sur-reply, Patent Owner contends Petitioner “argues for the first time that Quigley ‘would have tracked information such as speed, engine speed, road speed, and road load.’” Sur-reply 13. Patent Owner argues we should disregard this argument as untimely. *Id.* at 13 n. 9.

For the following reasons, we find Patent Owner’s contentions do not undercut Petitioner’s articulated reasons for the combination of Severinsky and Quigley, which is supported by a rational underpinning.

First, we agree with Petitioner that Patent Owner’s arguments attack Quigley in isolation for failure to disclose elements of the claim disclosed in Severinsky. Pet. Reply 5. For example, Patent Owner argues that Quigley “expressly does *not* use its ‘intelligent controller for selecting between electric motor operation and engine operation.’” PO Resp. 30–31. Petitioner, however, relies on Severinsky’s controller for selection of the

operating mode. *See, e.g.*, Pet. 23 (“If the vehicle then starts to climb a hill, the motor 20 is used to supplement the output torque of engine 40.

Similarly, the motor 20 can be used to start the engine 40, e.g., when accelerating in traffic or the like.” (citing Ex. 1013, 10:30–51, Fig. 4–9)); Ex. 1001, 24:30–40 (describing Severinsky operating the engine and motor in different modes); Ex. 1008 ¶¶ 169–173 (Dr. Davis testifying concerning Severinsky controlling the engine and motor in various modes in connection with Figures 4 and 5 of Severinsky). Petitioner proposes to modify Severinsky’s controller with pattern information as taught by Quigley. *See* Pet. 30 (arguing Quigley discloses a controller that monitors patterns to alter vehicle operation which Applicant represented to the Examiner was missing in Severinsky during prosecution of the ’761 patent); Ex. 1008 ¶ 198 (“It would have been obvious to a person of ordinary skill in the art when viewing the teachings of Quigley to use the pattern data in Severinsky’s controller to further optimize the control scheme based on how the vehicle is predicted to be used.”).

Second, Patent Owner’s contention that Quigley only monitors parameters such as journey time and journey distance and those parameters could only be used to obtain average speed is unavailing. As discussed above in connection with claim element 1e, we find Quigley’s disclosure is not limited to monitoring only those parameters but also monitors the first generation parameters, so this contention is contrary to Quigley’s disclosure. In addition, regardless of Quigley’s disclosure, Petitioner relies on Figure 3

of Severinsky which shows its controller monitors engine speed and motor speed. *See* Pet. 23 (citing Ex. 1013, Fig. 3).¹⁶

Third, Patent Owner’s argument that Petitioner fails to show a reasonable expectation of success ignores the explicit teaching of the ’761 patent. The ’761 patent states “It is within the skill of the art to program a microprocessor to record and analyze such daily patterns, and to adapt the control strategy accordingly.” Ex. 1001, 39:58–61. Dr. Davis testifies “[a] skilled artisan would have understood how to implement Quigley’s pattern monitoring functionality into the controller of the Severinsky hybrid vehicle to alter the vehicle’s operating points” and “would only need to modify Severinsky’s logic to use the information reflecting the predicted journey parameters as taught by Quigley, rather than simply using ‘vehicle designer’s’ choices which are independent of predicted usage.” Ex. 1008 ¶ 200. Petitioner’s proposed combination as articulated by Dr. Davis establishes a reasonable expectation of success because it requires no more than what the ’761 patent describes is within the level of skill in the art.

In this case, both Severinsky and Quigley address control strategies for hybrid vehicles. Quigley discloses monitoring vehicle operations and predicting an expected pattern of operation. The applicant distinguished Severinsky during prosecution of the ’761 patent for the precise reason that Severinsky lacks Quigley’s monitoring of vehicle operation to derive a pattern of operation. Petitioner shows Severinsky’s controller monitors

¹⁶ We disagree with Patent Owner’s contention that Petitioner’s argument that Quigley teaches monitoring engine speed and other matters is untimely. Petitioner’s argument is responsive to Patent Owner’s contentions that Quigley monitors only journey time and journey distance.

many of the same parameters as Quigley¹⁷ and a skilled artisan would have been motivated to combine the teachings for the reasons disclosed in Quigley. Pet. 30–34; Ex. 1008 ¶¶ 197–200. The interrelated teachings of Severinsky and Quigley, thus, provide sufficient motivation to combine. *KSR*, 550 U.S. at 418 (explaining motivation to combine can be found in the “interrelated teachings of multiple patents”); *Zup, LLC v. Nash Manufacturing, Inc.*, 896 F. 3d 1365, 1369 (Fed. Cir. 2018).

h. Summary of Claim 1

For all the foregoing reasons, we determine Petitioner establishes by a preponderance of the evidence that the combined teachings of Severinsky and Quigley disclose each limitation of claim 1 and that a skilled artisan would have been motivated to combine the teachings and would have had a reasonable expectation of success in doing so.

4. Claim 2

Claim 2 depends from claim 1 and recites “wherein said derived predicted pattern of operation comprises at least one repetitive pattern of operation of said hybrid vehicle.” Ex. 1001, 56:51–53.

Petitioner contends a skilled artisan would understand Quigley’s reference to “‘habitual’ usage characteristics mean[s] or would necessarily include a repetitive pattern.” Pet. 35 (citing Ex. 1008 ¶ 203). Petitioner further contends Quigley’s Figures 6 and 7 “expressly recognized patterns based on the commute repeating during 7-8 am on weekdays.” *Id.* (citing Ex. 1054, 132–133).

¹⁷Dr. Shahbakhti does not dispute that throttle and brake information are used in Severinsky’s controller. Ex. 1103, 123:7–13.

Patent Owner counters that “[t]here is nothing repetitive about Quigley’s parameters.” PO Resp. 36. Patent Owner further contends “As set forth above, these are isolated values, and there is no evidence that they are repetitive in nature.” PO Resp. 36 (citing Ex. 2016 ¶¶ 57–59). Patent Owner repeats its contention from claim 1 that “the only thing that Quigley calculates that is ‘predicted’ or ‘expected’ are isolated parameters, not a repetitive pattern of operation.” *Id.* at 37 (citing Ex. 2016 ¶ 59).

