

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLIED MATERIALS, INC.,
Petitioner,

v.

OCEAN SEMICONDUCTOR LLC,
Patent Owner.

IPR2021-01340
Patent 6,725,402 B1

Before MIRIAM L. QUINN, JOHN D. HAMANN, and
DAVID COTTA, *Administrative Patent Judges*.

COTTA, Administrative Patent Judge.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Dismissing-in-Part, Granting-in-Part, and Denying-in-Part
Petitioner's Motion to Strike
Dismissing Petitioner's Motion to Exclude
35 U.S.C. § 318(a). 37 C.F.R. §§ 42.20, 42.23(b), 42.64(c)

I. INTRODUCTION

Applied Materials, Inc. (“Petitioner”)¹ filed a Petition to institute *inter partes* review of claims 1–17 of U.S. Patent No. 6,725,402 B1 (Ex. 1001, “the ’402 patent”). Paper 1 (“Pet.” or “Petition”). We instituted trial on February 9, 2022. Paper 14 (“Inst. Dec.”). During trial, Ocean Semiconductor LLC (“Patent Owner”)² filed a Patent Owner Response. Paper 18 (“PO Resp.”). Later filings include Petitioner’s Reply (Paper 26 (“Pet. Reply”))³ and Patent Owner’s Sur-reply (Paper 36 (“Sur-reply”)). We also authorized Petitioner to file a Motion to Strike (Paper 38 (“Mot.”)) to which Patent Owner filed an Opposition (Paper 41 (“Mot. Opp.”)) and Petitioner filed a Reply (Paper 44 (“Mot. Reply”)). In addition, Petitioner filed a Motion to Exclude (Paper 42 (“Mot. Excl.”)) to which Patent Owner filed an Opposition (Paper 43 (“Mot. Excl. Opp.”)) and Petitioner filed a Reply (Paper 44 (“Mot. Excl. Reply”). An oral hearing was held on October 26, 2022, and a transcript is entered in the record. Paper 51 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6(b). After considering the

¹ Petitioner identifies itself, Applied Materials, Inc., as the real party-in-interest. Petitioner also identifies PDF Solutions, Inc. as a “potential real party-in-interest” with whom Petitioner “discussed this Petition and the Ground presented.” Pet. 1. Petitioner further lists a number of other “potential real parties-in-interest, none of whom had any access to this Petition.” *Id.* at 1–2.

² Patent Owner identifies itself, Ocean Semiconductor LLC, as the real party-in-interest. Paper 5, 2.

³ Paper 26 is an “amended” version of a Reply filed earlier the same day. Petitioner filed an amended version of its Reply to correct what we deemed to be a harmless error in its original filing. Ex. 3001.

parties' arguments and evidence, we determine that Petitioner has proved by a preponderance of the evidence that the challenged claims are unpatentable. *See* 35 U.S.C. § 316(e). We dismiss-in-part as moot, grant-in-part, and deny-in-part, Petitioner's Motion to Strike. We dismiss Petitioner's Motion to Exclude as moot. Our reasoning is explained below, and we issue this Final Written Decision under 35 U.S.C. § 318(a).

A. Related Proceedings

According to the parties, Patent Owner has asserted the '402 patent against defendants including: Analog Devices, Inc.; Infineon Tech. AG; Huawei Device USA, Inc.; MediaTek Inc.; NVIDIA Corp.; NXP USA, Inc.; Renesas Elec. Corp.; Silicon Labs. Inc.; STMicroelectronics Inc.; and Western Digital Tech., Inc. in lawsuits in district courts in the District of Massachusetts, the Eastern District of Texas, and the Western District of Texas. Pet. 2; Paper 5, 2. Petitioner indicates that it is not a party to any pending litigations involving the '402 patent. Pet. 7.

B. Asserted Ground of Unpatentability

Petitioner asserts one ground of unpatentability in this Petition (Pet. 14–15), which is provided in the table below:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–17	103(a) ⁴	Coronel ⁵ , Fox ⁶

Petitioner relies on the declaration of Dr. Miltiadis Hatalis, among other evidence. Ex. 1002. Patent Owner relies on the declaration of Kurt D. Humphrey, among other evidence. Ex. 2040.

C. Technology Overview & the '402 Patent

The '402 patent relates to “fault detection and control of a processing tool using an Advanced Process Control (APC) framework” in the field of semiconductor fabrication. Ex. 1001, 1:9–12. By way of background, the '402 patent explains that “[a]lthough there has been an improvement in detecting faults associated with semiconductor manufacturing processes, one problem currently encountered . . . is the delay in reporting these faults such that corrective measures can be implemented in a more expedient manner.” *Id.* at 1:29–34. The '402 patent seeks to address this problem, which can result in a number of faulty devices being produced. *Id.* at 1:34–39.

