

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT and
BMW OF NORTH AMERICA, LLC,
Petitioner,

v.

PAICE LLC & THE ABELL FOUNDATION, INC.,
Patent Owner.

IPR2020-01386
Patent 7,237,634 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 and
Denying-in-Part and Dismissing-in-Part Petitioner's Motion to Exclude
35 U.S.C. § 318(a); 42 C.F.R. §§ 42.64, 42.71

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 33–44, 46, 49, 50, 52–55, 68, 105, 188, 189, 199–206, 208, 211–214, 242, and 268¹ (the “challenged claims”) of U.S. Patent No. 7,237,634 B2 (Ex. 1001, “the ’634 patent”). Petitioner filed a Declaration of Dr. Gregory W. Davis in support of the Petition. Ex. 1008. Patent Owner, Paice LLC and the Abell Foundation, Inc., (collectively “Patent Owner” or “Paice”) 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 ’634 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 13 (“Dec.”).

During the course of trial, Patent Owner filed a Patent Owner Response. Paper 20. (“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 28 (“Sur-reply”). An oral hearing was held on November 9, 2021 and a transcript of the hearing has been entered into the record. Paper 36 (“Tr.”).

¹ Patent Owner statutorily disclaimed claims 242 and 268. Ex. 2004, 3.

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 '634 patent. For the reasons discussed below, we determine Petitioner establishes by a preponderance of the evidence that all challenged claims of the '634 patent are unpatentable.

A. Related Matters

The parties state that the '634 patent is asserted in *Paice LLC et al. v. Bayerische Motoren Werke Aktiengesellschaft*, 1:19-cv-03348-SAG (D. Md.). Pet. 75; Paper 5, 2. The '634 Patent was the subject of review in IPR2014-00904, IPR2014-01416, IPR2015-00606, IPR2015-00722, IPR2015-00758, IPR2015-00784, IPR2015-00785, IPR2015-00787, IPR2015-00790, IPR2015-00791, IPR2015-00799, IPR2015-00800, IPR2015-00801, IPR2016-00246, IPR2016-00247, IPR2016-00248, IPR2016-00249, IPR2016-00251, IPR2017-00228, IPR2017-00229, IPR2017-00230, IPR2017-00231, IPR2017-00232, IPR2017-00233, IPR2017-00234, and IPR2017-00235. Pet. 76. Final Written Decisions were issued in IPR2014-00904, IPR2014-01416, IPR2015-00606, IPR2015-00722, IPR2015-00758, IPR2015-00784, IPR2015-00785, IPR2015-00787, IPR2015-00790, IPR2015-00791, IPR2015-00799, IPR2015-00800, and IPR2015-00801. The Federal Circuit affirmed the Board's Final Written Decisions in IPR2014-00904, IPR2014-01416, IPR2015-00606, IPR2015-00758, IPR2015-00785, IPR2015-00799, and IPR2015-00801. Ex. 1072; Ex. 1073.

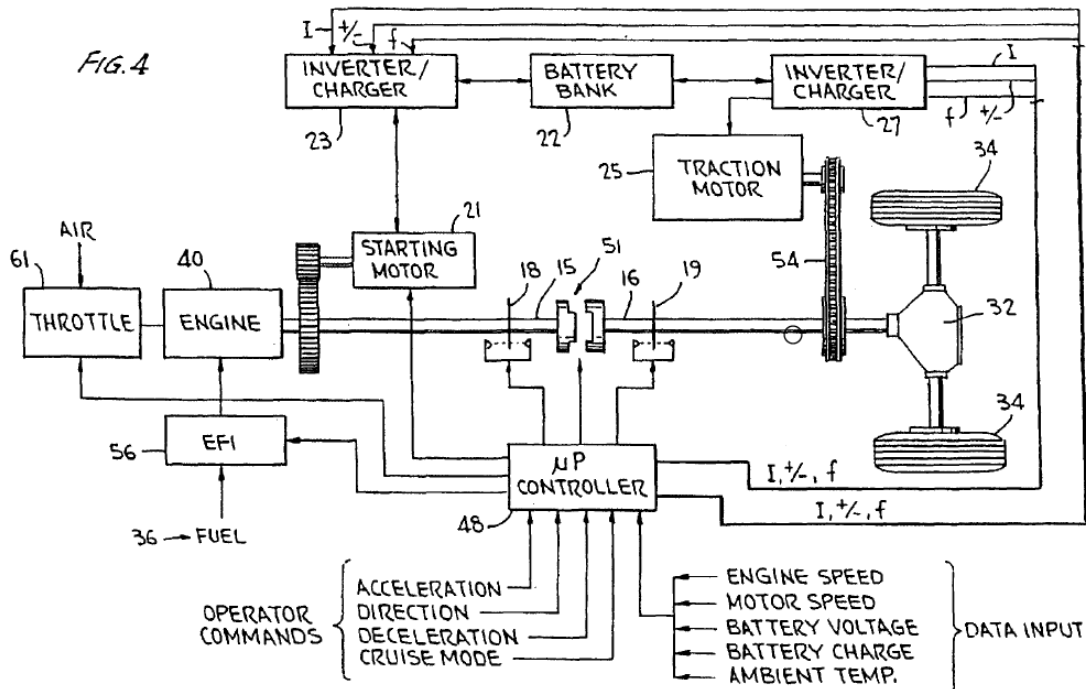
B. Real Parties in Interest

Petitioner and Patent Owner each identifies itself as the only real party in interest. Pet. 75; Paper 5, 2.

C. *The '634 Patent (Ex. 1001)*

The '634 Patent issued on July 3, 2007, and is titled “Hybrid Vehicles.” Ex. 1001, codes (45), (54). The '634 Patent issued from U.S. Patent Application 11/229,762 filed on January 13, 2006 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 '634 Patent contained 306 claims when issued. *Id.* at 58:2–92:53. Of the 306 claims, 156 claims have been cancelled in prior *inter partes* reviews. *Id.* at pp. 66–72 (*Inter Partes* Review Certificates).

The '634 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, 1:21–29. In particular, the '634 Patent is directed to hybrid vehicles comprising an internal combustion engine, a traction motor, and a battery bank that are controlled by a microprocessor so that the engine runs only under high efficiency conditions in response to the vehicle’s torque requirements. *Id.* at code (57). Figure 4 of the '634 Patent, reproduced below, illustrates the drive system of a hybrid vehicle:



(i.e., the amount of torque required to propel the vehicle, or “road load”) is at least equal to 30% of the engine’s maximum torque output (“MTO”) capability. *Id.* at 20:61–21:2, 35:3–15; *see also id.* at 13:52–65 (“the engine is never operated at less than 30% of MTO, and is thus never operated inefficiently.”).

Running the engine only when it is efficient to do so leads to improved fuel economy. *Id.* at 13:55–561. To achieve such efficiency, the

hybrid vehicle includes various operating modes that depend on the vehicle's torque requirements, the battery's state of charge, and other operating parameters. *Id.* at 36:60–62, 37:20–23.

Figure 6 of the '634 Patent, reproduced below, schematically illustrates an embodiment of the claimed invention.

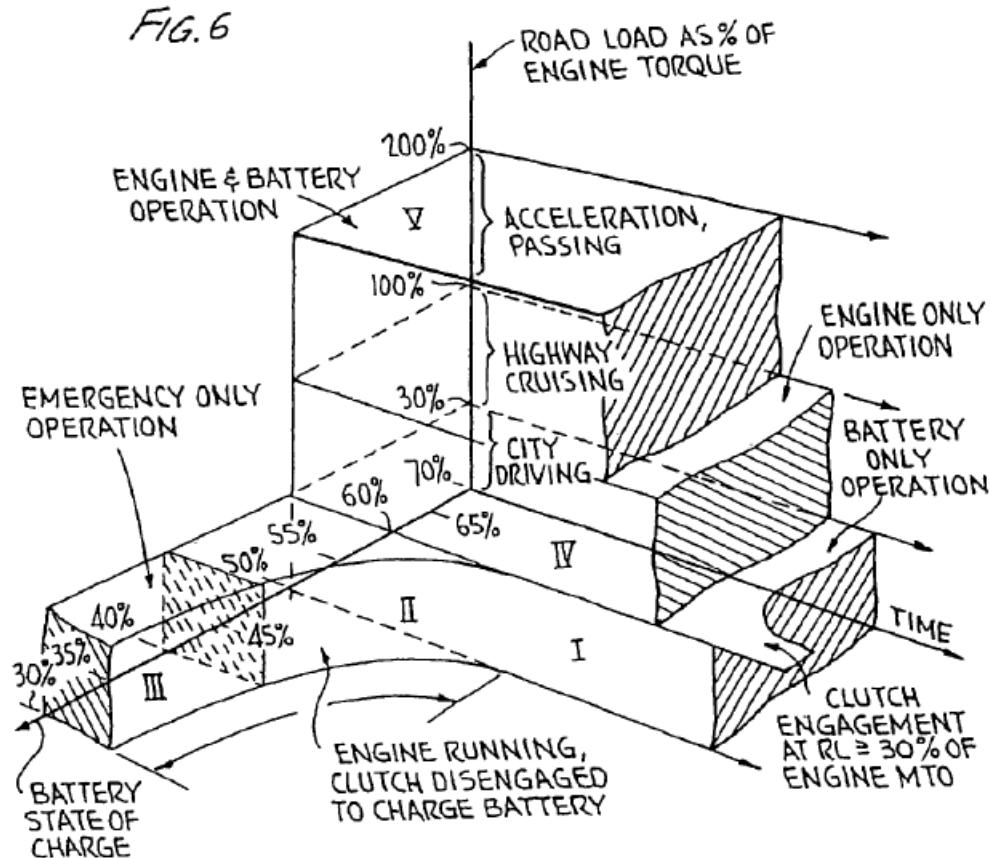


Figure 6 illustrates differing modes of vehicle powertrain operation, plotted on a three dimensional chart, illustrating that the mode of vehicle operation is a function of the state of charge of the battery bank, the instantaneous road load, and time. *Id.* at 2:33–37.

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 37:24–28. 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 37:28–32. "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 37:32–36. 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 37:37–41. "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 37:42–44. "If the operator then calls for additional power, e.g. for acceleration or passing, region V is entered." *Id.* at 38:1–2. 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 38:2–7.

The above embodiment includes a controlled transition from low-speed operation to highway cruising at a transition point or setpoint (i.e., between operation in modes I and IV). *Id.* at 40:41–47. Using a constant setpoint, however, can sometimes lead to undesirable engine starting and shut-off, until extended highway cruising is attained. *Id.* at 40:65–41:1. To address this potential undesirable effect, the microprocessor monitors the vehicle's operation over a period of days or weeks and resets the setpoint in

response to a repetitive driving pattern. *Id.* at 40:50–65. The '634 Patent explains that by the microprocessor “monitoring the road load over time, and comparing it to different setpoints accordingly, much of this undesirable repetitive sequence of engine starting and shut-off can be eliminated.” *Id.* at 41:30–33.

D. Challenged Claims

Claims 33 and 188 are the only independent claims challenged.

Ex. 1001, 60:58–61:8, 76:50–77:7. Claims 33 and 188 are reproduced below with Petitioner’s annotations:

33. A method for controlling a hybrid vehicle, comprising:
- a. determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;
 - b. operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);
 - c. operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO;
 - d. operating both the at least one electric motor and the engine to propel the hybrid vehicle when the torque RL required to do so is more than the MTO; and
 - e. monitoring patterns of vehicle operation over time and varying the SP accordingly.

188. A method for controlling a hybrid vehicle, comprising:
- a. determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;
 - b. operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);
 - c. operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce

- torque above the SP, and wherein the SP is substantially less than the MTO; and
- d. operating both the at least one electric motor and the engine to propel the hybrid vehicle when the torque RL required to do so is more than the MTO; and
- e. operating a turbocharger controllably coupled to the engine to increase the MTO of the engine when desired.

Id. at 60:58–61:8, 76:50–77:7.

E. Asserted Grounds of Unpatentability

Petitioner challenges claims 33–44, 46, 49, 50, 52–55, 68, 105, 188, 189, 199–206, 208, and 211–214 of the '634 Patent based on the asserted grounds of unpatentability set forth below (Pet. 16–74):

Claim(s) Challenged	Basis ²	Reference(s)
33	103(a)	Severinsky ³ , Nii ⁴
33	103(a)	Severinsky, Quigley ⁵
33	103(a)	Severinsky, Graf ⁶
34–38, 42–44, 46, 50, 52, 55, 68	103(a)	Severinsky and Nii, Quigley, or Graf
39, 40	103(a)	Severinsky, (Nii, Quigley, or Graf), Frank ⁷

² 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 '186 patent claims priority to applications filed before the effective date of the relevant amendment, the pre-AIA version of § 103 applies.

³ U.S. Pat. No. 5,343,970, issued Sept. 6, 1994 (Ex. 1013, “Severinsky”).

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

⁵ C. P. Quigley et al., *Predicting the Use of a Hybrid Electric Vehicle*, IFAC Proceedings Volumes, 1996 (Ex. 1054 “Quigley”).

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

⁷ U.S. Pat. No. 5,842,534, issued Dec. 1, 1998 (Ex. 1068, “Frank”).

Claim(s) Challenged	Basis ²	Reference(s)
41	103(a)	Severinsky, (Nii, Quigley, or Graf), Lateur ⁸
49	103(a)	Severinsky, (Nii, Quigley, or Graf), Ma ⁹
53	103(a)	Severinsky, (Nii, Quigley, or Graf), Vittone ¹⁰
54	103(a)	Severinsky, (Nii, Quigley, or Graf), Yamaguchi ¹¹
105	103(a)	Severinsky, Frank, Ma
188, 189, 199–203, 205, 206, 211, 213	103(a)	Severinsky, Ma
204	103(a)	Severinsky, Ma, Lateur
212	103(a)	Severinsky, Ma, Yamaguchi
214	103(a)	Severinsky, Ma, Suga ¹²

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). 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).

⁸ U.S. Pat. No. 5,823,280, issued Oct. 20, 1998 (Ex. 1051, “Lateur”).

⁹ WIPO Pat. No. WO 92/15778, published Sept. 17, 1992 (Ex. 1021, “Ma”).

¹⁰ O. Vittone et al., “*Fiat Conceptual Approach to Hybrid Cars Design*,” 12th International Electric Vehicle Symposium, Volume 2, 458–469 (1994) (Ex. 1069, “Vittone”).

¹¹ U.S. Pat. No. 5,865,263, issued Feb. 2, 1999 (Ex. 1070, “Yamaguchi”).