To the extent Patent Owner relies on its contentions from claim 1 concerning the parameters monitored by Quigley, the contention is unavailing for the same reasons discussed in connection with claim element 1e.

Based on our review of the evidence cited by Petitioner and after considering Patent Owner’s contentions, we determine Petitioner establishes by a preponderance of the evidence that claim 2 would have been obvious over the combined teachings of Severinsky and Quigley.

5. Claim 3

Claim 3 depends from claim 2 and recites “said controller stores a day-to-day record of vehicle operation in order to detect repetitive patterns of operation of said hybrid vehicle.” Ex. 1001, 56:54–56.

Petitioner contends Quigley “discloses collecting data and segmenting it into weekday (Monday to Friday) and weekend (Saturday and Sunday) data for evaluation.” Pet. 36 (citing Ex. 1054, 131–133, Figs. 6, 7). Based on this, Petitioner contends “Quigley’s derived pattern is based upon a stored day-to-day record of vehicle operations.” *Id.* (citing Ex. 1008 ¶ 203).

Patent Owner does not dispute Petitioner’s contentions for claim 3 separate from its contentions for claim 1. PO Resp. 43 n.23.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 3 would have been obvious over the combined teachings of Severinsky and Quigley.

6. *Claim 4*

Claim 4 depends from claim 3 and recites “wherein said controller monitors variation in road load experienced by said hybrid vehicle and compares patterns of variation in road load experienced from day to day in order to identify said repetitive patterns of operation of said hybrid vehicle.” Ex. 1001, 56:57–61.

Petitioner starts with the proposition that Severinsky’s microprocessor at all times “determine[s] the load . . . to be provided to the engine by the motor, responsive to the load imposed by the vehicle’s propulsion requirements, so that the engine 40 can be operated in its most fuel efficient operating range.” Pet. 36–37 (citing Ex. 1013, 6:19–26, 17:11–15, 10:26–43). Relying on the testimony of Dr. Davis, Petitioner contends a skilled artisan “would recognize that if the load is being determined ‘at all times,’ the controller would necessarily be monitoring variations in the load.” *Id.* at 37 (citing Ex. 1008 ¶¶ 209–216). Petitioner acknowledges Quigley “does not expressly specify that it is comparing ‘variation in road load’ to determine such patterns” but contends that because “Quigley bases pattern data on variations in speed and operator inputs such as throttle or brake pedal, it is necessarily basing its pattern data on variations in road load.” *Id.* at 37–38 (citing Ex. 1008 ¶¶ 217–218). Petitioner further contends a skilled artisan applying Quigley’s teachings to Severinsky as in claim 1 would have been additionally “motivated to detect variations in road load to determine patterns when optimizing vehicle control because Severinsky’s engine

control strategy is based on comparing road load to setpoints in order to determine when to change modes of operation.” *Id.* at 38 (citing Ex. 1008 ¶ 219). Petitioner further contends Quigley’s “estimation of upcoming journey parameters can allow ‘optimal operation with respect to exhaust emissions and fuel consumption.’” *Id.* at 39 (citing Ex. 1054, 130).

Petitioner further contends a skilled artisan modifying Severinsky “would have desired to look for predicted patterns of operation and would have recognized that pattern information based on road load can further optimize the determination of when to enter each different mode of operation.” *Id.* (citing Ex. 1008 ¶¶ 197–200, 219).

Patent Owner, in turn, contends that neither Severinsky nor Quigley discloses comparing patterns of variation in road load day-to-day. PO Resp. 37–38, 42. Patent Owner further contends Quigley tracks time of departure, journey time elapse, and speed over ground and “[n]one of these variables are the ‘amount of *instantaneous* torque required for propulsion of the vehicle.’” *Id.* at 38 (citing Ex. 2016 ¶¶ 65–69). Patent Owner further contends Petitioner’s “conclusory statement that monitoring operator inputs ‘necessarily’ results in patterns of variation in road load fall short of the inherency standard.” *Id.* Patent Owner then repeats its contention from claim 1 that Quigley does not actually “monitor ‘Drivers Operation Inputs’ (including the throttle and brake).” *Id.* at 39; *see also id.* at 41 (“Quigley only looks at time of departure, journey duration, and total distance to predict these parameters for a future trip.” (citing Ex. 1054, 5)).

Petitioner responds that “Severinsky, when modified in view of Quigley, would maintain such a history as would be required for the controller to analyze the patterns of the road load and to adjust the controller

strategy accordingly.” Pet. Reply 16 (citing Ex. 1088 ¶ 26). Petitioner further contends that regardless of Quigley’s lack of explicit disclosure of “monitoring road load, ‘the subject matter as a whole would have been obvious at the time the invention was made’ because road load would be among the parameters that a [skilled artisan] would monitor and use for the adjustment of control *in Severinsky* based on Quigley’s teachings.” *Id.* at 17 (citing Ex. 1088 ¶ 27).

For the following reasons, Patent Owner’s contentions are unavailing.

First, to the extent that Patent Owner and Dr. Shahbakhti rely on claim 1 contentions that Quigley does not monitor the Driver’s Operation Inputs, those contentions are unavailing for the same reasons discussed above for claim 1.

Second, Petitioner’s challenge to claim 4 is based on modifying Severinsky’s controller based on Quigley’s pattern detection. Ex. 1088 ¶ 26. Dr. Davis testifies “a skilled artisan applying the pattern detection teachings from Quigley into Severinsky would know to detect the variations in road load to determine patterns when optimizing vehicle control because Severinsky’s engine control strategy is based on comparing road load to set points to determine when to change modes.” Ex. 1008 ¶ 219; Ex. 1088 ¶ 26. Patent Owner does not dispute Petitioner’s contention “that Severinsky ‘teaches an engine control strategy that depends on road load.’” PO Resp. 37 (citing Ex. 1003, 16); *see also* Ex. 2016 ¶ 61 (Dr. Shahbakhti stating that “Severinsky at best calculates the instantaneous torque requirements but does not maintain any historical record of variations in road load.”).