⁴ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103. Based on the filing date of the '402 patent, we apply the pre-AIA version of § 103.

⁵ Coronel et al., EP 0 932 194 A1, published July 28, 1999 (Ex. 1006, “Coronel”).

⁶ Fox et al., US 5,479,340, issued Dec. 26, 1995 (Ex. 1005, “Fox”).

Figure 1 of the '402 patent (reproduced below) shows a system for determining fault detection based on process tool operational state data in a semiconductor fabrication process. *Id.* at 2:41–45.

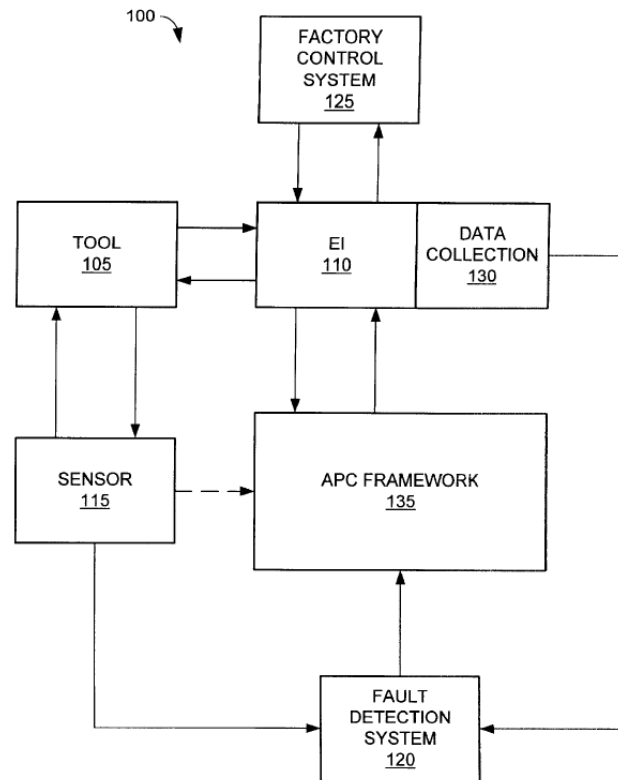


Figure 1

As shown above, the system in Figure 1 includes processing tool 105, which “is in the form of semiconductor fabrication equipment used to produce a processing piece, such as a silicon wafer.” *Id.* at 2:45–48. Equipment interface 110 retrieves tool state data from tool 105, such as temperature, pressure, and gas flow, and “communicates this data to a fault detection system 120 via the data collection unit 130 to determine whether the tool 105 is experiencing a faulty operation.” *Id.* at 2:58–65. More specifically,

the tool state data received by equipment interface 110 is collected by data collection unit 130, converted into a tool data file, and forwarded to fault detection system 120 for near real-time analysis. *Id.* at 3:28–34. Fault detection system 120 “sends the results of potential faults and/or proper operation of the tool 105 in the form of tool ‘health’ data to the Advanced Process Control (APC) framework 135.” *Id.* at 4:19–24. APC 135 “may send control signals to the equipment interface 110 to control the processing tool 105 based upon the tool health data results forwarded from the fault detection system 120.” *Id.* at 4:24–28.

D. Challenged Claims

The ’402 patent includes seventeen claims, each of which is challenged here. Pet. 14–15. Claims 1, 8, and 15 are independent. Claim 1 is illustrative of the challenged claims and reads as follows:

1. A method comprising:

receiving at a first interface operational state data of a processing tool related to the manufacture of a processing piece;

sending the state data from the first interface to a fault detection unit, wherein the act of sending comprises:

sending the state data from the first interface to a data collection unit;

accumulating the state data at the data collection unit;

translating the state data from a first communications protocol to a second communications protocol compatible with the fault detection unit; and

sending the translated state data from the data collection unit to the fault detection unit;

determining if a fault condition exists with the processing tool based upon the state data received by the fault detection unit;

performing a predetermined action on the processing tool in response to the presence of a fault condition; and

sending an alarm signal indicative of the fault condition to an advanced process control framework from the fault detection unit providing that a fault condition of the processing tool was determined by the fault detection unit,

wherein performing a predetermined action further comprises sending a signal by the framework to the first interface reflective of the predetermined action.

Ex. 1001, 7:10–38.