¹² U.S. Patent No. 5,623,104, issued Apr. 22, 1997 (Ex. 1071, “Suga”).

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 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).¹³ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We analyze the asserted obviousness grounds with these principles in mind.

B. Level of Ordinary Skill in the Art

Petitioner contends that 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. 7 (citing Ex. 1008 ¶¶ 44–47). Patent Owner does not address the level of ordinary skill in the art. *See generally* PO Resp.

¹³ Neither party has introduced evidence of secondary considerations.

We apply Petitioner’s level of ordinary skill in the art because it is consistent with the problems addressed in the ’634 Patent and the prior art of record. *See, e.g.*, Ex. 1001, 2:20–15:51.

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) (2020). Accordingly, we construe each challenged claim of the ’634 Patent to generally be “the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.*

Petitioner notes that the Board previously construed several terms of the ’634 Patent as part of prior final written decisions reviewing other claims of the ’634 Patent. Pet. 8–9. Petitioner asserts that the “construed terms should therefore be used consistently here.” *Id.* at 10. We reproduce below Petitioner’s chart listing the previously construed claim terms.

IV. Terms Already Construed by the Board

Term	Construction	IPR
“road load”/“RL”	“amount of instantaneous torque required to propel the vehicle[, be it positive or negative]”	<i>E.g.</i> , BMW1063, 6-10; BMW1059, 7-10; BMW1064, 9-12; BMW1065, 8-11;
“setpoint”/“SP”	“a predetermined [or predefined] torque value that may or may not be reset”	
“mode I”/“low-load operation mode I”	“a mode of operation of the vehicle, in which all torque provided to the wheels [is] supplied by an electric motor”	<i>E.g.</i> , BMW1065, 11-16; BMW1066 11-16
“high-way cruising operation mode IV”	“a mode of operation of the vehicle in which all torque provided to the wheels [is] supplied by	

Term	Construction	IPR
	the internal combustion engine”	
“acceleration operation mode V”	“a mode of operation in which the torque provided to the wheels is supplied by the internal combustion engine and at least one electric motor”	
“abnormal and transient conditions”	these conditions include starting the engine and stopping the engine	
“maximum DC voltage”	“a voltage under load”	BMW1067, 7.
“monitoring patterns of vehicle operation over time”	“monitoring a driver’s repeated driving operations over time”	<i>E.g.</i> , BMW1060, 6-8; BMW1061, 7-9; BMW1062, 7-9.

Petitioner’s claim term chart includes under separate column headings, “Term,” “Construction,” and “IPR.” Pet. 8–9. Under the heading “IPR,” Petitioner refers to BMW1059–1067 which correspond to Exhibits 1059–1067 in this proceeding. Exhibit 1059 corresponds to the Final Written Decision in IPR2014-01416, Exhibit 1060 corresponds to the Institution Decision in IPR2015-00722, Exhibit 1061 corresponds to the Institution Decision in IPR2015-00787, Exhibit 1062 corresponds to the Institution Decision in IPR2015-00791, Exhibit 1063 corresponds to the Final Written Decision in IPR2014-00904, Exhibit 1064 corresponds to the Final Written Decision in IPR2015-00758, Exhibit 1065 corresponds to the Final Written Decision in IPR2015-00785, Exhibit 1066 corresponds to the

Final Written Decision in IPR2015-00801, and Exhibit 1067 corresponds to the Final Written Decision in IPR2015-00606.

“Patent Owner agrees to the claim constructions adopted previously by the . . . Board, which BMW applies in its Petition.” PO Resp. 27.

Therefore, we utilize these claim constructions in this Decision as necessary.

D. Ground 1: Claim 33 – Alleged Obviousness over Severinsky and Nii

Claim 33 recites, *inter alia*, “monitoring patterns of vehicle operation over time and varying the SP accordingly.” Ex. 1001, 61:7–8. Petitioner refers to this limitation as 33e. Pet. 19. Petitioner contends that claim 33 is obvious over Severinsky and Nii. *Id.* at 16–23. In support, Petitioner asserts that Severinsky discloses most of the claimed limitations, and relies on the combination of Severinsky and Nii to disclose limitation 33e. *Id.* at 16–20. Petitioner identifies the disclosures in Severinsky and Nii alleged to describe the subject matter in the challenged claims. *Id.* Additionally, Petitioner offers declaration testimony from Dr. Gregory W. Davis in support of its position. Ex. 1008 ¶¶ 214–284.

Patent Owner contends neither Severinsky nor Nii discloses limitation 33e and disputes Petitioner’s reasons to combine Severinsky and Nii. PO Resp. 18–44.

We begin our analysis with a brief overview of Severinsky and Nii. We then address the parties’ respective contentions with respect to claim 33.

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 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 that “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 that “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 *Nii* — *Ex. 1022*

Nii is a United States Patent issued on July 22, 1997. *Ex. 1022*, code (45). *Nii* is entitled “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 “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 “the 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 6:47–49. 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.

3. *Analysis*

Limitations 33a–33d

Petitioner contends “[t]he majority of the Challenged Claims’ limitations are *identical* to limitations in claims that were previously cancelled based on the same prior art asserted here.” Pet. 14 (citing IPR2014-01416 with respect to claim limitations 33a–33d). Petitioner provides a chart setting forth in detail the disclosure in Severinsky allegedly corresponding to limitations that Petitioner identifies as 33a–33d. *Id.* at 16–19. Patent Owner disputes only the limitation identified by Petitioner as 33e and Petitioner’s reasons for the proposed combination. PO Resp. 18–44.

We reviewed Petitioner’s contentions and evidence cited for limitations 33a–33d and find Petitioner establishes Severinsky discloses limitations 33a–33d.

We now turn to the parties' respective contentions concerning limitation 33e and motivation to combine.

33e. monitoring patterns of vehicle operation over time¹⁴ and varying the SP accordingly

Petitioner contends Nii discloses the requirement of claim 33 of “*monitoring a driver’s repeated driving operations over time.*” Pet. 19–20. Petitioner contends Nii’s “controller stores and monitors 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’” and “describes ‘recognizing a travel pattern when ... travelling under the same condition is repeated a predetermined number of times or more.’” *Id.* at 19 (citing Ex. 1022, 2:4–5, 2:21–24, 3:7–9, 5:59–64, 6:43–51). Petitioner also contends Nii “stores travel patterns over time so that the ‘target generator output becomes more accurate.’” *Id.* at 20 (citing Ex. 1022, 6:9–13).

Petitioner further contends it would have been obvious “to incorporate Nii’s teachings into Severinsky to lessen the inefficiency caused by Severinsky’s use of hysteresis . . . to refine the varying of the setpoint discussed in Severinsky.” *Id.* at 21–22 (citing Ex. 1008 ¶¶ 279–280; Ex. 1013, 18:23–42). Petitioner further contends a skilled artisan would have been motivated to vary Severinsky’s engine setpoint by using Nii’s “pattern information based on actual vehicle usage” rather than Severinsky’s general purpose parameters in order “to enhance the vehicle’s efficiency.” *Id.* at 22 (citing Ex. 1008 ¶ 280). Petitioner further contends a skilled artisan

¹⁴ The Board previously construed “monitoring patterns of vehicle operations over time as “monitoring a driver’s repeated driving operations over time.” Ex. 1060, 6–8; Ex. 1061, 7–9; Ex. 1062, 7–9.

would have had a reasonable expectation of success because incorporating Nii's pattern monitoring functionality into Severinsky's controller "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 23 (citing Ex. 1008 ¶¶ 278, 283).

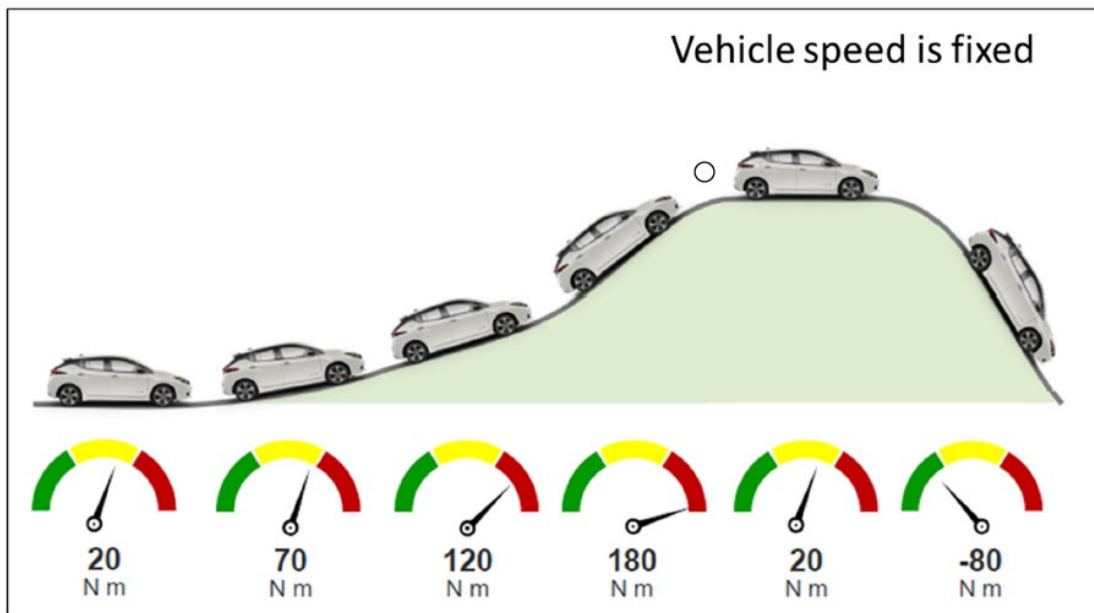
Patent Owner first contends "Nii adjusts the power output of a generator, which is not a 'setpoint,' *i.e.*, 'a predefined *torque* value that may or may not be reset.'" PO Resp. 28 (citing Ex. 1022, 2:14–18; Ex. 2016 ¶¶ 78, 95–102). According to Patent Owner, "the generator power output for charging the battery in a series hybrid vehicle¹⁵ has nothing to do with varying the claimed 'setpoint,' which is a parameter used by the controller for determining when to employ the engine or electric motor." *Id.* at 28–29 (citing Ex. 2016 ¶¶ 102–144).

Petitioner, in turn, responds Patent Owner "does not dispute Nii discloses '*monitoring a driver's repeated driving operations over time.*'" Pet. Reply 2 (citing PO Rep. 28–29). We agree with Petitioner on this point. We reviewed the evidence cited by Petitioner and find that Nii discloses monitoring a driver's repeated driving operations over time. Ex. 1022, 2:4–5, 2:21–24, 3:7–9, 5:59–64, 6:43–51.

Patent Owner next contends "Severinsky's 'speed-responsive hysteresis' does not result in varying a speed- or torque-based setpoint." PO Resp. 20. Patent Owner argues Severinsky's "speed-responsive hysteresis" mode "is simply a time-based hysteresis that adds a time delay ('2-3

¹⁵ Patent Owner provides a discussion of the differences between a parallel hybrid architecture as disclosed in Severinsky and Nii's series hybrid. PO Resp. 13.

minutes’) to a speed threshold (‘20-25 mph’) for turning the engine off.” *Id.* (citing Ex. 2016 ¶ 57). Patent Owner further contends “Severinsky’s ‘speed-responsive hysteresis’ maintains a **fixed** speed threshold and requires that the vehicle speed remain below the speed threshold for a predetermined amount of time” and a skilled artisan “would understand that the threshold would be written into source code and not change throughout the lifetime of the vehicle.” *Id.* (citing Ex. 2016 ¶¶ 59–60). Patent Owner further contends “there is no record evidence that the **speed**-based time delay or the use of different **speed** thresholds for turning the engine on vs. turning the engine off would result in Severinsky ‘varying said setpoint’ which is a **torque** value.” *Id.* at 21 (citing Ex. 2016 ¶¶ 63–66). Patent Owner further contends a skilled artisan would understand Severinsky discloses “these separate control algorithms would operate in parallel: the speed-based algorithm (in which vehicle speed is the control variable) and the torque-based algorithm (in which road load is the control variable) both send signals to the controller to turn the engine on/off.” *Id.* at 22 (citing Ex. 2016 ¶¶ 64–66). Patent Owner further contends that “[t]he physical relationship between speed and torque does not bridge the chasm between Severinsky’s separate speed and torque-based algorithms” because “[v]ehicle speed and torque are both independent variables that do not vary proportionately under many conditions.” *Id.* at 23 (citing Ex. 2016 ¶ 67). Patent Owner provides the following illustration of a vehicle traveling over a hill to support this contention:



The preceding image provided by Patent Owner shows a vehicle traveling from left to right from flat ground and then up and over a hill to illustrate that “the instantaneous torque required to propel the vehicle varies with grade and has no dependence on speed.” PO Resp. 24.

According to Patent Owner, “when the speed is low and the instantaneous torque is high . . . a [skilled artisan] would understand that Severinsky would need to arbitrate between the speed-based algorithm and the torque-based algorithm by prioritizing one over the other,” and that “[r]egardless of whether Severinsky prioritizes the speed- or torque-based algorithm, Severinsky does not disclose or suggest varying the 60% MTO value.” *Id.* (citing Ex. 2016 ¶¶ 73–74). According to Patent Owner, a skilled artisan would understand “that Severinsky’s decision to prioritize the ‘speed-based hysteresis’ algorithm simply results in disregarding the alleged torque-based setpoint (60% MTO), not varying it.” *Id.* at 24–25 (citing Ex. 2016 ¶ 74).

Petitioner, in turn, contends “Severinsky’s engine will normally be operated above 60% MTO (the ‘setpoint’) . . . but will also operate ‘outside its most fuel efficient operating range on occasion.’” Pet. Reply 9 (citing

Dec. 34–35; Ex. 1013, 18:23–25). Petitioner contends “Severinsky will ‘vary said setpoint’ by lowering it below 60% MTO (corresponding to 30–35 mph speed in ‘highway mode’) to avoid nuisance engine starts” and “to avoid discharging the batteries excessively.” *Id.* (citing Dec. 32; Pet. 21–22; Ex. 1013, 18:25–33; Ex. 1088 ¶¶ 9–10). Petitioner further contends Patent Owner’s argument that Severinsky’s hysteresis is speed-based only rather than a torque-based setpoint is “a red herring” because “Severinsky’s control system does not take *only* speed into account—the Board debunked that argument years ago. . . but *must also* take torque into account.” *Id.* at 10 (citing Ex. 1059, 14–17; Ex. 1088 ¶¶ 8–26); *see also id.* at 12–13 (arguing that Patent Owner’s arguments are precluded by determinations in a prior *inter partes* review of the ’634 patent).