We credit the testimony of Dr. Davis who testifies that “if Severinsky’s controller were to be modified in view of Quigley’s pattern

related teachings, it would have to maintain such a history” of road load pattern variations in order “to adjust the ‘controller strategy’ accordingly as taught by Quigley.” Ex. 1088 ¶ 26. Dr. Davis further testifies Severinsky’s modified controller “would have to compare ‘variations’ of such patterns of road load” on a day to day basis in connection with Quigley’s morning weekday commute. *Id.* ¶ 30. The fact that neither Quigley nor Severinsky explicitly disclose monitoring variations in road load from day to day is of little import because a skilled artisan is not an automaton. *KSR*, 550 U.S. at 421 (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”). Further, we do not agree with Patent Owner that Dr. Davis posits an unsupported inherency argument. In point of fact, Dr. Shahbakhti confirms that Severinsky calculates instantaneous torque which is essentially equivalent to road load. *See* Pet. 14 (citing construction of road load from prior *inter partes* reviews on related patents as the “amount of instantaneous torque required for propulsion of the vehicle”) (citing Ex. 1003, 8, 11; Ex. 1004, 8, 11; Ex. 1005).

Dr. Davis’s testimony is based on the disclosure of both Quigley and Severinsky and how a skilled artisan would combine those teachings. In order to vary Severinsky’s control strategy based on Quigley’s patterns, Severinsky would necessarily monitor patterns of variation of road load because the torque is instantaneous and varying. Petitioner, thus, articulates reasons supported by a rational underpinning to combine the teachings of Severinsky and Quigley to monitor the day to day variations of road load.

Based on our review of the evidence cited by Petitioner and after considering Patent Owner’s contentions, we determine Petitioner establishes

by a preponderance of the evidence that claim 4 would have been obvious over the combined teachings of Severinsky and Quigley.

7. *Claim 5*

Claim 5 depends from claim 2 and recites:

wherein said hybrid vehicle is operated in different operational modes dependent on road load experienced by said hybrid vehicle, including switching from a low-load mode wherein the hybrid vehicle is propelled solely by said at least one traction motor to a higher-load mode wherein the hybrid vehicle is propelled at least in part by said internal combustion engine, the transition between said low-load and higher-load modes being initiated when the road load reaches a predetermined percentage of a maximum torque output of the internal combustion engine, and wherein said predetermined percentage can be varied by said controller responsive to said detected patterns of vehicle operation so as to avoid excessive transitions between said low-load and higher-load modes, thereby avoiding excessive engine starting operations.

Ex. 1001, 56:62–57:9.

Petitioner contends Severinsky’s “microprocessor determines whether the engine, motor, or both should be operated in order to provide the torque required for propulsion of the vehicle.” Pet. 39 (citing Ex. 1013, 6:19–26, 10:26–43). Petitioner further contends Severinsky “specifically describes the ‘various modes of operation’ in connection with Figures 4–9.” *Id.* at 39–40 (citing Ex. 1013, 10:40–51, Figs. 4–9).

Petitioner contends Severinsky’s Figure 4 illustrates operating in low speed circumstances where “electric motor 20 . . . provides all of the torque . . . needed to move the vehicle.” *Id.* at 40 (citing Ex. 1013, 10:52–53, 10:66–68, Fig. 4). Petitioner further contends Severinsky’s Figure 5 illustrates operating in highway cruising mode where “all torque . . . required to drive the vehicle at normal highway speeds . . . is provided by the internal combustion engine.” *Id.* at 41 (citing Ex. 1013, 13:66–42, Fig.

5). Petitioner further contends Severinsky’s “microprocessor determines the mode . . . depending on operating conditions, and will transition from motor only . . . to engine only . . . during steady state cruising on the highway.” *Id.* at 42 (citing Ex. 1013, 6:23–43). Based on this, Petitioner contends Severinsky discloses “switching from a low-load mode where the vehicle is propelled only by a traction motor to higher-load mode where the vehicle is propelled at least in part by an engine” as required by claim 5. *Id.* (citing Ex. 1008 ¶¶ 231–238).

Petitioner contends “Severinsky discloses that the ‘internal combustion engine is run only in the near vicinity of its most efficient operational point, that is, such that it produces 60–90% of its maximum torque whenever operated.’” Pet. 42–43 (citing Ex. 1013, 20:63–67). Petitioner further contends “Severinsky discloses a transition between a low load mode (*e.g.*, Fig. 4) and a higher-load mode (*e.g.*, Fig. 5) when the road load reaches a predetermined percentage (greater than 60%) of the maximum torque output” which satisfies the requirements of claim 5. *Id.* at 43 (citing Ex. 1008 ¶¶ 243–246).

Petitioner next contends that the language in claim 5 “that the predetermined percentages ‘*can be varied* by said controller responsive to said detected patterns” does not further limit the method of claim 5 because it is optional claim language. Pet. 44. Petitioner alternately contends that “Severinsky discloses varying the point for transition amongst modes on certain occasions where it may be beneficial to operate the engine outside of its most fuel-efficient operating range.” *Id.* (citing Ex. 1013, 18:23–42). Petitioner relies on Severinsky’s hysteresis mode “to ‘eliminate nuisance engine starts’ . . . that may occur in suburban driving if the vehicle speed

fluctuates above and below the 30-mph highway mode speed.” *Id.* at 45 (citing Ex. 1013, 18:34–40). Petitioner contends that a skilled artisan would understand that Severinsky’s hysteresis mode “var[ies] the transition point [and] could be optimized using the pattern information disclosed by Quigley, which is designed to adapt the vehicle to a wider range of operation.” *Id.* (citing Ex. 1008 ¶ 254).

Patent Owner does not dispute Petitioner’s contentions for claim 5 separate from its contentions for claim 1. PO Resp. 43 n.23.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 5 would have been obvious over the combined teachings of Severinsky and Quigley.

8. *Claim 6*

Claim 6 depends from claim 1 and recites:

wherein said hybrid vehicle is operated in different operational modes dependent on road load experienced by said hybrid vehicle, including switching from a low-load mode wherein the hybrid vehicle is propelled solely by said at least one traction motor to a higher-load mode wherein the hybrid vehicle is propelled at least in part by said internal combustion engine, and wherein a value of said road load at which said transition between said first and second modes occurs can be varied by said controller responsive to anticipated patterns of vehicle operation.

Ex. 1001, 57:10–19.