II. ANALYSIS

A. Principles of Law

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which that 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 ordinary skill in the art; and (4) secondary considerations of nonobviousness when presented. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Person of Ordinary Skill in the Art (“POSA”)

In determining the level of skill in the art, we consider the problems encountered in the art, the art’s solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986).

Petitioner contends:

A POSA would have at least a B.S. in mechanical engineering, electrical engineering, materials science engineering, or a related field, and four years of experience working with semiconductor fabrication processes and measurement techniques.

Pet. 18 (citing Ex. 1002 ¶ 29). Patent Owner does not dispute Petitioner’s proposed level of skill in the art, proposing only to add that “additional education can compensate for less work experience and vice versa.” PO Resp. 6.

Petitioner’s proposal appears to be generally consistent with the level of skill reflected in the specification and in the cited prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158,

163 (Fed. Cir. 1985)). And we agree with Patent Owner that “additional education can compensate for less work experience and vice versa.” Accordingly, we adopt Petitioner’s proposed definition of the POSA level with the additional clarification proposed by Patent Owner.

C. Claim Construction

We interpret a claim “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b) (2020). Under this standard, we construe the claim “in accordance with 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 does not identify any claim terms that require construction. Pet. 15. Patent Owner does not dispute Petitioner’s assertion that no claim terms require construction. PO Resp. 6.

We do not find it necessary to provide an express construction for any claim terms. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))); *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (“[C]laim terms need only be construed ‘to the extent necessary to resolve the controversy’”).

D. Overview of the Asserted Prior Art

1. Coronel (Exhibit 1006)

Coronel relates to a “[m]ethod and system for real-time in-situ interactive supervision of a step performed in a tool during [a] semiconductor wafer fabrication process.” Ex. 1006, code (57). In particular, Coronel describes monitoring process parameters in an end-point controller and comparing them with data in a database to identify process deviations. *Id.* 1:5–19. “If a process deviation is detected, an alert code is flagged to signal an alarm and the adequate action is immediately taken.” *Id.* at 1:22–24.

Figure 7 of Coronel (reproduced below) is a schematic showing an improved system for processing semiconductor wafers. *Id.* at 12:53–56.

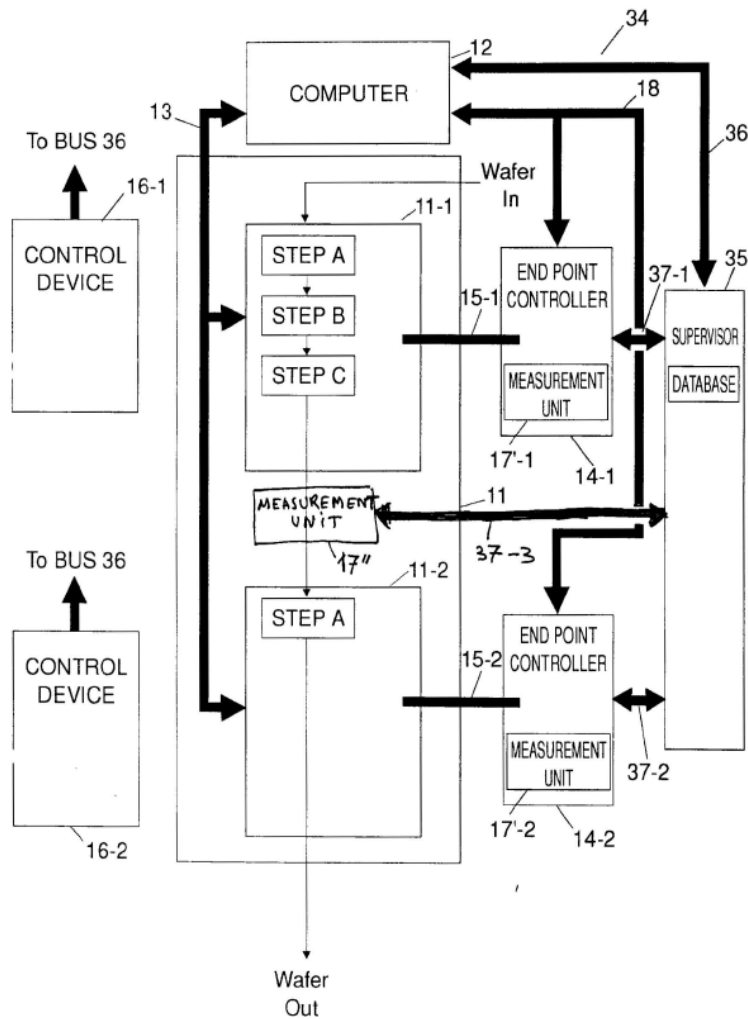


FIG.7

Figure 7 depicts a system with a measurement unit “internally mounted in an EPD [end-point detection] controller and/or in tool 11.” *Id.* at 13:3–6. In one alternative, measurement unit 17’ “performs an indirect measurement (e.g. an etch rate) through the tool view-port.” *Id.* at 13:6–9. In another alternative, measurement unit 17’ “performs direct measurement (e.g. a thickness) on the wafer before it enters in any of the chambers composing the multi-chamber tool 11.” *Id.* at 13:9–13. “Measurement results are transmitted in real-time to supervisor 35,” which has “both computing and