Petitioner next contends “[w]hile PO asserts that Severinsky’s normal 30–35 mph/60% MTO threshold is ‘written into source code and would not change’ . . . the challenged claims are agnostic as to how ‘varying said setpoint’ is accomplished.” Pet. Reply 11 (citing PO. Resp. 21–22; Ex. 1088 ¶¶ 27–29). Petitioner further contends the challenged claims “do not preclude switching between two (or more) values that represent the ‘setpoint’ at any given time, as in Severinsky’s hysteresis.” *Id.* at 11–12 (citing Ex. 1088 ¶¶ 27–29). Petitioner further contends Dr. Shahbakhti testified “this is the ‘main example’ in the ’634 Patent of how ‘varying said setpoint’ can be accomplished.” *Id.* at 11 (citing Ex. 1001, 4147; Ex. 1105, 29:14–30:17, 30:18–32:6). According to Petitioner, during Severinsky’s hysteresis mode, “if the vehicle drops below the lower setpoint, *the engine will be shut off*,” and “[t]he original setpoint is not disregarded but *replaced*—

—i.e., it is ‘varied’—by a lower setpoint, *just as it is in the ‘634 Patent.*” *Id.* at 12 (citing Ex. 1001, 41:4–47; Ex. 1013, 18:34–42; Ex. 1088 ¶ 30).

In the Sur-reply, Patent Owner contends “Severinsky’s choice to operate the engine below the 60% MTO setpoint does not mean that Severinsky varies the setpoint;” rather, it means “Severinsky operates the engine inefficiently in certain circumstances (*i.e.*, below 60% MTO).” Sur-reply 4. Patent Owner further contends Petitioner’s “insinuation that Severinsky’s controller ‘switch[es] between two (or more) values that represent the ‘setpoint’ at any given time’ is wrong” because, according to Patent Owner, “[t]here is no variation or dynamic ‘switching’ of the different thresholds to speak of.” *Id.* at 5–6 (citing Reply 10; Ex. 2016 ¶¶ 110–111). Patent Owner further contends that “[t]he word ‘accordingly’ indicates that varying the setpoint occurs based on vehicle monitoring over time” but “BMW . . . provides no evidence that Severinsky’s controller selects between the engine on and engine off thresholds during vehicle operation.” *Id.* at 4–5.

Patent Owner also contends Petitioner’s “assertions that ‘Severinsky’s speed-based thresholds correlate to torque-based thresholds’ and ‘speed thresholds’ are also torque thresholds by their very nature’ . . . are new arguments” and exceed the proper scope of a Reply. Paper 25,¹⁶ 2 (citing Reply 11); *see also* Sur-reply 9 n.4 (arguing the same). Patent Owner contends the Petition “did not explain any relationship between ‘speed thresholds’ and ‘torque thresholds.’” *Id.* Patent Owner makes similar arguments against “paragraphs 7–26 of Dr. Davis’s reply declaration

¹⁶ “Paper 25” refers to “Patent Owner’s Identification of New Evidence and Arguments Beyond the Proper Scope of Petitioner’s Reply.”

(Ex. 1088)” and Exhibits 1015, 1091, and 1092 that are referenced in Dr. Davis’s reply declaration. *Id.*

Petitioner responds that pages 10 and 11 of the Reply and paragraphs 8–26 of Dr. Davis’s Reply Declaration

directly rebut and respond to **(i)** the POR argument that Severinsky’s hysteresis is only speed based while the “setpoint” claimed in the ’634 Patent is “a *torque* value;” and **(ii)** the POR’s acknowledgement of a “physical relationship between speed and torque,” but argument that it “does not bridge the chasm between Severinsky’s separate speed and torque-based algorithms.”

Paper 26,¹⁷ 2 (citing PO Resp. 18–23). Petitioner further argues that Exhibit 1015 has been part of the record since the Petition was filed and “Exhibit 1092 contains omitted excerpts from a 2005 textbook that PO submitted with its POR as Exhibit 2020.” *Id.*

For the following reasons, we are persuaded Severinsky teaches “vary[ing] said setpoint SP,” as required by claim 33, during the hysteresis mode.

We first analyze the Board’s prior findings in IPR2014-01416 regarding the question of whether Severinsky’s hysteresis mode is a speed based threshold only, as Patent Owner asserts, or is also a torque based threshold as Petitioner asserts. In light of arguments by Patent Owner in IPR2014-01416 that Severinsky’s control is speed based, the Board previously found, merely because Severinsky discusses “‘speed’ as one of the parameters used by the microprocessor” that “does not negate its overall

¹⁷ “Paper 26” refers to “Petitioner’s Response Identifying Issues Raised In the Patent Owner Response or The Institution Decision to Which the Evidence And/or Arguments Identified by Patent Owners Responds.”

and express teaching of employing the engine ‘responsive to the load imposed by the vehicle’s propulsion requirements,’ or road load, ‘so the engine [] can be operated in its most fuel efficient operating range.’”

Ex. 1059, 17 (citing Ex. 1013, 17:11–15). In addition, the Board specifically rejected Patent Owner’s “arguments that criticize Severinsky’s references to ‘speed,’ when the ’634 patent itself recognizes that ‘speed’ plays a role in a road load-responsive hybrid control strategy.” *Id.*; *see also* Ex. 1064,¹⁸ 20 (“In other words, torque and speed are not mutually exclusive concepts. Thus, regardless of whether the modifier ‘high-speed’ or ‘low speed’ is used, Severinsky expressly describes the consideration of ‘torque’ or ‘load’ for triggering the mode.”).

We now turn to Patent Owner’s contention in Paper 25 that Petitioner exceeds the proper scope of a reply. Petitioner “may not submit new evidence or argument in reply that it could have presented earlier” but “may submit rebuttal evidence in support of its reply.” Consolidated Trial Practice Guide (“Consol. TPG”), 73 (Nov. 2019)¹⁹. In this case, Patent Owner specifically argues that Severinsky’s hysteresis mode is speed-based not torque-based. *See* PO Resp. 21 (“there is no record evidence that the *speed*-based time delay or the use of different *speed* thresholds for turning the engine on vs. turning the engine off would result in Severinsky ‘varying said setpoint,’ which is a *torque* value.”). Thus, we agree with Petitioner that its Reply at pages 10–11 and paragraphs 8–26 of Dr. Davis’s Reply Declaration directly respond to the issue raised by Patent Owner concerning whether

¹⁸ Exhibit 1064 is the Board’s Final Written Decision in IPR2015-00758 which also involved the ’634 patent.

¹⁹ <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

Severinsky's hysteresis mode results in varying a torque-based setpoint.²⁰ In addition, in our Decision on Institution, we referenced the Board's discussion in IPR2014-00758 concerning the relationship between torque and speed in Severinsky's control system. Dec. 34. Our Trial Practice Guide also allows Petitioner's Reply to address "issues discussed in the institution decision." Consol. TPG at 79. Therefore, to the extent necessary, we consider the arguments on pages 10–11 of Petitioner's Reply as well as paragraphs 8 to 26 of Dr. Davis's Reply Declaration and the exhibits referenced therein.

Patent Owner provides numerous arguments why Severinsky's hysteresis mode is speed-based rather than torque-based. *See e.g.*, PO Resp. 20. However, Patent Owner never directly reconciles those arguments with the Board's findings in IPR2014-01416 and IPR2014-00758 that Severinsky's microprocessor considers both speed and torque when determining whether to run the engine. Ex. 1059, 17; Ex. 1064, 20; *see also* Pet. Reply 10 ("Severinsky's control system does not take *only* speed into account—the Board debunked that argument years ago . . . but *must also* take torque into account.") (citing Ex. 1059, 14–17; Ex. 1088 ¶¶ 8–26). In fact, Patent Owner and Dr. Shahbakhti both acknowledge "[s]peed may 'play[] a role' in altering road load." PO Resp. 23 n.6; Ex. 2016 ¶ 68. Further, Patent Owner relies on Dr. Shahbakhti's testimony that Severinsky's controller considers both speed *and* torque in connection with his diagram illustrating the torque required to propel a vehicle over a hill at constant speed. *Id.* at 24 (citing Ex. 2016 ¶ 73) ("[W]hen the speed is low

²⁰ We note that Patent Owner deposed Dr. Davis and questioned him on his Reply Declaration. *See, e.g.*, Ex. 2035, 31:4–5.

and the instantaneous torque is high . . . a POSA would understand that Severinsky would need to arbitrate between the speed-based algorithm and the torque-based algorithm by prioritizing one over the other.”). To the extent that Patent Owner’s contentions are based on its assertion that Severinsky’s hysteresis mode is speed-based rather than torque based, those contentions are unavailing based on the Board’s prior findings.

The primary basis for Patent Owner’s argument that disregarding Severinsky’s setpoint does not correspond to “varying” the setpoint as required by claim 33 is that Severinsky’s setpoints “would be written into source code and not change throughout the lifetime of the vehicle.” PO Resp. 20; *see also* Sur-reply 5 (“[T]hey are written into source code and do not change.”).

Notwithstanding Patent Owner’s arguments, we agree with Petitioner that “the challenged claims are agnostic as to how ‘varying said setpoint’ is accomplished.” Pet. Reply 11 (citing Ex. 1008 ¶¶ 27–29). Petitioner’s contention is supported by Dr. Davis whose testimony we credit. Dr. Davis testifies:

The claims do not require that “*varying said setpoint*” must be accomplished by changing a single variable in the source code that represents the claimed “setpoint.” Nor do they preclude “*varying said setpoint*” by switching between two (or more) separate variables (or fixed values) that represent the “setpoint” at any given time depending on the circumstances during operation, as is the case with the standard engine on mode (60% MTO) and the lower value during the highway hysteresis mode (lower MTO %) thresholds in Severinsky.

Ex. 1088 ¶ 28. Dr. Davis’ testimony is consistent with Patent Owner’s position and Dr. Shahbakhti’s testimony that Severinsky’s controller must consider both speed and torque. *See* PO Resp. 23 (citing Ex. 2016 ¶ 122) (arguing that a skilled artisan “would understand that Severinsky would need

to arbitrate between the speed-based algorithm and the torque-based algorithm by prioritizing one over the other.”). Dr. Davis also testifies that “Severinsky’s hysteresis methodology utilizes a fixed general-purpose speed range, and a general-purpose fixed time period to lower the setpoint for running the engine outside of its most efficient operating range.” Ex. 1008 ¶ 279 (citing Ex. 1013, 18:36–40). In response to Patent Owner’s argument that Severinsky’s hysteresis mode is speed-based, Dr. Davis credibly testifies that “when hysteresis is not being employed, the ‘setpoint’ in Severinsky for engine operation is 60% MTO; when hysteresis is being employed, that setpoint becomes a lower percentage MTO to minimize engine starts.” Ex. 1088 ¶ 28. Dr. Davis supports this testimony that the claimed setpoint can be varied in this manner by citing to the discussion of varying setpoints during hysteresis in the ’634 patent. *Id.* (citing Ex. 1001, 41:10–54). Dr. Davis’s testimony is consistent with that of Dr. Shahbakhti who testified that the paragraph beginning at column 41, line 30 of the ’634 patent is the “main example” of varying the setpoint. Ex. 1105, 29:14–31:24.

Based on our review of Petitioner’s evidence and after considering Patent Owner’s contentions, we find Petitioner establishes Severinsky discloses varying the setpoint as required by claim 33, at least, during the hysteresis mode.

Motivation to Combine

Patent Owner first contends that “Severinsky’s ‘speed-responsive hysteresis’ does **not** result in varying the claimed ‘setpoint.’” PO Resp. 29, 30 (“BMW’s fallacy—that a speed-based time delay varies a torque-based setpoint—permeates BMW’s reasons to combine.”). To the extent that

Patent Owner bases its motivation to combine contentions on its assertion that Severinsky's hysteresis mode is speed based rather than torque based, those contentions fail at the outset for the reasons discussed above in connection with claim limitation 33e.

Patent Owner next contends "Nii's disclosure has nothing to do with varying a setpoint used for determining when to employ the engine or electric motor." PO Resp. 32 (emphasis omitted); *see also* Sur-reply 11 (arguing the same). The Petition, however, does not rely on Nii for disclosing varying a setpoint but for "monitoring a driver's repeated driving operations over time." *See* Pet. 19–20. This contention is unavailing because it is an attack on Nii individually while the challenge is based on the combined teachings of Severinsky and Nii. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

Patent Owner next contends a skilled artisan would not use Nii's pattern information to adjust Severinsky's set point. PO Resp. 32. Patent Owner further contends any pattern information derived from Nii's series hybrid where the engine is always on "is unrelated to operating mode selection in a parallel hybrid vehicle and unrelated to adjusting the claimed 'setpoint' which the claims use to select between electric motor operation and engine operation." *Id.*; *see also id.* at 13–14 (arguing the difference between series and parallel hybrid vehicle architecture "is fundamental and renders the control systems . . . different as night and day"). Patent Owner contends Nii "at best discloses how to use 'vehicle patterns' to determine time-averaged values, which has no applicability to the claimed 'setpoint.'" *Id.* at 33 (citing Ex. 2016 ¶ 103). Patent Owner further contends Nii "determines the average power consumption over an entire trip." *Id.*

According to Patent Owner, this is in contrast to the '634 patent which adjusts the setpoint “by knowing how the instantaneous torque requirements fluctuated in relationship to the setpoint on previous trips.” *Id.* (citing Ex. 1001, 39:62–40:3, 40:56–61). Patent Owner further contends “[t]he average power of a previous trip does not provide any information about the actual torque requirements” because “a ‘low *average* power’ requirement does not provide any information about the *instantaneous* torque requirement because averages do not provide any information regarding any one (instantaneous) value.” *Id.* at 37 (citing Ex. 2016 ¶¶ 111–117); *see also id.* at 39 (“Knowing the average power requirement of a previous trip does not provide any information about which of these actually took place and certainly does not provide information about the ‘vehicle’s actual torque requirements.”). Patent Owner relatedly contends that because Nii does not disclose “monitoring patterns that could be useful in better aligning the setpoint with the instantaneous torque requirement,” Petitioner fails to support its reasoning for the combination of Severinsky and Nii that incorporating Nii’s pattern information “would be beneficial because it would more closely align those values with the vehicle’s actual torque requirements.” PO Resp. 41–42 (citing Pet. 21; Ex. 1001, 40:63–41:3; Ex. 2016 ¶ 125).