Petitioner contends that several limitations of claim 6 are the same as those of claim 5 and relies on its contentions for claim 5. Pet. 47. Petitioner further contends, similar to claim 5, the language in claim 6 “transition between said first and second modes can be varied by said controller” is optional language that does not limit the claims. *Id.* Petitioner alternately

contends that Severinsky discloses this limitation in claim 5. *Id.* at 48.

Petitioner contends “if Severinsky’s controller utilized Quigley’s recognized travel patterns to derive near term pattern of operation usage to increase engine efficiency and reduce emissions, it would do that by altering the value of the road load at which the transition between modes occurs.” *Id.* (citing Ex. 1008 ¶¶ 262–263).

Patent Owner does not dispute Petitioner’s contentions for claim 6 separate from its contentions for claim 1. PO Resp. 43, n.23.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 6 would have been obvious over the combined teachings of Severinsky and Quigley.

9. Claim 7

Petitioner relies on substantially the same arguments and evidence for claim 7 as for claim 1. Pet. 49. Patent Owner does not provide any separate contentions for claim 7. *See* PO Resp. 22–43. For the same reasons discussed above in connection with claim 1, we determine Petitioner establishes by a preponderance of the evidence that claim 7 would have been obvious over the combined teachings of Severinsky and Quigley.

10. Dependent Claims 8–12

For claims 8–12, Petitioner relies on its contentions for claims 2–6 respectively which recite substantially similar limitations. Pet. 49–50. For claims 8 and 10, Patent Owner relies on its contentions for claims 2 and 4 respectively. PO Resp. 36, 37. Because claims 2 and 4 recite substantially similar limitations and for the same reasons discussed above in connection with claims 2 and 4, we determine Petitioner establishes by a preponderance of the evidence that claims 8 and 10 would have been obvious over the

combined teachings of Severinsky and Quigley. For claims 9, 11 and 12, Patent Owner refers us to its contentions for claims 7 and 8 and argues that the claims are not unpatentable for the same reasons. PO Resp. 43 n.23. Because we determine that claims 7 and 8 would have been obvious over the combined teachings of Severinsky and Quigley, we likewise determine that claims 9, 11, and 12 would have been obvious over Severinsky and Quigley.

E. Ground 2: Obviousness over Severinsky and Nii

In this ground, Petitioner substitutes Nii's disclosure of expected patterns of operation for that of Quigley in Ground 1. Pet. 50–62. Consequently, we begin our analysis with a brief overview of Nii. We then address the parties' respective contentions with respect to the challenged claims.

1. Overview of Nii — Ex. 1022

Nii is a United States Patent issued on July 22, 1997. Ex. 1022, code (45). Nii is titled “Generator Output Controller for Electric Vehicle with Mounted Generator.” *Id.* at code (54). Nii describes a generator output controller for an electric vehicle where “power generation is properly controlled by recognizing a predetermined travel pattern by an instruction of the driver or recognizing a travel pattern in accordance with the start time of a vehicle.” *Id.* at 1:64–67. Nii discloses “people commuting using a standard vehicle” as a regular travel pattern. *Id.* at 2:21–22. Nii discloses “travel-pattern recognition means for recognizing a travel pattern when travelling under the same condition is repeated a predetermined number of times or more in accordance with stored data by storing the starting time, power consumption for travel, and duration of travel of a vehicle whenever the vehicle travels.” *Id.* at 3:7–12. Nii further discloses “[w]hen a journey

at the same time and the same accumulated motor output is performed many times, a target generator output is stored by using the journey as a travel pattern.” *Id.* at 6:44–46. “[T]he travel pattern is recognized by the starting time and the output of the generator 20 is automatically set to the target generator output.” *Id.* at 6:46–49. Nii explains that because a travel pattern normally consumes approximately the same power, by operating generator 20 without load fluctuation, “it is possible to decrease harmful components in exhaust gas and improve fuel consumption.” *Id.* at 6:1–8.

2. Claim 1

Limitations a–d and f

Petitioner relies on the same contentions discussed above in connection with Ground 1 for limitations a–d and substitutes Nii’s disclosure for that of Quigley with respect to limitations e and f. Pet. 50, 52. Patent Owner does not directly address limitations a–d and f in the Patent Owner Response but disputes claim element e and Petitioner’s motivation to combine. *See* PO Resp. 44–59. For the same reasons discussed above in connection with Ground 1, we are persuaded by Petitioner’s contentions with respect to limitations a–d. Therefore, we limit our analysis to claim elements e and f and motivation to combine.

e. said controller derives a predicted near-term pattern of operation of said hybrid vehicle by monitoring operation of said hybrid vehicle

Petitioner contends Nii discloses a controller for a hybrid vehicle wherein the “controller stores and determine patterns of vehicle operation over time, such as ‘people commuting using a standard vehicle or taking people to and from their offices using a commercial vehicle.’” Pet. 51 (citing Ex. 1022, 1:24–39, 2:21–24, 4:17–24, 5:59–64, Fig. 1). Petitioner

further contends Nii discloses this limitation because “Nii describes ‘*recognizing a travel pattern* when a [sic] travelling under the same condition is repeated a predetermined number of times or more” and Nii’s “controller will recognize a travel pattern even if the driver is not aware of it, and automatically set the output of the generator.” *Id.* (citing Ex. 1022, 2:4–5, 2:63–64; 3:7–9; 6:43–51) (alteration in original). Petitioner further contends Nii stores the travel patterns to increase the accuracy of the generator target output. *Id.* at 51–52 (citing Ex. 1022, 6:9–13). According to Petitioner, because “Nii recognized travel patterns to set target outputs, a POSA would recognize that it is deriving a predicted near-term pattern of operation, as the target output is intended to cover the expected upcoming operation based on the detected pattern.” *Id.* (citing Ex. 1008 ¶¶ 286–288).