data storage capabilities.” *Id.* at 13:15–16, 40–41. Supervisor 35 is connected to computer 12, where computer 12 “has the role of controlling the physical process parameters of tool 11 during the wafer processing while supervisor 35 is mainly interested by what happens to the wafer itself.” *Id.* at 13:41–45.

Figure 15 of Coronel (reproduced below) is a process flow for a wafer fabrication process. *Id.* at 18:1–2.

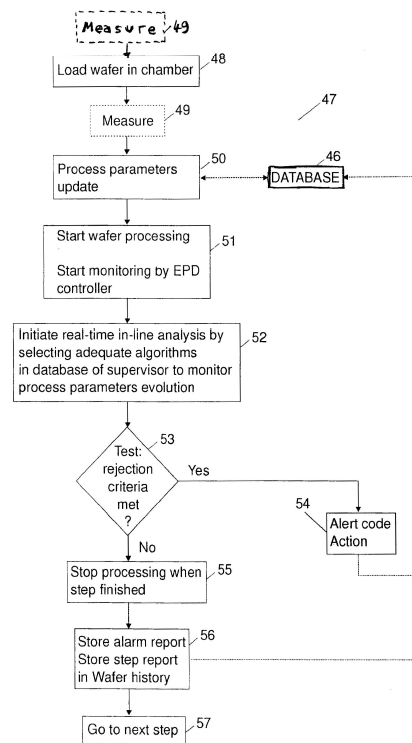


FIG. 15

The process flow in Figure 15 begins at step 48 with loading a wafer into a tool chamber. *Id.* at 18:6–8. Computer 12 downloads batch and process names, and, upon each wafer change, a wafer ID. *Id.* at 18:8–13. A measurement is performed by measurement unit 17’ or 17” at step 49, although this measurement could also be performed prior to loading the wafer. *Id.* at 18:13–22. At step 50, supervisor 35 stores the measurement in

database 46 for immediate or subsequent use. *Id.* at 18:22–33. “Supervisor 35 may either use the measurement result or instead retrieve corresponding measurement data that were previously stored in database 46 to up-date (i.e. to change one or several process parameters for the said processing step (box 50).” *Id.* at 18:25–29. Wafer processing is initiated and the EPD controller is activated at step 51, and at step 52, “supervisor 35 starts the analysis of the selected process parameters by applying the adequate algorithms stored in the database to analyze the corresponding signals generated by the EPD controller according to the analysis rules stored in the database.” *Id.* at 18:37–42. At step 53, supervisor 35 tests whether any rejection criteria is met, and “[i]f an anomaly (i.e. a deviation) is detected, supervisor 35 provides an alert code to the computer 12, so that the adequate action can be immediately taken (step 54).” *Id.* at 18:44–53. Otherwise, “the step in consideration is continued until the end (step 55).” *Id.* at 18:53–55. “The alert code and the action to be taken constitute the so-called ‘alarm report’ (step 56).” *Id.* at 19:2–4.

2. Fox (Exhibit 1005)

Fox relates “to a technique of utilizing multivariate analysis for monitoring and controlling a plasma process” in semiconductor processing equipment. Ex. 1005, 1:9–12. In particular, Fox uses a “Hotelling’s T^2 multivariate analysis” (“a statistical method well known in the prior art” (*id.* at 4:7–9)) in which “[e]leven components of the RF spectra are measured and converted as input variables to the T^2 calculation” and “[a] software routine provides the necessary calculations to solve for Hotelling’s T^2

value.” *Id.* at 1:46–51. Fox then uses the T^2 output “to determine if the plasma process is within an acceptable tolerance.” *Id.* at 1:52–53.

Figure 1 of Fox (reproduced below) is a block diagram showing equipment that can provide a multivariate analysis based on Hotelling’s T^2 analysis to control a plasma process. *Id.* at 2:12–15.