Patent Owner also contends that the Petition fails to establish that a skilled artisan would have had a reasonable expectation of success in combining the teachings of Severinsky and Nii. PO Resp. 43. Patent Owner further contends Petitioner “fails to explain how a [skilled artisan] would apply any ‘pattern information’ from Nii to adjust Severinsky’s control

system” and argues again that average power requirements are not useful. *Id.* (citing Ex. 2016 ¶¶ 126–128).

Petitioner, in turn, contends “Nii teaches the same monitoring of repeated driving operations over time as the ’634 Patent: a daily commute.” Pet. Reply 3 (citing Ex. 1001, 40:50–41:3; Ex. 1022, 2:21–24). Petitioner further contends that its proposed combination relies on incorporating Nii’s disclosure of “monitoring a driver’s repeated driving operations over time” to vary Severinsky’s setpoint. *Id.* at 5 (citing Dec. 35–36; Pet. 19–23; Ex. 1008 ¶¶ 276–283; Ex. 1088 ¶¶ 34–37). According to Petitioner, Patent Owner’s arguments focusing on the different architectures of Severinsky (parallel hybrid) and Nii (series hybrid) and Nii’s determination of actual power are irrelevant because the arguments “would require an actual, physical substitution of elements” from Nii into Severinsky. *Id.* (citing *In re Mouttet*, 686 F. 3d 1322, 1332 (Fed. Cir. 2012)).

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 have recognized that Nii’s teaching of monitoring a driver’s repeated driving operations over time in a series hybrid vehicle in order to vary Severinsky’s setpoint would improve 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 operation, *i.e.*, average power consumed during the daily commute, into Severinsky’s controller. Claim 33, however, requires only monitoring a driver’s repeated driving operations over time not the monitoring of any particular data. It is Nii’s disclosure of monitoring a driver’s repeated driving operations over time, a daily commute, that Petitioner relies on to modify Severinsky’s controller. Patent Owner’s argument that the *vehicle data*, *i.e.*, average power, resulting from Nii’s monitoring patterns of vehicle operation over time would not be used by a skilled artisan to vary Severinsky’s setpoint does not change the fact that Nii discloses “monitoring a driver’s repeated driving operations over time” which is all claim 33 requires. Patent Owner’s contentions are not tethered to the language of claim 33 or responsive to the actual combination proposed in the Petition.

Patent Owner repeatedly argues that Nii monitors patterns of vehicle operations over time to obtain average power values which, according to Patent Owner, is not remotely related “to using its ‘vehicle patterns’ . . . to

more accurately adjust the setpoint in relation to the *instantaneous* torque required to propel the vehicle.” PO Resp. 31 (citing Ex. 2016 ¶ 103), 37 (“The average power of a previous trip does not provide any information about the actual torque requirements.”), 39 (“Knowing the average power requirement of a previous trip does not provide any information about which of these actually took place and certainly does not provide information about the ‘vehicle’s actual torque requirements.”), 41–42 (“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.”). These contentions are unavailing for two reasons.

First, Patent Owner bases these contentions on the disclosure in the Specification of the ’634 patent of varying the setpoint based on “knowing how the instantaneous torque requirements fluctuated in relationship to the setpoint of previous trips.” See PO Resp. 33 (citing Ex. 1001, 39:62–403, 40:56–61; Ex. 2016 ¶ 103). Claim 33, however, does not require monitoring patterns of instantaneous torque. In any event, to the extent that claim 33 requires “determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command,” Petitioner relies on Severinsky to satisfy this limitation. Pet. 16–17 (citing Ex. 1008 ¶¶ 220–222; Ex. 1013, 16:67–17:15). Patent Owner does not dispute that Severinsky discloses this limitation. See PO Resp. 18–44. Second, Patent Owner’s contentions are premised on a bodily incorporation of the *vehicle data* resulting from Nii’s monitoring patterns of vehicle operations over time directly into Severinsky’s control scheme. Further, the ’634 patent states that “[i]t 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” to “prevent repetitive engine starts.” Ex. 1001, 40:61–63.

To the extent Patent Owner’s contentions are premised on the alleged failure by Petitioner to show how a skilled artisan would have used average power data in the context of Severinsky’s control scheme, Dr. Davis testifies “both series and parallel hybrid vehicles are concerned with average power requirements.” Ex. 1088 ¶ 60. Dr. Davis directs us to Severinsky’s disclosure of using average power for turning the engine on or off. *Id.* (citing Ex. 1013, 5:46–51, 8:10–19, 8:52–67; 17:34–42). In particular, Severinsky discusses “the average power required in typical city driving is less than 5 hp . . . the average power consumed in suburban driving is 10 hp.” Ex. 1013, 8:14–17. Severinsky specifically provides that “engine 40 is cycled on and off in this speed range [25–35 mph] when the average power demand is small” (*id.* at 17:38–39) as opposed to “the engine running constantly after the vehicle reaches a speed of 30–35 mph.” *Id.* at 17:38–39, 18:36–38. We, thus, find Severinsky discloses a relationship between low average power and cycling the engine on and off during suburban driving. Therefore, Patent Owner’s argument that average power values are unrelated to Severinsky’s setpoint for turning the engine on/off is contrary to this disclosure in Severinsky.

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.’” Except for mentioning the ‘average power requirements.’” PO Resp. 43. The Petition explains a skilled artisan “would have understood how to implement Nii’s pattern monitoring functionality into Severinsky’s

controller to alter the vehicle’s operating points.” Pet. 23 (citing Ex. 1008 ¶¶ 278, 283). According to Petitioner, this “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.* Dr. Davis testifies he relies on Nii’s recognition of a pattern such as a daily commute and further testifies why a skilled artisan would be motivated to use the pattern information to modify Severinsky’s controller. Ex. 1008 ¶¶ 274–276. 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 ’634 patent describes is within the level of skill in the art. Ex. 1001 40:61–63.

Based on our review of the evidence cited by Petitioner and after considering Patent Owner’s contentions, we find Petitioner states reasons why a skilled artisan would have been motivated to combine the teachings of Severinsky and Nii and would have had a reasonable expectation of success in doing so.

For all the foregoing reasons, Petitioner establishes by a preponderance of the evidence that claim 33 is unpatentable over Severinsky and Nii.

E. Grounds 2, 3: Claim 33 – Alleged Obviousness over Severinsky and Quigley and over Severinsky and Graf

Petitioner alternately contends that claim 33 would have been obvious over Severinsky and Quigley (Pet. 23–29) and Severinsky and Graf (*id.* at 29–35). We do not reach these alternate grounds. *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).

*F. Ground 4: Claims 34–38, 42–44, 46, 50, 52, 55, and 68 –
Alleged Obviousness over Severinsky and Nii or Quigley or
Graf*

Claims 34–44, 46, 50, 52–55, and 68 depend directly or indirectly from claim 33. Ex. 1001, 61:9–62:14; 62:38–44; 62:65–63:2; 63:6–23; 64:13–17. Petitioner contends that all claims challenged in this ground except claims 37 and 44 “include additional limitations previously found by the Board to have been disclosed by Severinsky.” Pet. 35. Petitioner further contends that “Severinsky discloses the limitations of Claims 37 and 44 as well.” *Id.*

Petitioner provides detailed contentions for each of the claims challenged in this ground with reference to the disclosure in Severinsky with supporting testimony from Dr. Davis alleged to correspond to the limitations in these dependent claims. Pet. 35–43.

Patent Owner does not directly address Petitioner’s specific contentions for any of the claims challenged in this ground. PO Resp. 56. Patent Owner argues “Grounds 4–9 all rely on Grounds 1–3 to address claims that depend from claim 33. Thus, Grounds 4–9 are flawed for at least the reasons set forth with respect to Grounds 1–3.” *Id.* Because we determine that claim 33 is unpatentable over Seveinsky and Nii, Patent Owner’s contentions for the claims challenged in this ground are unavailing.

Claim 34

Petitioner contends Severinsky’s “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,’ and below that setpoint

the microprocessor employs the motor alone” and “[w]hen only the motor is propelling the vehicle, the engine is turned off.” Pet. 35 (citing Ex. 1008 ¶¶ 316–321; Ex. 1013, 20:63–67, 7:8–16, 12:64–13:2, 17:4–47).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 34 is unpatentable over Severinsky and Nii.²¹

Claim 35

For claim 35, Petitioner refers to its contentions for claim 34 and further contends that Severinsky’s “engine is operated to ‘charge the batteries while driving the vehicle forward’ or when the vehicle is stopped.” Pet. 35–36 (citing Ex. 1013, 15:1–10, 16:67–17:15). Petitioner further contends that “[A]t all times’ the microprocessor determines the load ‘to be provided to the engine by the motor’ when it is acting as a generator ‘so that the engine 40 can be operated in its most fuel-efficient operating range.’” *Id.* at 36 (citing Ex. 1013, 16:67–17:15). Petitioner further contends that a skilled artisan would have understood that Severinsky’s “engine is turned off when the torque required for propulsion and/or to charge the battery is less than the predetermined torque value of 60% MTO (i.e., ‘SP’).” *Id.* (citing Ex. 1008 ¶¶ 323–333; Ex. 1013, 15:1–10, 6:19–23, 9:65–68, 18:9–12, Figs. 3, 9).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 35 is unpatentable over Severinsky and Nii.

²¹ Because we do not reach Petitioner’s alternate Grounds 2 and 3, we do not address Petitioner’s alternate contentions that the claims in Ground 4 are unpatentable over Severinsky and Quigley and Severinsky and Graf.

Claim 36

Petitioner contends Severinsky’s microprocessor 48 “determines when to charge the battery by ‘monitoring the state of charge of battery 22 via control signal line 66.’” Pet. 36 (citing Ex. 1008 ¶¶ 334–335; Ex. 1013, 15:1–10, 6:19–23, 9:65–68, 18:9–12, Figs. 3, 9). Petitioner further contends Severinsky’s battery 22 supplies stored electric energy to motor 20 and is charged by power generated by motor 20 when motor 20 operates as a generator driven by engine 40 or from regenerative braking. *Id.* (citing Ex. 1008 ¶¶ 336–340; Ex. 1013, Abstract, 9:65–10:14, 15:1–10, 22:15–18). Petitioner further contends Severinsky’s electric motor “is capable of providing ‘output torque . . . to the vehicle drive wheels 34’ by ‘using power stored in batteries’ (i.e., supplied current).” *Id.* at 37 (citing Ex. 1013, Abstract, 9:61–10:4, 10:52–11:6, 11:53–57). Petitioner also illustrates the energy flow from battery 22 to motor 20 which causes torque to flow to vehicle wheels 34. *Id.* (citing Ex. 1008 ¶¶ 341–343; Ex. 1013, 10:52–11:6, Fig. 4).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 36 is unpatentable over Severinsky and Nii.

Claim 37

Petitioner contends Severinsky’s microprocessor monitors the state of charge of battery 22 and automatically enters “‘battery charging mode’ where the ‘engine 40 charges battery 22 by rotating motor 20’ and ‘also supplies torque to road wheels 24.’” Pet. 38 (citing Ex. 1013, 15:1–10, 17:34–18:22). Petitioner further contends that, in Severinsky, when the instantaneous torque required to propel the vehicle is below 60% MTO, the

engine “is used only to charge the batteries *as needed*.” *Id.* (citing Ex. 1013, 7:8–16). Petitioner also contends “Severinsky discloses operating the engine to propel the vehicle ‘under the most efficient conditions of output power and speed’ . . . such as when the vehicle is cruising along the highway” and “[a]ny of the ‘engine’s excess torque may be used to drive the motor 20 as a generator so as to charge the batteries.” *Id.* (citing Ex. 1013, 6:36–48, 7:8–16, 10:30–36, 14:18–22, 17:68–18:8, 20:63–67). Petitioner further contends “in order for the Severinsky engine to provide torque to propel the hybrid vehicle and to drive the electric motor to charge the battery, a [skilled artisan] would have found it inherent or obvious that ‘*starting the engine* would have been necessary ‘*if the engine is not already running*.’” *Id.* at 39 (citing Ex. 1008 ¶¶ 357–359).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 37 is unpatentable over Severinsky and Nii.

Claim 38

Petitioner contends a skilled artisan “would have found it inherent or obvious that ‘*starting the engine*’ would have been necessary ‘*if the engine is not already running*’ to operate the engine to propel the Severinsky vehicle.” Pet. 39 (citing Ex. 1008 ¶¶ 360–362, Ex. 1013, 6:36–39, 10:38–40, 14:54–68).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 38 is unpatentable over Severinsky and Nii.

Claim 42

Petitioner contends that Severinsky's "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. 39 (citing Ex. 1008 ¶¶ 363–365; Ex. 1013, 17:64–18:2, 20:63–67).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 42 is unpatentable over Severinsky and Nii.

Claim 43

Petitioner contends Severinsky discloses a setpoint as 60% of the MTO of the engine and that microprocessor 48 compares the road load "to the *setpoint* to determine whether to operate the motor, engine, or both." Pet. 40 (citing Ex. 1008 ¶¶ 366–372; Ex. 1013, 6:19–48, 7:8–16, 16:67–17:15, 20:63–67, 22:20–29). Petitioner next contends Severinsky discloses a motor-only mode "referred to as a 'low speed' mode of operation performed during 'city traffic'" when "the 'average power demand is small' and operation using the motor alone is more efficient than operation of the engine." *Id.* (citing Ex. 1008 ¶¶ 379–381; Ex. 1013, 10:52–11:6, 17:34–42, 20:63–67, 24:14–20, Fig. 4, claims 3, 6, 12). Petitioner next contends "Severinsky discloses a 'steady state highway cruising' mode where" the engine supplies torque to the drive wheels when "the *road load* requirements are above the 60% *setpoint* and below 90% of the engine's MTO." *Id.* at 41 (citing Ex. 1008 ¶¶ 382–389; Ex. 1013, Abstract, 13:66–14:7, 18:35–47, 22:45–47, 25:4–24, 36:20–36, Fig. 5, claims 3, 17). Petitioner next contends "Severinsky discloses an 'acceleration or hill climbing mode' where both the electric motor and engine provide torque to the vehicle wheels when "the

road load requirements are beyond the engine’s MTO.” *Id.* (citing Ex. 1008 ¶¶ 390–399; Ex. 1013, Abstract, 6:43–45, 13:65–14:36, 25:26–34, Fig. 5, claim 3).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 43 is unpatentable over Severinsky and Nii.