Patent Owner contends Nii “at best derives a predicted output of the power generator — not a ‘predicted near-term’ or ‘expected pattern of operation’” as required by claim 1. PO Resp. 44–45. While acknowledging that Nii “look[s] at things that happened in the past, they look at commutes, but what they derive for the future are not patterns of operation. They are single values.” Tr. 39:23–25. Patent Owner further contends Petitioner “only asserts that Nii considers patterns in order to predict the power output generator value, which is different from deriving a ‘predicted near-term’ or ‘expected pattern of operation.’” PO Resp. 45 (citing Ex. 2016 ¶¶ 89–91). According to Patent Owner, Petitioner’s assertions are undercut by the testimony of Dr. Davis “that Nii simply predicts a ‘target generator output.’” *Id.* (citing Ex. 2034, 44:19–23). Patent Owner directs us to testimony from Dr. Shahbakhti that a skilled artisan “would not consider Nii’s power generator output value to constitute an expected pattern of operation.” *Id.*

(citing Ex. 2016 ¶ 91). Patent Owner contends “Nii’s average generator output value . . . is a single data point that does not provide any information about travel conditions.” *Id.* at 46 (citing Ex. 2016 ¶ 94); *see also* Sur-Reply 17–18 (arguing the same). Patent Owner further contends “it is impossible to back out any of the specific driving conditions (reflected by instantaneous power) by looking at the average power value of 3kW.” PO Resp. 46 (citing Ex. 2016 ¶¶ 95–96).

Petitioner, in turn, contends that “instead of addressing the obviousness of modifying Severinsky’s controller in view of Nii’s pattern-related teachings, PO improperly attacks Nii’s teachings in isolation.” Pet. Reply 19. Petitioner contends Patent Owner’s argument “that there is no evidence that the target generator output value is a ‘pattern of any kind’” (citing PO Resp. 45) . . . arises from an unduly narrow understanding contrary to *the words actually used in Nii*.” *Id.* Petitioner further contends this argument is irreconcilable “with Nii’s disclosure of a ‘*travel-pattern recognition means* for recognizing travel repeated in accordance with a *specific pattern*’ and that ‘*the output of a generator is set to a generator output equal to the power consumption value corresponding to the travel pattern.*’” *Id.* (citing Ex. 1022, 2:4–5, 2:13–16). Petitioner further contends this disclosure in Nii “tracks the only supporting disclosure in the ’761 Patent Specification.” *Id.* Petitioner provides the following table comparing the disclosure in the ’761 patent to that in Nii:

'761 Patent Specification	Nii
“For example, in response to recognition of a regular pattern as above, the transition point might be adjusted to 60% of MTO; this would prevent repetitive engine starts as the road load exceeded 30% of MTO for a few hundred yards at a time, as might often occur in suburban traffic.” BMW1001, 39:61-66.	“travel-pattern recognition means for recognizing travel I repeated in accordance with a specific pattern... According to the present invention, the output of a generator is set to a generator output equal to the power consumption value corresponding to the travel pattern in the case of traveling according to a travel pattern.” BMW1022, 2:4-16

Pet. Reply 20. The foregoing table compares the disclosure in the '761 patent (Ex. 1001, 39:61–66) with the text of Nii (Ex. 1022, 2:4–16). Petitioner contends that “Nii’s disclosure is almost identical to the only written description of the purported invention.” Pet. Reply 20 (citing Ex. 1088 ¶ 42).

For the following reasons, Patent Owner’s contentions are unavailing.

Nii discloses “travel pattern recognition means for recognizing a travel pattern when traveling under the same conditions is repeated a predetermined number of times . . . with stored data by storing the starting time, power consumption for travel, and duration of travel of a vehicle whenever the vehicle travels.” Ex. 1022, 3:7–12. We, thus, find Nii discloses “monitoring operation of said hybrid vehicle” as required by claim element 1e because it stores data derived from vehicle operation “whenever the vehicle travels.”

We now turn to the question of whether Nii “derives a predicted near-term pattern of operation.”

Nii discloses “[a] travel pattern can frequently be determined by the start time of a vehicle” making it “possible to recognize a travel pattern and set the power generation of a generator to a proper value even if the driver is not conscious of the travel pattern.” Ex. 1022, 2:62–67. Nii provides an example of a regular travel pattern “as people commuting using a standard vehicle or taking people to or from their offices using a commercial vehicle.” *Id.* at 2:21–23.

Nii’s disclosure of a travel pattern involving commuting to work aligns with the example in the ’761 patent where “the operator drives the same route from a congested suburban development to a work place about the same time every morning.” Ex. 1001, 39:51–53; *see also* Tr. 39:23–24 (“they look at commutes”). Patent Owner argues Nii’s disclosure of a weekday commuting pattern is not a pattern because Nii derives the average power which is not a pattern of operation. Tr. 39:22–40:3. This argument, however, conflates Nii’s travel patterns, *i.e.*, morning commute, with the data resulting from Nii’s monitoring of travel patterns. The language of claim element 1e broadly recites deriving “a predicted near-term pattern of operation” but does not require any particular pattern or pattern of data.

We also disagree with Patent Owner’s assertion that Nii only looks at the past and does not derive a future pattern of operation. Nii discloses “a driver turns ON the start switch to notify the controller 26 of the start of a travel pattern in which the same type of travel such as people commuting using a standard vehicle taking people to and from their offices . . . is repeated many times.” Ex. 1022, 5:59–63. Nii discloses when the travel pattern is recognized, the generator output “after the start switch is turned ON is set to the target generator output obtained from the accumulated

output of the motor 10 before the last travel pattern.” *Id.* at 5:64–6:1. Nii thus specifically discloses deriving a future pattern of operation, *i.e.*, a workday commute, and then setting the generator output for the upcoming trip based on the power used during the last travel pattern.

Based on the evidence cited by Petitioner and after considering Patent Owner’s contentions, we find the combined teachings of Severinsky and Nii disclose this claim limitation.

f. controls operation of said at least one traction motor and said internal combustion engine for propulsion of said hybrid vehicle responsive to said derived near-term predicted pattern of operation

Petitioner contends “Nii discloses using the predicted travel pattern information . . . to generate the ‘optimum amount’ of power from the generator/motor” and “adjusts the engine’s operating values in order to control the generator’s output power.” Pet. 52 (citing Ex. 1008 ¶ 289; Ex. 1022, 2:17–47, 5:9–11). Based on this disclosure, Petitioner contends “Nii teaches optimizing/controlling engine and generator (motor) operations based on the predicted upcoming operations” for the reasons discussed in connection with claim element 1e. *Id.*

Patent Owner does not dispute Petitioner’s contentions for claim element 1f. *See* PO Resp. 44–48.

Based on our review of the evidence cited by Petitioner, we find the combined teachings of Severinsky and Nii disclose this claim limitation.

g. Motivation to Combine

Petitioner contends a skilled artisan would have been motivated to incorporate Nii’s teachings into Severinsky’s control scheme “to further optimize parameters to increase engine efficiency and reduce emissions based on how a particular vehicle is being used.” Pet. 53 (citing Ex. 1008,

¶ 290). According to Petitioner, “modification of Severinsky with Nii would optimize the control scheme and increase the engine’s efficiency, which is a goal expressly stated in both references, and a well-known principle of motor vehicle design.” *Id.* at 53 (citing Ex. 1008 ¶¶ 290–292; 52–64; 91–115). Petitioner further contends a skilled artisan “would have recognized that incorporating the pattern information from Nii to vary the engine’s setpoint . . . would be beneficial . . . would provide for better efficiency because it would more closely align those values with the vehicle’s actual torque requirements.” *Id.* (citing Ex. 1008 ¶ 290). Petitioner contends a skilled artisan would have looked to Nii to address inefficiencies, and would have had a reasonable expectation of success in implementing Nii’s teachings because they “would only require modifying Severinsky’s logic to use the information reflecting the driver’s repeated driving operations over time, rather than simply using general-purpose parameters.” *Id.* at 55 (citing Ex. 1008 ¶ 297). Petitioner further contends “Severinsky’s hysteresis mode requires engine operation outside of its most fuel efficient operating range.” *Id.* at 54 (citing Ex. 1008 ¶ 295; Ex. 1013, 18:23–25). Petitioner contends “the hysteresis could be refined by eliminating the delay in turning off the engine when the controller knows from the expected pattern that the vehicle will stay at the lower power/speed for a sufficient duration” and “by raising the engine turn on setpoint to keep the vehicle in motor only mode in recognition of a pattern of vehicle operation requiring low average power.” *Id.* at 54–55 (citing Ex. 1008 ¶¶ 295–296).

Patent Owner contends Nii’s use of “‘pattern information’ to set a constant generator output for charging a battery in a series hybrid [] has no use in a parallel hybrid architecture where the engine must respond to the

instantaneous demands of the driver.” PO Resp. 48 (citing Ex. 2016 ¶¶ 124–136). Patent Owner further contends Petitioner’s assertion that combining Nii with Severinsky “would more closely align those values with the vehicle’s actual torque requirements . . . is based on conclusory expert testimony, not evidence.” *Id.* at 48–49 (citing Pet. 53) (alteration in original). According to Patent Owner, “Dr. Davis’s declaration does not explain what ‘pattern information from Nii’ a [skilled artisan] would use to improve Severinsky or how such ‘pattern information’ would more closely align Severinsky’s setpoint with the ‘vehicle’s actual torque requirements.’” *Id.* at 49 (citing Ex. 1008 ¶ 290). Patent Owner further contends “Nii’s disclosure has nothing to do with varying a setpoint (especially the alleged setpoint in Severinsky).” *Id.* (citing Ex. 2016 ¶¶ 136–131); *see also id.* at 50 (“Nii’s ‘pattern information’ has no relevance to Severinsky’s alleged setpoint, and BMW identifies no other ‘pattern information’ that would enable Severinsky to ‘more closely align Severinsky’s setpoint with the vehicle’s actual torque requirements.’” (citing Pet. 53; Ex. 2016 ¶¶ 131–132)). Patent Owner also contends that “averages are not useful for ‘energy management’ in ‘complex propulsion systems’ such as Severinsky’s parallel hybrid vehicles.” *Id.* at 52 (citing Ex. 2033, 38; Ex. 2016 ¶¶ 141–142); *see also id.* at 57 (“A [skilled artisan] would not vary Severinsky’s alleged ‘setpoint’ using *time averaged* values because such values are unrelated to road load, *i.e.*, ‘the *instantaneous* torque required to propel the vehicle.’” (citing Ex. 2016 ¶¶ 144–154)).

Patent Owner further contends that Petitioner fails to establish reasonable expectation of success because the Petition “fails to explain how a [skilled artisan] would apply any ‘pattern information’ from Nii to adjust

Severinsky’s control system” because it “does not describe this ‘pattern information’ except for mentioning the ‘a pattern of vehicle operation requiring low average power,’ which is not useful for the reasons described above.” *Id.* at 58 (citing Ex. 2016 ¶¶ 155–157).

Petitioner, in turn, contends Patent Owner’s argument that “Nii only uses its ‘pattern information’ to set a constant generator output for charging a battery in a series hybrid, which has no use in parallel hybrid architecture . . . is a straw-man argument.” Pet. Reply 22 (citng PO Resp. 48). Petitioner argues this challenge “relies on Nii for a disclosure of monitoring a vehicle’s operation to look for patterns of expected vehicle operations and modifying *Severinsky’s controller* ‘responsive to’ such patterns.” *Id.* (citing Pet. 51–55; Ex. 1008 ¶¶ 290–291; Ex. 1088 ¶ 51); *see also id.* at 23 (arguing Patent Owner’s “focus on Nii’s teachings in isolation is one of bodily incorporation and fails to address the proposed modification of *Severinsky’s controller*”). Petitioner further contends “[b]oth series and parallel hybrid architectures are concerned with enhancing hybrid vehicle performance,” “share primary considerations, such as controlling battery state of charge or determining when to employ the engine,” and “both have different modes of operation.” *Id.* (citing Ex. 1088 ¶¶ 57–66; Ex. 1089, 66:24–67:17, 68:7–71:19, 130:11–131:21, 138:24–140:21).

Petitioner next contends that even if Nii only disclosed patterns of average power “there should be no dispute that Nii’s recognition of a pattern of average power would be used to adjust Severinsky’s controller settings such as the threshold for turning off the engine during hysteresis sooner or at a slightly higher percentage of engine MTO and corresponding speed.” Pet. Reply 24 (citing Ex. 1088 ¶¶ 70–80). Petitioner further contends a skilled

artisan “would have understood that average power requirements can directly correlate with driving patterns, which would be useful to control operation responsive to said derived near-term predicted pattern of operation.” *Id.* (citing Ex. 1088 ¶¶ 70–80).

For the following reasons, Patent Owner’s contentions are unavailing.