Claim 44

Petitioner contends “Severinsky discloses a ‘two-way clutch 50’ operated by ‘microprocessor 48,’ in combination with a ‘controllable torque transfer unit 28,’ to controllably connect and/or to disconnect the engine to the ‘wheels 34’ of the vehicle.” Pet. 42 (citing Ex. 1008 ¶¶ 400–403, Ex. 1013, 9:58–65, 15:11–32, Fig. 3). Petitioner further contends Severinsky’s microprocessor 48 disconnects engine 40 when “battery 22 is fully charged and the vehicle speed is below about 25-35 mph.” *Id.* (citing Ex. 1008 ¶¶ 404–406; Ex. 1013, 17:443–55). Petitioner further contends Severinsky discloses coupling the engine to the wheels in “highway cruising mode” and both the motor engine to the wheels “in a high-speed acceleration and/or hill climbing mode.” *Id.* at 42–43 (citing Ex. 1008 ¶¶ 407–409; Ex. 1013, 13:65–14:9, 14:22–35, Fig. 6).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 44 is unpatentable over Severinsky and Nii.

Claim 46

Petitioner contends “Severinsky’s vehicle receives operator inputs via ‘accelerator and brake pedals’ and determines the amount of torque required to propel the vehicle in response.” Pet. 43 (citing Ex. 1008 ¶¶ 411–414; Ex.

1013, 13:10–29, 10:14–20). Petitioner further contends that Severinsky’ “microprocessor may switch directly from ‘*mode I*’ to ‘*mode V*’ . . . in circumstances where ‘electric motor 20 provides all of the torque needed to move the vehicle’ (i.e., in ‘*mode I*’), ‘if the operator continues to command acceleration, an acceleration/hill climbing mode’ (i.e., ‘*mode V*’) ‘may be entered.’” *Id.* at 43–44 (citing Ex. 1008 ¶¶ 417–421; Ex. 1013, 10:52–11:6).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 46 is unpatentable over Severinsky and Nii.

Claim 50

Petitioner contends “[a]ny of [Severinsky’s] ‘engine’s excess torque may be used to drive the motor 20 as a generator to as to charge the batteries’ which can also take place when the vehicle is driving downhill.” Pet. 44 (citing Ex. 1008 ¶¶ 423–424; Ex. 1013, 6:36–48, 10:30–38, 14:15–22, 17:68–18:8, Fig. 7). Petitioner further contends Severinsky discloses regenerative braking may occur when the vehicle is driving downhill or when braking is initiated by the operator. *Id.* (citing Ex. 1008 ¶¶ 425–430; Ex. 1013, Abstract, 9:68–10:4, 10:32–36, 13:16–21, 14:37–53, 17:46–51, Fig. 7).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 50 is unpatentable over Severinsky and Nii.

Claim 52

Petitioner contends “Severinsky discloses a ‘two-way clutch 50’ operated by ‘microprocessor 48,’ in combination with a ‘controllable torque transfer unit 28,’ to controllably connect and/or disconnect the engine to the

‘wheels 34’ of the vehicle.” Pet. 44–45 (citing Ex. 1008 ¶¶ 431–435; Ex. 1013, 9:58–65, 15:11–32, Figs. 3, 10).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 52 is unpatentable over Severinsky and Nii.

Claim 55

Petitioner contends Severinsky discloses operating the engine inefficiently in certain circumstances “rather than to discharge the batteries excessively, which would substantially reduce the battery lifetime.” Pet. 45 (citing Ex. 1008 ¶¶ 441–442; Ex. 1013, 16:67–17:15, 18:23–33). Petitioner further contends a skilled artisan “would have understood the lifetime of the battery in a hybrid electric vehicle is both a drivability consideration and a safety consideration.” *Id.* (citing Ex. 1008 ¶¶ 442–443).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 55 is unpatentable over Severinsky and Nii.

Claim 68

Petitioner contends Severinsky discloses a battery that supplies stored electric energy to the motor which “is capable of providing ‘output torque . . . to the vehicle drive wheels 34’ by ‘using power stored in the batteries.’” Pet. 46 (citing Ex. 1008 ¶¶ 444–447; Ex. 1013, Abstract, 9:58–10:14, 10:52–11:6, 22:15–18, Fig. 3). Petitioner further contends “Severinsky discloses an embodiment in which ‘the DC voltage will be 1000 to 1400 volts’ when ‘50 amperes maximum current’ is supplied to operate a ‘60-80 horsepower motor’” which according to Petitioner yields “the ratio of the maximum DC

voltage to maximum current supplied is 28:1.” *Id.* (citing Ex. 1008 ¶¶ 448–449; Ex. 1013, 19:39–47).

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 68 is unpatentable over Severinsky and Nii.

G. Ground 5: Claims 39 and 40 – Alleged Obviousness over Severinsky and Nii or Quigley or Graf and Frank

Claims 39 and 40 each depend from claim 33. Ex. 1001, 61:42–54. Petitioner contends claims 39 and 40 “include additional limitations related to hysteresis found by the Board to have been disclosed by the obvious combination of Severinsky and Frank.” Pet. 47.

Petitioner details its contentions for each of the challenged claims with a chart listing the disclosure in Severinsky and Frank with supporting testimony from Dr. Davis alleged to correspond to the limitations in these dependent claims. *Id.* at 47–50. Petitioner also provides reasons for combining the teachings of Severinsky and Frank which Petitioner contends is “[i]n accordance with the Board’s previous findings (*e.g.*, [Ex.] 1066).” *Id.* at 50.

a. Overview of Frank – Exhibit 1068

Frank is a United States Patent titled “Charge Depletion Control Method and Apparatus for Hybrid Powered Vehicle.” Ex. 1068, code (54). Frank is directed to “[a] charge depletion method and apparatus for operating the electric motor and small auxiliary power unit, such as an internal combustion engine, in a hybrid electric vehicle (HEV) separately or together depending upon the driving conditions.” *Id.* at code (57). Frank discloses preventing ‘undesirable or excessive cycling of the [engine] 14 due to fluctuations in sensed speed.’ *Id.* at 8:6–7.

b. Analysis

We first address Petitioner’s contentions concerning the limitations of claims 39 and 40 and then Petitioner’s reasons for combining Severinsky and Frank.

Claim 39

Petitioner contends a skilled artisan “would have understood that Severinsky discloses monitoring the [road load] over the entire period of the hybrid vehicle’s operation” because it “determin[es] the *road load* requirements based on an operator’s input and vehicle performance to ‘maintain a given road speed’ . . . and modifying operation of the vehicle based on these and other sensed inputs.” Pet. 47 (citing Ex. 1013, 6:19–35, 14:9–22; Ex. 1008 ¶¶ 451–456). Petitioner further contends “Severinsky employs a ‘speed responsive hysteresis in mode switching’” where the vehicle operates in “highway mode with the engine running constantly after the vehicle reaches a speed of 30-35 mph” ‘unless the engine speed is reduced to 20-25 mph for a period of time, typically 2-3 minutes.’” *Id.* at 48 (citing Ex. 1008 ¶ 461; Ex. 1013, 18:23–42). Petitioner further contends although “Severinsky’s discussion of ‘hysteresis’ references speed, Severinsky’s vehicle nevertheless ‘operate[s] in different modes depending on the *torque* required.’” *Id.* (citing Ex. 1001, 35:3–17).

Petitioner next contends “Frank similarly discloses well-known hysteresis control techniques used to prevent ‘undesirable or excessive cycling of the ICE 14 due to fluctuations in sensed speed.’” Pet. 48 (citing Ex. 1068, 8:4–7). Petitioner further contends “Frank discloses ‘a single threshold could be used in combination with a time delay between the ‘on’ and ‘off’ modes to prevent frequent cycling’ of the engine and motor.” *Id.*

(citing Ex. 7:66–8:11). Petitioner further contends that, in another embodiment, Frank discloses separate on and off thresholds. *Id.* at 48–49 (citing Ex. 1008 ¶¶ 465–472; Ex. 1068, 7:66–8:11, Fig. 4).

Claim 40

Petitioner contends “Severinsky discloses a ‘hysteresis’ mode in which the engine will continue to operate (and the electric motor will remain off) ‘unless the engine speed is reduced to 20-25 mph for a period of time, typically 2-3 minutes.’” Pet. 50 (citing Ex. 1013, 18:23–42). Based on this, Petitioner contends a skilled artisan “would have understood that reducing the engine speed would have a corresponding reduction in *road load* and that operating the vehicle at 20-25 mph would result in the engine operating outside its most fuel efficient operating range.” *Id.* (citing Ex. 1008 ¶¶ 478–481).

Petitioner next contends “Frank discloses that ‘a single threshold could be used in combination with a time delay between the [engine] ‘on’ and ‘off’ modes to prevent frequent cycling [of the engine].’” Pet. 50 (citing Ex. 1008 ¶¶ 482–485; Ex. 1068, 7:66–8:11).

Motivation to Combine

Petitioner contends a skilled artisan would have found it obvious “to combine hysteresis strategies, as described by Frank, with Severinsky’s control strategies . . . because both address parallel hybrid vehicles and switching an engine on/off based on a threshold.” Pet. 50 (citing Ex. 1008 ¶¶ 486–488). Petitioner further contends it would have been obvious to combine Frank’s hysteresis strategies “with Severinsky’s mode selection strategies when switching between motor mode and engine mode to obtain the well-known benefit of hysteresis—avoiding excessive on/off switching

of the engine—that Severinsky and Frank both expressly disclose.” *Id.* at 50–51 (citing Ex. 1008 ¶¶ 489–491; Ex. 1013, 18:34–42; Ex. 1068, 7:66–8:11). Petitioner contends that excessive engine cycling “was known to increase emissions and fuel consumption” and “to contribute to engine wear and noise concerns.” *Id.* at 51 (citing Ex. 1008 ¶¶ 480, 489–491; Ex. 1013, 5:24–36; Ex. 1068, 3:62–67). Petitioner further contends that “[f]or all of these reasons, a [skilled artisan] would have looked to utilize hysteresis controls, as taught by Frank, to reduce excessive engine cycling in Severinsky.” *Id.* (citing Ex. 1008 ¶¶ 486–491).

Patent Owner does not directly address Petitioner’s specific contentions for claim 39 or claim 40. PO Resp. 56. Patent Owner argues “Grounds 4–9 all rely on Grounds 1–3 to address claims that depend from claim 33. Thus, Grounds 4–9 are flawed for at least the reasons set forth with respect to Grounds 1–3.” *Id.* Because we determine that claim 33 is unpatentable over Severinsky and Nii, Patent Owner’s contentions for the claims challenged in this ground are unavailing.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 39 and claim 40 are unpatentable over Severinsky, Nii, and Frank.

We do not reach Petitioner’s alternate contentions that these claims are also unpatentable over Severinsky, Quigley, and Frank and Severinsky, Graf, and Frank.

H. Ground 6: Claim 41 – Alleged Obviousness over Severinsky and Nii or Quigley or Graf and Lateur

Claim 41 depends from claim 33. Ex. 1001, 61:55–61. Petitioner contends that claim 41 “includes additional limitations related to cruise

control previously found by the Board to have been disclosed by the obvious combination of Severinsky and Lateur.” Pet. 51–52.

Petitioner details its contentions for claim 41 with a chart listing the disclosure in Severinsky and Lateur with supporting testimony from Dr. Davis alleged to correspond to the limitations in claim 41. *Id.* at 52–53. Petitioner also provides reasons for combining the teachings of Severinsky and Lateur which Petitioner contends is “[i]n accordance with the Board’s previous findings (*e.g.*, [Ex.] 1066).” *Id.* at 53.

a. Overview of Lateur – Exhibit 1051

Lateur is a United States Patent titled Hybrid Electric Vehicle. Ex. 1051, code (54). Lateur discloses switch inputs for control of the drive system including a cruise control switch for selection by the operator. *Id.* at 4:25–30.

b. Analysis

Petitioner contends Severinsky’s microprocessor receives control inputs from a “driver through operator input devices 70 such as ‘accelerator and brake pedals, directional control switches, and the like.” Pet. 52 (citing Ex. 1008 ¶ 494; Ex. 1013, 6:19–26, 13:16–21).

Petitioner further contends Lateur discloses speed cruise control switch 36 for “producing a ‘cruise control on’ signal or a ‘cruise control off’ signal in response to a selection made by the operator.” *Id.* (citing Ex. 1008 ¶¶ 495–496; Ex. 1051, 4:25–30, 9:46–64, Fig. 1). Petitioner further contends “Lateur’s microprocessor determines ‘that [if] the present speed should be maintained but the load required to maintain that speed changes’ the microprocessor will make “changes to the current flowing in the first and second motor/generators . . . to change the torque being applied to output

shaft 62 such that the desired speed is maintained.” *Id.* at 53 (citing Ex. 1051, 10:1–5, 10:36:–60, Fig. 7).

Petitioner next contends a skilled artisan would have been motivated “to add cruise control, as taught by Lateur, into the controller of Severinsky” because “[c]ruise control is a driver convenience that also improves fuel efficiency.” Pet. 53 (citing Ex. 1008 ¶¶ 509–510). Petitioner further contends both Severinsky and Lateur both evidence that “these control strategies could have been easily implemented in the microprocessor’s software for a cruise control feature based on a speed command from the operator of the vehicle . . . which requires nothing more than routine details added to the design.” *Id.* at 54 (citing Ex. 1008 ¶¶ 494, 509–515).

Patent Owner does not directly address Petitioner’s specific contentions for claim 41. PO Resp. 56. Patent Owner argues “Grounds 4–9 all rely on Grounds 1–3 to address claims that depend from claim 33. Thus, Grounds 4–9 are flawed for at least the reasons set forth with respect to Grounds 1–3.” *Id.* Because we determine that claim 33 is unpatentable over Severinsky and Nii, Patent Owner’s contentions for claim 41 are unavailing.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 41 is unpatentable over Severinsky, Nii, and Lateur.

We do not reach Petitioner’s alternate contentions that these claims are also unpatentable over Severinsky, Quigley, and Lateur and over Severinsky, Graf, and Lateur.

I. Ground 7: Claim 49 – Alleged Obviousness Severinsky and Nii or Quigley or Graf and Ma

Claim 49 depends from claim 33, and recites, “wherein the hybrid vehicle further comprises a turbocharger controllably coupled to the engine,

wherein the method further comprises: operating the turbocharger to increase the MTO of the engine when desired.” Ex. 1001, 62:60–64.