We start with the Supreme Court’s instruction that “if a technique has been used to improve one device and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR*, 550 U.S. at 417. In this case, we must determine whether one of ordinary skill in the art would recognize that Nii’s teaching of monitoring operation of a series hybrid vehicle to derive a predicted near-term pattern of operation would improve the operation of Severinsky’s parallel hybrid vehicle in the same way. In order for us to resolve this question in Petitioner’s favor, Petitioner must provide “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Id.* at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). However, bodily incorporation, *i.e.*, “an actual physical substitution of” the data resulting from Nii’s pattern monitoring into Severinsky’s control scheme, is not required. *See In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (“It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements.”); *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) (“Combining the teachings of references does not involve an ability to combine their specific structures.”).

We agree with Petitioner that Patent Owner’s arguments against the proposed combination are based on the bodily incorporation of the *data* resulting from Nii’s monitoring of vehicle operations, *i.e.*, average power consumed during the daily commute, into Severinsky’s controller. Claim 1, however, requires only deriving a predicted near-term pattern of operation, not the use of any particular data resulting from the monitoring. It is Nii’s disclosure of predicting a near-term pattern of operation, a daily commute, that Petitioner relies on to modify Severinsky’s controller. Patent Owner’s contentions are not tethered to the language of claim 1 or responsive to the actual combination proposed in the Petition.

Patent Owner’s contentions that average power data from Nii would not be useful in Severinsky’s control system is unavailing. Patent Owner relies on Dr. Shahbakhti who testifies that average power “is a single data point that provides no information regarding any of the specific driving conditions over the drive cycle.” Ex. 2016 ¶ 96. Dr. Davis responds that “Severinsky discusses average power requirements throughout its specification when describing its parallel hybrid vehicle.” Ex. 1088 ¶ 77. Dr. Davis cites to various portions of Severinsky in support of this testimony. *See id.* (citing Ex. 1013, 5:46–52, 8:10–19, 8:52–67, 17:34–42). Of particular relevance here, Severinsky discloses cycling the engine on and off “when the average power demand is small.” Ex. 1013, 17:37–39. We credit Dr. Davis’s testimony because it is corroborated by actual disclosure from Severinsky. Dr. Shahbakhti’s testimony is based on conflating Nii’s monitoring of vehicle information to derive an expected pattern of operation with the data resulting from Nii’s monitoring and does not undercut Petitioner’s reasons for combining the teachings of Severinsky and Nii.

Patent Owner contends Petitioner fails to show a reasonable expectation of success because it “fails to explain how a [skilled artisan] would apply any ‘pattern information’” and “does not describe this ‘pattern information.’” PO Resp. 57–58. The Petition explains a skilled artisan “would have recognized that incorporating pattern information from Nii to vary the engine’s setpoint in Severinsky would be beneficial and would provide for better efficiency because it would more closely align those values with the vehicle’s actual torque requirements.” Pet. 53 (citing Ex. 1008 ¶ 290). Dr. Davis testifies that he is relying on Nii’s recognition of a pattern such as a daily commute (Ex. 1008 ¶¶ 287–288) and further testifies why a skilled artisan would be motivated to use the pattern information to modify Severinsky’s controller. We credit Dr. Davis’s testimony. Petitioner’s proposed combination as articulated by Dr. Davis satisfies the reasonable expectation of success test because it requires no more than what the ’761 patent describes is within the level of skill in the art. Ex. 1001, 39:58–61.

For all of the foregoing reasons, we determine that Petitioner states numerous persuasive reasons why a skilled artisan would have been motivated to combine the teachings of Severinsky and Nii that are not undercut by Patent Owner’s contentions.

i. Summary of Claim 1

For all the foregoing reasons, we determine Petitioner establishes by a preponderance of the evidence that the combined teachings of Severinsky and Nii disclose each limitation of claim 1 and that a skilled artisan would have been motivated to combine the teachings and would have had a reasonable expectation of success in doing so.

3. Claim 2

Petitioner contends Nii discloses “recognizing a travel pattern when a [sic] travelling under the same condition is *repeated* a predetermined number of times or more.” Pet. 56 (citing Ex. 1022, 3:7–9, 6:43–51) (alteration in original). Petitioner further contends “Nii’s derived predicted pattern includes at least one repetitive pattern of operation of the vehicle.” *Id.* (citing Ex. 1008 ¶ 300).

Patent Owner, in turn, contends “Nii’s average power generator output value is also not a ‘repetitive pattern of operation of said hybrid vehicle.’” PO Resp. 59. Patent Owner further contends “[t]here is nothing repetitive about a single average value . . . and BMW presents no evidence of repetition.” *Id.* (citing Ex. 2016 ¶¶ 98–100). Patent Owner further contends the Petition “focuses only on what the vehicle has previously done, and not any ‘predicted’ or ‘expected’ pattern of operation.” *Id.* These contentions are merely a reiteration of Patent Owner’s contentions for claim 1 and are unavailing for the reasons discussed in connection with claim 1.

Based on our review of the evidence cited by Petitioner and after considering Patent Owner’s contentions, we determine Petitioner establishes by a preponderance of the evidence that claim 2 would have been obvious over the combined teachings of Severinsky and Nii.

4. Claim 3

Petitioner contends “Nii describes storing and determining patterns of vehicles, such as people commuting to and from their offices” and “analyzing travel patterns based on repeated travel.” Pet. 56 (citing Ex. 1022, 2:21–24, 3:7–9, 5:59–64, 6:43–51). Petitioner contends, based on

Nii's disclosures, a skilled artisan "would understand Nii's disclosure includes storing day-to-day records of vehicle operation." *Id.*

Patent Owner does not dispute Petitioner's contentions for claim 3 separate from its contentions for claim 1. PO Resp. 62 n.28.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 3 would have been obvious over the combined teachings of Severinsky and Nii.