Petitioner contends claim 49 would have been obvious over the combined teachings of Severinsky, Nii and Ma. Pet. 55. Petitioner alternately contends that Quigley or Graf could be substituted for Nii in this ground. *Id.*

Patent Owner contends Petitioner “failed to provide any legitimate reason to modify Severinsky’s parallel hybrid vehicle with the turbocharger found in Ma to arrive at claim[] 49.”²² PO Resp. 56. Patent Owner further contends that “Ground 7 is deficient for the additional reasons set forth in” its response with respect to Grounds 1, 2, and 3. *Id.* at n. 24.

a. Overview of Ma – Exhibit 1021

Ma discloses a hybrid vehicle driven by an internal combustion engine that includes a turbocharger or supercharger and an electric motor. Ex. 1021, code (54), Fig. 1. Ma further discloses that the torque output of the engine can be augmented through use of a turbocharger. *Id.* at 5. Further, both regenerative braking system 18 and electric motor 20 are connected in parallel with the engine “to enable the torque driving the vehicle to be assisted when the output power of the engine 10 is low.” *Id.*

b. Analysis

Petitioner contends “Ma discloses a vehicle having an ‘internal combustion engine (10) calibrated to operate in a lean burn mode comprising means for supplementing the total output torque,’ including ‘a supercharger’ (or turbocharger) and ‘an auxiliary motor.’” Pet. 55 (citing Ex. 1008 ¶ 518;

²² Patent Owner indicates that its contentions for claim 49 also apply to claims 105 and 188 which are challenged in Grounds 10 and 11 discussed below.

Ex. 1021, Abstract, 3:10–20). Petitioner further contends “Ma teaches that the total output torque can be supplemented with ‘an electric motor driven by a battery which is charged by the engine during idling and cruising conditions.’” *Id.* at 56 (citing Ex. 1008 ¶ 520; Ex. 1021, 3:36–29).

Petitioner further contends “Ma makes clear that the use of the turbocharger and an electric motor are not mutually exclusive approaches at supplementing engine power, but rather that ‘more than one source of supplementary torque may be used.’” *Id.* at 56 (citing Ex. 1008 ¶ 520; Ex. 1021, 3:26–29). Petitioner further contends Ma’s turbocharger “is controllably coupled to the ICE for being operated thereby” and is employed only “*when desired.*” *Id.* at 56–57 (citing Ex. 1008 ¶ 521; Ex. 1021, 5:11–18, 5:26–30).

Petitioner next contends it would have been obvious to supplement Severinsky’s hybrid vehicle configuration with Ma’s turbocharger because Severinsky teaches using an electric motor in its hybrid vehicle configuration when the required torque exceeds the capabilities of the engine and Ma teaches using a turbocharger to enhance the engine’s output in circumstances requiring maximum performance. *Id.* at 57–58 (citing Ex. 1008 ¶ 524; Ex. 1013, 14:15–26; Ex. 1021, 4:32–5:5). Petitioner further contends a skilled artisan “would have known that using a turbocharger would provide the additional benefits of allowing a smaller engine to be used and to provide better engine efficiency, resulting in improved fuel economy” and “would have been particularly motivated to achieve these efficiency benefits during extended periods of driving during which the instantaneous torque required to propel the vehicle exceeds the engine’s MTO.” *Id.* at 58 (citing Ex. 1008 ¶¶ 525–526). Petitioner further contends

that “[u]sing a turbocharger to provide additional torque during such circumstances would also help preserve battery charge, by taking some of the torque generation burden away from the motor.” *Id.*; *see also* Ex. 1008 ¶ 526 (Dr. Davis testifying to same). Petitioner further contends a skilled artisan would have been motivated to include Ma’s turbocharger in Severinsky’s hybrid vehicle and “would have had no difficulty [in] doing so as turbochargers were well known in the art, as were the means by which they could be incorporated into hybrid vehicles, as recognized by Ma and by the ’634 patent.” *Id.* (citing Ex. 1001, 45:7–30; Ex. 1008 ¶¶ 527–528; Ex. 1021, 5:20–25).

Patent Owner’s contentions are directed to motivation to combine. PO Resp. 56–70.

Patent Owner’s first contention is that “Severinsky’s electric motor alone achieves the touted benefits of Ma’s turbocharger such that there is no reason to add a turbocharger to Severinsky.” PO Resp. 57; Sur-reply 23–25. According to Patent Owner, Severinsky’s electric motor already provides the benefits that Petitioner contends Ma provides, *i.e.*, additional torque when the engine is being driven for maximum performance. *Id.* at 57 (citing Pet. 57–58; Ex. 1013, 8:52–9:55, 14:15–26; Ex. 2016 ¶¶ 130–137).

Patent Owner next contends that “BMW does not explain why a [skilled artisan] would be motivated to include both a turbocharger and an electric motor in Severinsky to perform the same task.” PO Resp. 60; Sur-reply 25–26. According to Patent Owner, “Ma’s Figure 1 at best discloses that it is possible to combine a turbocharger and an electric motor in the same system.” *Id.* at 61 (citing Ex. 1021, 7:11–18, Fig. 1; Ex. 2016, ¶¶ 151, 47–148); *see also id.* at 63 (“At best, Ma discloses that the turbocharger and

electric motor ***could be*** alternatives to assist an underpowered engine – ‘torque is augmented by bringing any one or more supplementary sources of torque’ (*i.e.*, turbocharger, electric motor, or regenerative braking system).” (citing Ex. 1021, 7; Ex. 2016 ¶¶ 154–157). Patent Owner further contends “[w]hile Ma’s Figure 1 discloses both a turbocharger and electric motor, Ma provides no reason as to why a [skilled artisan] would use both sources of supplemental torque when just one is sufficient.” *Id.* at 61 (citing Ex. 2016 ¶¶ 147–148). According to Patent Owner, “Severinsky is considered a ‘full hybrid’ where the electric motor is sufficiently powerful to propel the vehicle on its own” but Ma “is directed to a ‘power assist’²³ hybrid where the electric motor is used only to supplement the engine.” *Id.* (citing Ex. 2016 ¶ 148).

Patent Owner next contends “BMW’s second reason to combine and obviousness assertions regarding the ‘sustained high-power turbocharged mode VI’ limitation of claims 49, 105, and 188 are based on hindsight, not evidence.” PO Resp. 64; *see also* Sur-reply 26 (“BMW cannot contest that its second reason to combine and obviousness assertions regarding the sustained high-power turbocharged mode VI’ limitations of claims 11 and 33 are based on improper hindsight of the ’634 patent.”). Patent Owner provides a comparison of the text from page 58 of the Petition to certain text from the ’634 patent in support of this contention. PO Resp. 64–65 (citing Pet. 58; Ex. 1001, 44:49–45:6; Ex. 2016 ¶¶ 142–146).

Patent Owner next contends a skilled artisan would have understood “that adding a turbocharger to a parallel hybrid like Severinsky has

²³ Patent Owner also refers to Ma as a “Limited Motor Assist” hybrid which “is a form of a Mild HEV.” PO Resp. 61–62.

significant drawbacks that outweigh BMW's alleged benefits." PO Resp. 67. Patent Owner contends that naturally-aspirated engines have high compression ratios and will suffer from engine-knock if a turbocharger is added. *Id.* at 67–68 (citing Ex. 2016 ¶¶ 165–166). Patent Owner further contends "turbocharging is particularly a bad idea in Severinsky because turbocharged gasoline engines are less efficient than natural-aspirated engines especially at the engine's 'sweet-spot' where Severinsky specifically endeavors to operate the engine" and would be "ill-suited in Severinsky because turbochargers only improve efficiency at low loads where Severinsky does not utilize the engine at all." *Id.* at 68–69 (citing Ex. 1013, 17:68–18:2, 20:63–21:4; Ex. 2016 ¶¶ 168–169; Ex. 2019, 874). Patent Owner further identifies other purported problems such as added weight, packaging problems, and complicating the control system. *Id.* at 69–70.

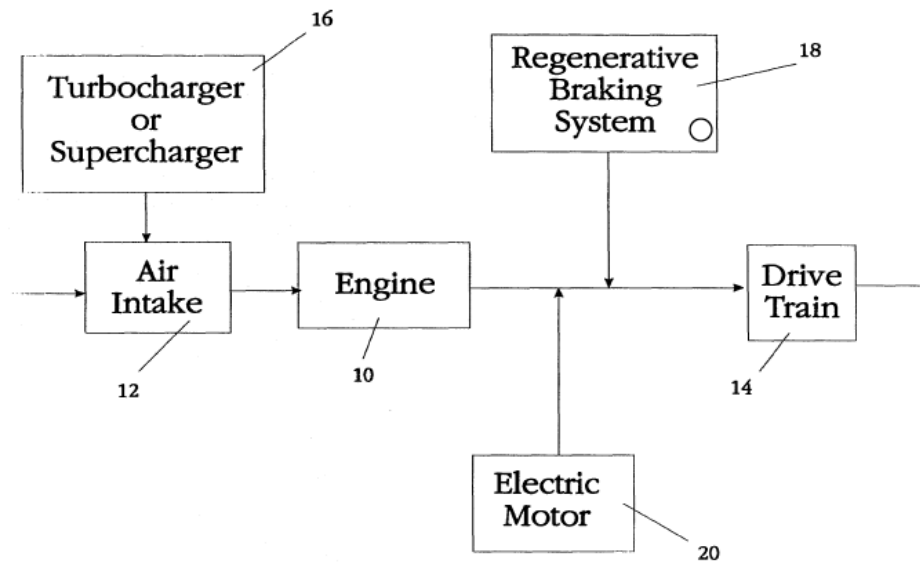
Petitioner, in turn, contends both Severinsky and Ma "concern[] hybrid vehicle control to maximize the engine's fuel efficiency by using supplemental sources of torque." Pet. Reply 25 (citing Pet. 55–58; Ex. 1008 ¶¶ 517–527). According to Petitioner, "[t]hese interrelated teachings' alone provide a sufficient motivation to combine." *Id.* (citing *ZUP v. Nash Mfg.*, 896 F. 3d 1365, 1371 (Fed. Cir. 2018)). Petitioner further contends that "Ma expressly teaches an engine deployed in conjunction with multiple 'source[s] of additional torque,' including a 'Turbocharger' *and* an 'Electric Motor,' and supplementing torque with '**any one or more** of the[se] supplementary sources.'" *Id.* (citing Ex. 1021, Abstr., Fig. 1, 7:11–18, 7:27–36). With respect to Patent Owner's contention that the benefits of combining Ma with Severinsky are redundant, Petitioner points to other benefits that a turbocharger would provide such as better efficiency, improved fuel

economy, use of a smaller engine, and preserving battery charge. *Id.* at 26–27 (citing Pet. 58; Ex. 1008 ¶¶ 525–526). Petitioner further contends that Patent Owner’s arguments about weight, packaging problems, and engine-knock are misguided and overstated. *Id.* at 29 (citing PO Resp. 67–70).

According to Petitioner, adding “turbochargers to engines was well understood and a [skilled artisan] would know how to size and calibrate the engine for use with a turbocharger, as recognized by Ma and the ’634 Patent itself.” *Id.* at 29–30 (citing Ex. 1001, 45:7–31; Ex. 1008 ¶¶ 527, 123–134; Ex. 1021, 5:20–25).

Based on our review of the evidence cited by Petitioner and after considering Patent Owner’ contentions, we determine, for the reasons discussed below, Petitioner establishes by a preponderance of the evidence that claim 49 is unpatentable over Severinsky, Nii, and Ma.

We first discuss Patent Owner’s attempt to circumvent the explicit disclosure of Ma by arguing “Ma’s Figure 1 at best discloses that it is *possible* to combine a turbocharger and an electric motor in the same system.” PO Resp. 61 (emphasis added). To the contrary, Ma does not merely suggest the possibility of combining a turbocharger and electric motor in the same system, but in fact, explicitly discloses using an electric motor operating in parallel with a turbocharged engine in the embodiment shown in Ma’s Figure 1. Pet. Reply 25–26. Ma’s Figure 1 is reproduced below:



Ma describes the system shown in this Figure as:

In the drawing, an engine 10 has an air intake system 12 and a drive train 14. The output torque of the engine can be augmented by means of a supercharger or turbocharger 16 connected to the intake system 12. A regenerative braking system 18 and an electric motor 20 are connected to the drive train 14 *in parallel with the engine to enable the torque driving the vehicle to be assisted when the output power of the engine 10 is low.*

Ex. 1021, 7:11–18, Fig. 1 (emphasis added). Patent Owner’s contentions disregard this explicit disclosure of how both a turbocharger and electric motor can be used in a parallel hybrid drive train. Dr. Shahbakhti, in fact, testifies Ma discloses “the engine, turbocharger, originally with the braking system and electric motor. And then it shows that they are linked by arrow to the drivetrain.” Ex. 1089, 148:23–149:8. We find that Ma’s Figure 1 and the text quoted above disclose how to use both an electric motor and a turbocharger to supplement engine torque in a parallel hybrid. This finding significantly undercuts Patent Owner’s contentions.

Petitioner must provide an “explanation as to *how or why* the references would be combined to produce the claimed invention.”

Trivascular, Inc. v. Samuels, 812 F. 3d 1056, 1066 (Fed. Cir. 2016) (emphasis added). As discussed above, Ma’s Figure 1 shows *how* to modify Severinsky to incorporate a turbocharger. Ex. 1021, Fig. 1. With respect to *why* a skilled artisan would combine Severinsky and Ma, the Federal Circuit explains that

motivation to combine may be found explicitly or implicitly in market forces; design incentives; the ‘interrelated teachings of multiple patents’; ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’; and the background knowledge, creativity, and common sense of the person of ordinary skill.

Zup, LLC v. Nash Manufacturing, Inc., 896 F.3d 1365, 1371 (Fed. Cir. 2018).

In this case, Ma and Severinsky both relate to hybrid vehicles with parallel drive trains. Severinsky discloses a system with a non-turbocharged internal combustion engine and an electric motor. Ex. 1013, Fig. 3. Ma discloses a system with an electric motor and a turbocharged engine. Ex. 1021, Fig. 1. Ma discloses a goal of “reducing fuel consumption” but recognizes the problem that an efficient engine “lacks power.” Ex. 1021, 1:30–2:2. Both Ma and Severinsky disclose providing additional torque to supplement the torque provided by the engine alone. Ex. 1013, 3:16–20; Ex. 1008 ¶¶ 474, 475; Ex. 1021, Abstract, 3:10–20. Ma explicitly discloses that “more than one source of supplementary torque may be used.” Ex. 1008 ¶ 476; Ex. 1021, 3:26–29. A skilled artisan, thus, would have been motivated to consider Ma’s explicit teachings and add Ma’s turbocharger to Severinsky because Ma and Severinsky disclose interrelated teachings

addressing the problem of supplementing the torque of an internal combustion engine in a hybrid drive train. Consequently, we determine that Petitioner shows both *how and why* a skilled artisan would have been motivated to combine Severinsky and Ma to produce the claimed invention.

Patent Owner's contention that a skilled artisan would not have added Ma's turbocharger to Severinsky because Severinsky is a full hybrid in contrast to Ma which, according to Patent Owner is a power assist hybrid, is not persuasive for several reasons. First, claim 49 makes no distinction between full hybrids and power assist hybrids. Second, this contention is based on Dr. Shahbakhti's testimony. Ex. 2016 ¶¶ 148–149. Dr. Shahbakhti, however, also testifies Ma is “hard to understand and does not make sense.” Ex. 1089, 149:20–24. Dr. Shahbakhti points to the word “auxiliary” preceding the word “motor” in Ma's Abstract with no other citation to Ma in support of his opinion that Ma is a power assist hybrid. *See* Ex. 2016 ¶ 148. Given the paucity of support in Ma for this testimony and his admission that Ma is hard to understand and does not make sense, we find Dr. Shahbakhti's testimony that Ma discloses a power assist hybrid to be entitled to little weight. Third, even if Dr. Shahbakhti's testimony were credible, we agree with Petitioner that this contention is improperly premised on a bodily incorporation of Ma's alleged power assist hybrid into Severinsky's full hybrid. *See* Pet. Reply 29.

Patent Owner's contention that the benefit of adding a turbocharger to Severinsky, *i.e.*, additional torque, is redundant is unavailing for the following reasons. Patent Owner cites two Federal Circuit cases for the proposition that the Petition's first reason for the combination fails because “Severinsky alone already achieves the purported benefit associated with the

addition of Ma's turbocharger." PO Resp. 59 (citing *South-Tek Systems, LLC v. Engineered Corrosion Solutions, LLC*, 748 Fed. Appx. 1003 (Fed. Cir. 2018); *Kinetic Concepts, Inc. v. Smith and Nephew, Inc.*, 688 F.3d 1342 (Fed. Cir. 2012)).

In our Decision on Institution, we preliminarily found that Petitioner's first reason for the combination was sufficiently established for institution purposes under the reasonable likelihood standard. Dec. 50. Petitioner, however, provided other reasons why a skilled artisan would have combined Severinsky and Ma including "allowing a smaller engine to be used," "provide better engine efficiency resulting in improved fuel economy," and "preserve battery charge, by taking some of the torque generation burden away from the motor." Pet. 58. Patent Owner does not contend that these other alleged benefits are redundant. See PO Resp. 57–60.

Regardless of whether adding a turbocharger to Severinsky would provide the same benefit as Severinsky's electric motor, taking some of the torque generation burden away from the electric motor to preserve battery charge is a specific non-redundant improvement to Severinsky. This reason is supported by the testimony of Dr. Davis. Ex. 1008 ¶¶ 525–526; Ex. 1088 ¶ 127 (citing Ex. 1013, 6:19–21; Ex. 1045, 3). Dr. Shahbakhti contends that Dr. Davis's testimony is based on hindsight because the prior art does not teach "that adding a turbocharger to a parallel full hybrid system with a properly-sized electric motor would help preserve the state of charge of the battery by permitting the turbocharger to supplement the engine when the road load exceeds the MTO of the engine for extended periods of time." Ex. 2016 ¶ 144. Dr. Davis responds that "no hindsight is required" because skilled artisans "would have readily understood that using a turbocharger to

increase the power output and increase the fuel efficiency is not new, but dates back to the invention of the automobile.” Ex. 1088 ¶ 127 (citing Ex. 1045, 3). Dr. Davis further testifies that a skilled artisan would have been motivated “to use this well-known technique in a hybrid vehicle to maintain and control the battery state of charge (by reducing the burden on the motor)” and “Severinsky itself identifies ‘the state of charge of the battery’ as one of the ‘significant variables’ monitored by its vehicle.” *Id.* We find that Dr. Davis’s testimony is not based on hindsight because it is based on prior art of record. Therefore, we find Dr. Davis’s testimony to be credible and entitled to substantial weight, which distinguishes this case from *Kinetic Concepts*. In *Kinetic Concepts*, the Federal Circuit determined the patent challenger “never offered evidence articulating why a person having ordinary skill in the art would combine the primary references to obtain the disclosed inventions.” *Kinetic Concepts*, 688 F.3d at 1368–1369.

We are not persuaded by Patent Owner’s contention that Petitioner’s second reason for the combination is based on hindsight. PO Resp. 64. Patent Owner first repeats Dr. Shahbakhti’s assertion that Petitioner and Dr. Davis rely on hindsight in connection with its contention that turbocharging Severinsky’s engine will preserve battery charge. *Id.* This contention is unavailing for the same reasons just discussed above. Patent Owner also refers to a “sustained high-power turbocharged mode VI” limitation of claims 49, 105, and 188. *Id.* No such limitation appears in any of those

claims. Ex. 1001, 62:50–64, 67:63–67, 76:50–77:2.²⁴ Consequently, Patent Owner’s improper hindsight argument is not persuasive.

Based on the evidence and arguments presented in the Petition and after consideration of Patent Owner’s contentions, we determine Petitioner establishes by a preponderance of the evidence that claim 49 is unpatentable over Severinsky, Nii, and Ma.

We do not reach Petitioner’s alternate contentions that claim 49 is unpatentable over Severinsky, Quigley, and Ma and Severinsky, Graf, and Ma.

J. Ground 8: Claim 53 – Alleged Obviousness over Severinsky and Nii or Quigley or Graf and Vittone

Claim 53 depends from claim 33. Ex. 1001, 63:9–16. Petitioner contends claim 53 “includes additional limitations, related to stoichiometric fuel combustion, previously found by the Board to have been disclosed by the obvious combination of Severinsky and Vittone.” Pet. 59.

Petitioner details its contentions for claim 53 with a chart listing the disclosure in Severinsky and Vittone with supporting testimony from Dr. Davis alleged to correspond to the limitations in claim 53. Pet. 59–62. Petitioner also provides reasons for combining the teachings of Severinsky and Vittone which Petitioner contends is “[i]n accordance with the Board’s previous findings (e.g., [Ex.] 1066).” *Id.* at 62.

²⁴ The “sustained high-power turbocharged mode VI” appears in claims 11 and 33 of U.S. Patent No. 7,104,347 B2 that was the subject of IPR2020-00994. *See* IPR2020-00994, Paper 48, 33–34 (PTAB, Nov. 10, 2021).

a. Overview of Vittone – Exhibit 1069

Vittone is a technical symposium article titled Fiat Conceptual Approach to Hybrid Cars Design. Ex. 1069, 23.²⁵ Vittone discloses a parallel hybrid vehicle including an engine and electric motor. *Id.* at 28, Fig. 5.

b. Analysis

Petitioner contends “Severinsky’s microprocessor controls the rate of air and fuel supplied to the engine” which “is one way to control the engine’s output torque.” Pet. 59 (citing Ex. 1008 ¶¶ 530–534; Ex. 1013, 10:4–14, 12:41–52). Petitioner further contends Severinsky seeks to “lower emissions” and “[o]perating the engine close to the stoichiometric air/fuel ratio was one widely known method to reduce emissions.” *Id.* (citing Ex. 1008 ¶¶ 530–534; Ex. 1013, 21:12–22).

Petitioner next contends Vittone discloses a hybrid vehicle with a parallel hybrid drive train. Pet. 59 (citing Ex. 1069, 28, 35, Fig. 5). Petitioner further contends that Vittone discloses splitting the torque requirements between the electric motor and engine. *Id.* at 60 (citing Ex. 1008 ¶¶ 535–541; Ex. 1069, 29, 33). Petitioner directs us to Vittone’s Figure 8 reproduced below:

²⁵ We refer to the page numbers added by Petitioner.

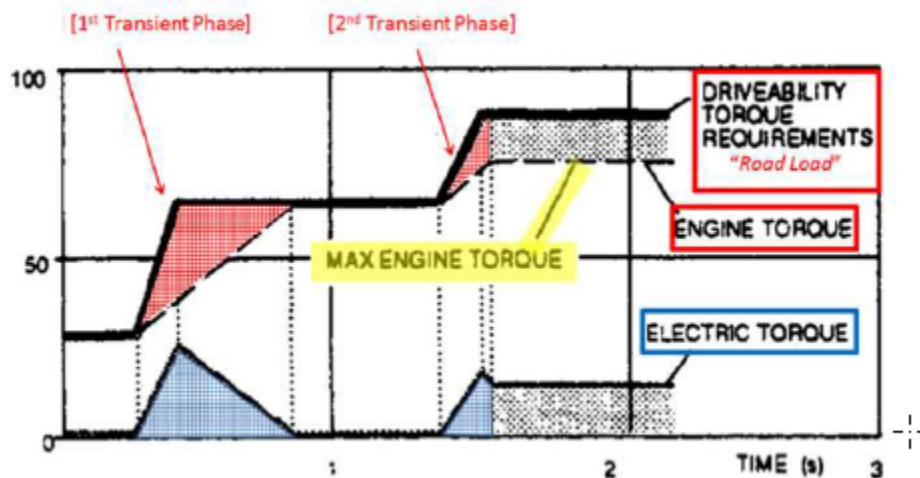


Figure 8, as annotated by Petitioner, is a graph with torque on the y-axis and time on the x-axis, illustrating torque management control strategies. *Id.* (citing Ex. 1069, Fig. 8). Petitioner annotates two “transient phases” in red in the above Figure. *Id.* Petitioner further contends “Vittone discloses ‘new control strategies in the transients . . . to achieve the stoichiometric control over the whole working range’ and that emission reduction is achieved through the ‘steady state’ management of the thermal engine in transient phases.” *Id.* at 61 (citing Ex. 1069, 28, 29). According to Petitioner, “‘steady-state’ management of the engine during transient phases is illustrated by the limited rate of change of the output torque in Figure 8.” *Id.* (citing Ex. 1008 ¶¶ 542–546).

Petitioner next contends it would have been obvious to a skilled artisan “to combine the control strategies taught by Severinsky . . . with the known technique of reducing engine transients, as expressly taught by Vittone, in order to stabilize the air/fuel ratio and thus maintain stoichiometry across the entire engine range.” Pet. 62 (citing Ex. 1008 ¶¶ 562–572. Petitioner further contends “[t]he rationale for the combination is provided by the objects of Severinsky—‘to provide an improved parallel

hybrid electric vehicle . . . to realize maximum fuel efficiency’ and ‘reduced pollutant emissions.’” *Id.* (citing Ex. 1008 ¶ 567; Ex. 1013, 5:24–36).

Petitioner further contends “[m]aximum fuel efficiency’ requires complete combustion of the fuel which can only be achieved if the engine is operating at a substantially stoichiometric ratio.” *Id.* at 62–63 (citing Ex. 1008 ¶¶ 562–566). Petitioner next contends a skilled artisan would have “combine[d] the mode selection controls and topology taught by Severinsky with the steady state management of the engine during ‘transient’ conditions in Vittone . . . to obtain the predictable results taught in Vittone, improved control of the stoichiometric air-fuel ratio which results in improved fuel economy and reduced emissions.” *Id.* at 63 (citing Ex. 1008 ¶¶ 569–571).

Patent Owner does not directly address Petitioner’s specific contentions for claim 53. PO Resp. 56. Patent Owner argues “Grounds 4–9 all rely on Grounds 1–3 to address claims that depend from claim 33. Thus, Grounds 4–9 are flawed for at least the reasons set forth with respect to Grounds 1–3.” *Id.* Because we determine that claim 33 is unpatentable over Seveinsky and Nii, Patent Owner’s contentions for claim 53 are unavailing.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 53 is unpatentable over Severinsky, Nii, and Vittone.

We do not reach Petitioner’s alternate contentions that this claim is also unpatentable over Severinsky, Quigley, and Vittone and Severinsky, Graf, and Vittone.

K. Ground 9: Claim 54 – Alleged Obviousness over Severinsky and Nii or Quigley or Graf and Yamaguchi

Claim 54 depends from claim 33. Ex. 1001, 63:18–20. Petitioner contends claim 53 “includes additional limitations, related to rotating the

engine before starting it in order to heat the cylinders, previously found by the Board to have been disclosed by the obvious combination of Severinsky and Yamaguchi.” Pet. 64.

Petitioner details its contentions for claim 54 with a chart listing the disclosure in Severinsky and Yamaguchi with supporting testimony from Dr. Davis alleged to correspond to the limitations in claim 54. Pet. 64–65.

Petitioner also provides reasons for combining the teachings of Severinsky and Yamaguchi which Petitioner contends are “[i]n accordance with the Board’s previous findings (*e.g.*, [Ex.] 1066).” *Id.* at 65–66.

a. Overview of Yamaguchi – Exhibit 1070

Yamaguchi is a United States Patent titled Hybrid Vehicle. Ex. 1070 code (54). Yamaguchi discloses a hybrid vehicle with “an engine and a generator/motor.” *Id.* at code (57). Yamaguchi discloses that its “vehicle is smoothly started by a driving motor.” *Id.*

b. Analysis

Petitioner contends “Yamaguchi discloses rotating the engine to a predetermined speed . . . before allowing the engine to be started . . . (*i.e.*, to ‘ignite’ the air/fuel mixture within the cylinder, which initiates combustion.” Pet. 64 (citing Ex. 1008 ¶¶ 577–578; Ex. 1070, 8:62–9:5). Petitioner contends it would have been obvious “to address the well-known problem with cold start emissions and the related reduction of fuel economy” “to combine the control strategies taught by Severinsky . . . with the known technique of preheating the engine, as expressly taught by Yamaguchi.” *Id.* at 65–66 (citing Ex. 1008 ¶¶ 583–594). According to Petitioner, “it was well known that during engine starts, and particularly during cold-starts, the engine must run rich to achieve sufficient vaporization of the fuel making it

difficult to maintain the stoichiometric ratio” and the proposed combination “would yield the predictable result of reducing ‘cold starts’ and thus improving fuel economy.” *Id.* at 66 (citing Ex. 1008 ¶¶ 585–594).

Patent Owner does not directly address Petitioner’s specific contentions for claim 54. PO Resp. 56. Patent Owner argues “Grounds 4–9 all rely on Grounds 1–3 to address claims that depend from claim 33. Thus, Grounds 4–9 are flawed for at least the reasons set forth with respect to Grounds 1–3.” *Id.* Because we determine that claim 33 is unpatentable over Seveinsky and Nii, Patent Owner’s contentions for claim 54 are unavailing.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 54 is unpatentable over Severinsky, Nii, and Yamaguchi.