5. Claim 4

Petitioner relies in part on its contentions for claim 4 based on Severinsky from the Quigley ground. Pet. 57. Petitioner contends "[b]ecause Nii's express teachings relate to detecting patterns of power consumption for travel, a [skilled artisan] would recognize that the power consumption for travel in Nii encompasses the 'road load' ('amount of instantaneous torque required for propulsion of the vehicle')." *Id.* (citing Ex. 1008 ¶ 308; Ex. 1022, 3:14–29). Petitioner further contends "since Nii teaches determining patterns based on the 'frequency' of vehicle power consumption in different zones, it is necessarily determining patterns based on *variation* in road load." *Id.* According to Petitioner, "the optimization of the control strategy in Severinsky by using pattern information disclosed by Nii would necessarily be based on information concerning the variation in road load." *Id.*

Patent Owner responds that neither Severinsky nor Nii expressly discloses monitoring any variations "in road load or "compare patterns of variation in road load experienced from day to day." PO Resp. 60. Patent Owner contends that the assertion in the Petition that a skilled artisan would recognize that the power consumption in Nii "encompasses the 'road load'"

is a vague reference “to the fact that it is *possible* to determine torque from instantaneous power if speed is known because $\text{power} = \text{torque} * \text{speed}$.” *Id.* According to Patent Owner, “the fact that it is *possible* to calculate torque does not mean that Nii ‘compares patterns of variation in road load experienced from day to day’” as required by claim 4. *Id.* Patent Owner further contends the Petition’s inherency assertions are unsupported and in particular fail to explain how Nii’s disclosure establishes the features are necessarily present in Nii. *Id.* at 61.

We agree with Patent Owner that the evidence cited in the Petition does not support Petitioner’s inherency assertion concerning Nii. Dr. Davis testifies that “Nii also recognized patterns in the *variation* of road load by determining and storing the frequency of vehicle power consumption in different zones.” Ex. 1008 ¶ 308. Dr. Davis does **not** testify that Nii “is necessarily determining patterns based on *variation* in road load.” Pet. 57. Because Petitioner does not support this contention with evidence, it also fails to support its conclusion that the control strategy of Severinsky modified with the teachings of Nii would necessarily be based on information concerning the variation in road load.

For these reasons, we determine Petitioner has **not** established by a preponderance of the evidence that claim 4 would have been unpatentable over the combined teachings of Severinsky and Nii.

6. Claim 5

Petitioner relies in part on its contentions for claim 5 based on Severinsky from the Quigley ground. Pet. 58. Petitioner repeats its contention from the Quigley ground that claim 5 contains non-limiting optional language but contends that Severinsky discloses the limitation. *Id.*

Petitioner contends a skilled artisan “would have understood that [Severinsky’s] general-purpose parameters (20-25 mph for 2-3 minutes) for varying the engine’s transition point could be improved using the pattern information disclosed by Nii.” *Id.* (citing Ex. 1008 ¶¶ 315–317). Petitioner contends a skilled artisan would have been motivated to incorporate Nii’s teachings “into Severinsky’s controller because Severinsky’s hysteresis requires engine operation outside its most fuel-efficient operating range” and doing so “would lessen the inefficiency created by using hysteresis.” *Id.* at 59 (citing Ex. 1008 ¶¶ 293–297, 315–317; Ex. 1013, 5:24–30, 18:23–25; Ex. 1022, 2:13–24).

Patent Owner does not dispute Petitioner’s contentions for claim 5 separate from its contentions for claim 1. PO Resp. 62 n.28.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 5 would have been obvious over the combined teachings of Severinsky and Nii.

7. Claim 6

Petitioner relies in part on its contentions for claim 6 based on Severinsky from the Quigley ground. Pet. 59. Petitioner repeats its contention from the Quigley ground that claim 6 contains non-limiting optional language but contends that Severinsky discloses the limitation. *Id.* at 60. Petitioner contends a skilled artisan “modifying Severinsky in view of Nii would have known to adjust the value of the road load at which the transition between the first and second mode occurs.” *Id.* In particular, Petitioner contends because “Severinsky’s control system relies on setpoints to determine the mode of operation, a [skilled artisan] viewing Nii’s teachings concerning the predicted pattern of operation would similarly alter

the setpoints . . . used by the controller in Severinsky based on such anticipated operation.” *Id.* (citing Ex. 1008 ¶¶ 325–326). According to Petitioner, a skilled artisan would recognize “that altering the value of the road load at which the transition between modes occurs would allow Severinsky’s controller to optimize operations to increase engine efficiency.” *Id.* at 60–61.

Patent Owner does not dispute Petitioner’s contentions for claim 6 separate from its contentions for claim 1. PO Resp. 62 n.28.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 6 would have been obvious over the combined teachings of Severinsky and Nii.

8. *Claim 7*

Petitioner relies on substantially the same arguments and evidence for claim 7 as for claim 1. Pet. 61–62. Patent Owner does not provide any separate contentions for claim 7. *See* PO Resp. 44–62. For the same reasons discussed above in connection with claim 1, we determine Petitioner establishes by a preponderance of the evidence that claim 7 would have been obvious over the combined teachings of Severinsky and Nii.

9. *Dependent Claims 8–12*

For claims 8–12, Petitioner relies on its contentions for claims 2–6 respectively which recite substantially similar limitations. Pet. 62. For claims 8 and 10, Patent Owner relies on its contentions for claims 2 and 4 respectively. PO Resp. 59. Because claim 2 recites substantially similar limitations and for the same reasons discussed above in connection with claim 2, we determine Petitioner establishes by a preponderance of the evidence that claim 8 would have been obvious over the combined teachings

of Severinsky and Nii, but for the reasons provided above with respect to claim 4, we determine that Petitioner fails to establish a preponderance of the evidence that claim 10 is unpatentable.

For claims 9, 11 and 12, Patent Owner refers us to its contentions for claims 7 and 8 and argues that the claims are not unpatentable for the same reasons. PO Resp. 62 n.28. Because we determine that claims 7 and 8 would have been obvious over the combined teachings of Severinsky and Nii, we likewise determine that claims 9, 11, and 12 would have been obvious over Severinsky and Nii.

III. CONCLUSION

Based on the record before us, we determine

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–12	103(a)	Severinsky, Quigley	1–12	
1–12	103(a)	Severinsky, Nii	1–3, 5–9, 11, 12	4, 10
1–12 ¹⁸	103(a)	Severinsky, Graf		
Overall Outcome			1–12	

IV. ORDER¹⁹

For the foregoing reasons, it is hereby:

ORDERED that, based on a preponderance of the evidence, claims 1–12 of the '761 patent are unpatentable; and

¹⁸ We do not reach this alternate ground. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *see also* 35 U.S.C. § 318(a).

¹⁹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of this Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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