We do not reach Petitioner’s alternate contentions that this claim is also unpatentable over Severinsky, Quigley, and Yamaguchi and over Severinsky, Graf, and Yamaguchi.

L. Ground 10: Claim 105 – Alleged Obviousness over Severinsky, Frank, and Ma

Claim 105 depends from claim 80, which similar to claim 49 further recites “wherein the hybrid vehicle further comprises a turbocharger controllably coupled to the engine, wherein the method further comprises: operating the turbocharger to increase the MTO of the engine when desired.” Ex. 1001, 67:63–67. The Board previously determined that claim 80 was unpatentable over Severinsky and Frank. Ex. 1059, 19–22. Petitioner relies on the same disclosure from Ma as for claim 49. Pet. 66–67. Patent Owner relies on the same contentions as for claim 49. PO Resp. 56–70.

For the reasons discussed above in connection with Ground 7, we determine Petitioner establishes by a preponderance of the evidence that claim 105 is unpatentable over Severinsky, Frank, and Ma.

M. Ground 11: Claims 188, 189, 199–203, 205, 206, 208, 211, and 213 – Alleged Obviousness over Severinsky and Ma

Independent claim 188 similar to claim 49, recites “operating a turbocharger controllably coupled to the engine to increase the MTO of the engine when desired.” Ex. 1001, 77:1–2. For limitations 188a to 188d, Petitioner relies on its contentions for claim 33. Pet. 67. For limitation 188e, Petitioner relies on the same disclosure from Ma as for claim 49. *Id.* Patent Owner relies on the same contentions as for claim 49. PO Resp. 56–70.

For the reasons discussed above in connection with Ground 7, we determine Petitioner establishes by a preponderance of the evidence that claim 188 is unpatentable over Severinsky, Frank, and Ma.

Claims 189, 199–203, 205, 206, 208, 211, and 213 depend from claim 188. Ex. 1001, 77:3–7; 77:62–78:26; 78:31–48, 78:52–56, 78:62–64, 79:1–4. Petitioner relies on its contentions for claims 68, 34, 35, 36, 37, 38, 42, 43, 50, 52, and 55 respectively for these claims. Pet. 67–69.

Patent Owner does not directly address Petitioner’s specific contentions for the claims challenged in this ground other than claim 188. PO Resp. 56–70.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claims 188, 189, 199–203, 205, 206, 208, 211, and 213 are unpatentable over Severinsky and Ma.

N. Ground 12: Claim 204 – Alleged Obviousness over Severinsky, Ma, and Lateur

Claim 204 depends from claim 188. Ex. 1001, 78:27–33. For this ground, Petitioner relies on its contentions for claims 33, 41, and 49. Pet. 69. Patent Owner does not provide separate contentions for the patentability of claim 204, but contends this ground is “flawed for at least the reasons set forth with respect to Ground 11.” PO Resp. 71.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 204 is unpatentable over Severinsky, Ma, and Lateur.

O. Ground 13: Claim 212 – Alleged Obviousness over Severinsky, Ma, and Yamaguchi

Claim 212, which depends from claim 188, recites “further comprising: rotating the engine before starting the engine such that its cylinders are heated by compression of air therein.” Ex. 1001, 78:65–67. For this ground, Petitioner relies on its contentions for claims 33, 49, and 54. Pet. 70. Patent Owner does not provide separate contentions for the patentability of claim 212, but contends this ground is “flawed for at least the reasons set forth with respect to Ground 11. PO Resp. 71.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 212 is unpatentable over Severinsky, Ma, and Yamaguchi.

P. Claim 214 – Alleged Obviousness over Severinsky, Ma, and Suga

Claim 214 depends from claim 188. Ex. 1001, 79:5–9. Petitioner contends claim 214 “includes additional limitations—related to the motor being powerful enough to provide sufficient acceleration on its own to conform to the Federal Urban Cycle Driving Fuel Mileage Test—previously

found by the Board to have been disclosed by the obvious combination of Severinsky and Suga.” Pet. 70.

Petitioner details its contentions for claim 214 with a chart listing the disclosure in Severinsky and Suga with supporting testimony from Dr. Davis alleged to correspond to the limitations in claim 214. Pet. 71. Petitioner also provides reasons for combining the teachings of Severinsky and Suga which Petitioner contends are “[i]n accordance with the Board’s previous findings (*e.g.*, [Ex.] 1066).” *Id.* at 71–74.

a. Overview of Suga – Exhibit 1071

Suga is a United States Patent directed “to an apparatus for testing electric motor performance and more particularly to an apparatus for testing the power performance of an electric motor for an electric vehicle.”

Ex. 1071, 1:6–9.

b. Analysis

Petitioner contends the ’634 patent “describes the ‘Federal urban cycle driving fuel mileage test’ using the acronym ‘FUDS,’ which a [skilled artisan] would have understood to be referencing the Federal Urban Driving Schedule, also referred to as the ‘LA4 cycle.’” Pet. 71 (citing Ex. 1001, 49:56–60). Petitioner further contends FUDS is “designed to evaluate the exhaust gas emissions during city driving by simulating a vehicle as though it were being driven along a specified route through downtown Los Angeles.” *Id.* (citing Ex. 1008 ¶¶ 631–638). Petitioner further contends “Suga discloses a test apparatus and procedure for testing an electric motor for an electric vehicle according to a predetermined test pattern, *e.g.*, the LA4 drive cycle (*i.e.*, FUDS).” *Id.* (citing Ex. 1008 ¶¶ 639–640; Ex. 1071, 4:6–17, Figs. 1, 3).

Petitioner next contends “it would have been obvious to a [skilled artisan] to test Severinsky’s electric motor using the test apparatus described in Suga, to determine if the electric motor alone meets the FUDS/LA4 acceleration requirements.” Pet. 72 (citing Ex. 1008 ¶¶ 644–652).

Petitioner further contends a skilled artisan “would have understood that Suga improved prior art test procedures of electric motors by providing . . . ‘a two-dimensional map showing the relationship between the output torque of the electric motor and the motor efficiency based on the detected values.’” *Id.* at 73 (citing Ex. 1071, Abstract, 2:42–48). According to Petitioner, Suga’s improved test procedures would have motivated a skilled artisan “to use the teachings of Suga to select an electric motor that could efficiently provide the power requirements necessary to provide the vehicle drive torque during Severinsky’s low speed mode.” *Id.* at 74 (citing Ex. 1008 ¶¶ 651–652).

Patent Owner does not provide separate contentions for the patentability of claim 214, but contends this ground is “flawed for at least the reasons set forth with respect to Ground 11.” PO Resp. 71.

Based on our review of the evidence cited by Petitioner, we determine Petitioner establishes by a preponderance of the evidence that claim 214 is unpatentable over Severinsky, Ma, and Lateur.

III. PETITIONER’S MOTION TO EXCLUDE

Petitioner filed a Motion to Exclude Evidence (“Mot.”) (Paper 31), Patent Owner filed an Opposition (“Opp.”) (Paper 32), and Petitioner filed a Reply (“Excl. Reply”) (Paper 33). Petitioner moves to exclude Dr. Shahbakhti’s Declaration, Exhibit 2016, as inadmissible under Federal Rules of Evidence 402 and 702. Mot. 1. Petitioner also moves to exclude Exhibits

2018, 2020, 2022–2024, 2028 and 2033 that are relied on by Dr. Shahbakhti under Rule 402 because the exhibits “post-date[] the ’634 Patent’s alleged priority date by several years, some by decades.” *Id.*

a. Dr. Shahbakhti’s Declaration – Ex. 2016

Petitioner contends that Dr. Shahbakhti “is not qualified, and has not otherwise become qualified, to testify regarding issues viewed from the perspective of a [skilled artisan] prior to the September 14, 1998 critical date.” Mot. 2. Petitioner further contends “Dr. Shahbakhti has no perspective of a skilled artisan as of 1998 and should therefore be prohibited from ‘testify[ing] as an expert on obviousness.’” *Id.* at 6 (citing *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F. 3d 1356, 1363–1364 (Fed. Cir. 2008)).

Patent Owner counters that Dr. Shahbakhti qualifies as an expert because, *inter alia*, he earned a Bachelor’s Degree in Mechanical Engineering in 2000, a Master’s Degree in 2003, and a Doctorate Degree in Mechanical Engineering in 2009. Opp. 4 (citing Ex. 2016 ¶ 8). Patent Owner further contends that “Dr. Shahbakhti has well over a decade of experience ‘work[ing] as a researcher in the automotive industry’ where he was ‘involved in research and development work on power train management systems for gasoline and natural gas vehicles.’” *Id.* at 5–6 (citing Ex. 2016 ¶¶ 9–11). Patent Owner also directs us to Dr. Shahbakhti’s experience teaching graduate level courses in internal combustion engines and hybrid electric vehicles and various publications he has authored. *Id.* at 6–7. Patent Owner next contends that “both the Federal Circuit and the PTAB have recognized ‘a person may not need to be a person of ordinary skill in the art in order to testify as an expert under Rule 702, but rather must

be ‘qualified in the pertinent art.’” *Id.* at 8 (citing Consol. TPG, 3 (2018); *Mytec Prods., Inc. v. Harris Research, Inc.*, 439 Fed. App’x, 882, 886–87 (Fed. Cir. 2011)).

i. Analysis

Our Consolidated Trial Practice Guide provides that “[a]n expert witness must be qualified as an expert by knowledge, skill, experience, training, or education to testify in the form of an opinion.” Consol. TPG, 34 (citing Fed. R. Evid. 702). Further, the Trial Practice Guide also provides that “[a] person may not need to be a person of ordinary skill in the art in order to testify as an expert under Rule 702, but rather must be ‘qualified in the pertinent art.’” *Id.* (citing *Sundance*, 550 F.3d at 1363–64).

In this case, Dr. Shahbakhti is qualified in the pertinent art. He earned a Ph.D in Mechanical Engineering and engaged in “research activities in the past 20 years . . . centered on design, modeling and control of automotive propulsion systems, including conventional, hybrid electric, and electric vehicles.” Ex. 2016 ¶ 8. He also “spent two years as a post-doctoral scholar at the Mechanical Engineering Department at the University of California, Berkeley.” *Id.* ¶ 7. He is currently “an Associate Professor of Mechanical Engineering at the University of Alberta and an Adjunct Professor of Mechanical Engineering at Michigan Technological University.” *Id.* ¶ 6. Dr. Shahbakhti also engaged extensively in various relevant research and development activities including building “a hybrid electric powertrain test platform including a 100-kW AC electric motor and a 201-kW GM Ecotec engine . . . for testing various aspects of powertrain performance including real-time torque control during transient and steady state operations.” *Id.* ¶ 10.

Petitioner doesn't specifically quarrel with Dr. Shahbakhti's qualifications in the pertinent art *per se* but rather focuses on whether he is sufficiently versed in the pertinent art as of September 1998 to offer testimony from the perspective of one of ordinary skill in the art. *See* Mot. 2. Whether or not Dr. Shahbakhti was a skilled artisan in September 1998 is irrelevant because an expert does not have to be one of ordinary skill in the art during the relevant time frame to be qualified as an expert. *T. Rowe Price Inv. Servs., Inc. v. Secure Access, LLC*, CBM2015-00027, Paper 31, 22 (PTAB June 13, 2016) (“[T]he Federal Circuit has not placed temporal restrictions, such as requiring an expert be qualified in the pertinent art at the time of the invention.”).

Petitioner next points to several exhibits relied on by Dr. Shahbakhti that are dated after September 1999 (Mot. 7) but does not point to any specific portions of Dr. Shahbakhti's testimony to support its contention that Dr. Shahbakhti's testimony is either unreliable or inadmissible because of these documents. *See* Mot 7. Finally, Petitioner's reliance on the Federal Circuit decision in *Sundance* is unavailing. In *Sundance*, a patent attorney who was not qualified as an expert in the relevant art testified on “invalidity, including the factual predicates underlying obviousness as well as his conclusion that claim 1 . . . would have been obvious.” 550 F. 3d at 1361. The Federal Circuit held that the district court abused its discretion by denying a motion in limine to exclude the testimony because the witness in that case, unlike Dr. Shahbakhti, was “not qualified in the pertinent art to testify as an expert on obviousness.” *Id.* at 1364. In this case, we find that Dr. Shahbakhti is qualified to testify as an expert.

For all the foregoing reasons, we deny Petitioner's motion to exclude Dr. Shahbakhti's testimony.

b. Exhibits 2018, 2020, 2022–2024, 2028 and 2033

We do not rely on any of these exhibits in our resolution of Petitioner's challenges. This portion of the Motion is, thus, dismissed as moot. Consol. Trial Practice Guide at 79–80.

IV. Conclusion

Based on the record before us, we determine the following:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
33	103(a)	Severinsky, Nii	33	
33	103(a)	Severinsky, ²⁶ Quigley		
33	103(a)	Severinsky, Graf		
34–38, 42–44, 46, 50, 52, 55, 68	103(a)	Severinsky, Nii	34–38, 42–44, 46, 50, 52, 55, 68	
39, 40	103(a)	Severinsky, Nii, Frank	39–40	
41	103(a)	Severinsky, Nii, Lateur	41	
49	103(a)	Severinsky, Nii, Ma	49	
53	103(a)	Severinsky, Nii, Vittone	53	
54	103(a)	Severinsky, Nii, Yamaguchi	54	
105	103(a)	Severinsky, Frank, Ma	105	
188, 189, 199–203, 205, 206, 211, 213	103(a)	Severinsky, Ma	188, 189, 199–203, 205, 206, 211, 213	
204	103(a)	Severinsky, Ma, Lateur	204	
212	103(a)	Severinsky, Ma, Yamaguchi	212	
214	103(a)	Severinsky, Ma, Suga	212	
Overall Outcome			33–44, 46, 49, 50, 52–55, 68, 105, 188, 189,	

			199–206, 208, 211–214	
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V. ORDER²⁷

In consideration of the foregoing, it is hereby:

ORDERED that, based on a preponderance of the evidence that claims 33–44, 46, 49, 50, 52–55, 68, 105, 188, 189, 199–206, 208, and 211–214 of the ’634 patent are unpatentable; and

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.

²⁶ Because we determine that Petitioner’s challenges involving Nii are sufficient to show unpatentability, we do not reach Petitioner’s alternate challenges involving Quigley or Graf in place of Nii in Grounds 2, 3, 4, 5, 6, 7, 8, and 9. *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).

²⁷ 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 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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