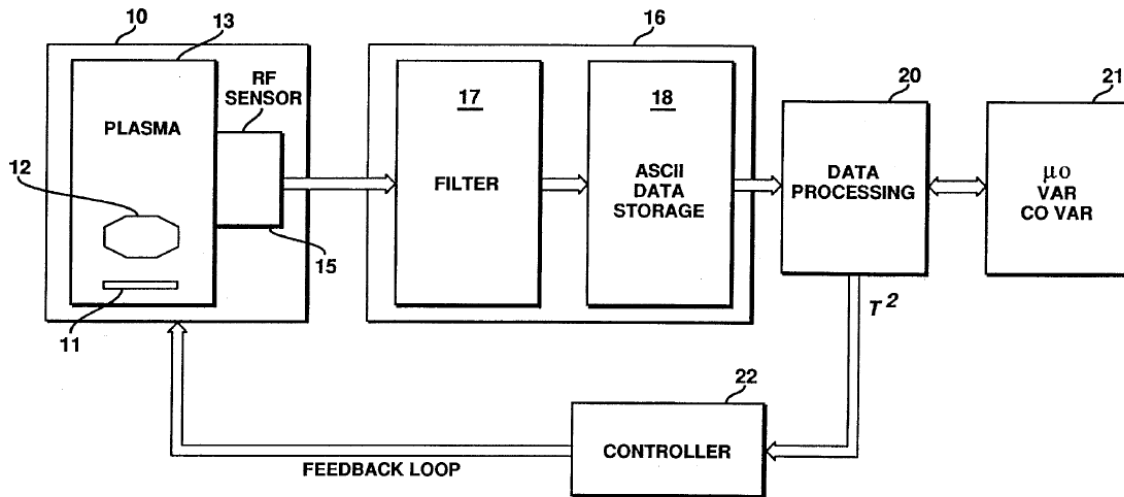


FIGURE 1

Figure 1 depicts plasma processing equipment, or tool, 10 in which wafer 11 is processed in reaction chamber 13. *Id.* at 2:35–37. In an embodiment, “tool 10 is a plasma etcher in which the plasma 12 in chamber 13 is utilized to etch one or more layers of wafer 11.” *Id.* at 2:39–41. A radio frequency (RF) sensor 15 measures RF properties in chamber 13. *Id.* at 2:50–52. Filter 17 separates raw data from sensor 15 into eleven components, which are stored in data storage memory 18. *Id.* at 2:67–3:, 3:26–28. Block 20 in Figure 1 includes a software program with an algorithm for calculating T^2 , and memory 21 stores certain values needed for the T^2 calculation. *Id.* at 5:52–57. After calculating T^2 based on the input values from memory 18,

block 20 outputs this value to controller block 22, which “in essence, determines the value of the T^2 which is acceptable for a given process being run in tool 10.” *Id.* at 5:57–63. In particular, Fox describes that an acceptable range of values are determined by an upper control limit (UCL) and a lower control limit (LCL), where “[t]he ideal Hotelling’s T^2 values for a process are determined by running a number of samples and developing a baseline for that particular process.” *Id.* at 5:65–6:11. “The parameter(s) which are used to measure the test wafers to develop the T^2 values [are] a design choice,” and can include, for example, the “film thickness of the semiconductor layer being etched.” *Id.* at 6:29–33. “Once the baseline numbers have been stored in memory 18, the system is set up to control the ongoing process of a production wafer.” *Id.* at 7:5–7. During wafer processing, “[i]f the T^2 value is within the acceptable UCL/LCL range for the given ongoing process, the controller 22 allows the process to continue”; otherwise, “an out of tolerance signal is generated.” *Id.* at 7:13–17.

E. Obviousness over Coronel and Fox

Petitioner asserts that claims 1–17 are unpatentable as obvious over Coronel and Fox. Pet. 31–63. We provided an overview of the prior art above. For the reasons discussed below, we find that Petitioner has established, by a preponderance of the evidence, that the cited art teaches or suggests all of the elements of the challenged claims.

1. Motivation to combine Coronel and Fox

Petitioner contends that it would have been obvious to combine Coronel and Fox with a reasonable expectation of success. Pet. 32–42. We agree.

Coronel discloses a system for fabricating semiconductor wafers that analyzes tool state data during wafer fabrication using a computer linked to a processing tool for real-time in-situ fault detection. Ex. 1006, code (57); Ex. 1002 ¶ 68. Coronel’s system stores “identified deviations . . . based on all the possible causes of wafer rejection based on experimental or empirical or other information known to the process engineers so far.” Ex. 1006, 10:5–7. During fault detection this stored data is compared to real-time in-situ data. *Id.* at 10:25–39. “If a deviation is detected, the supervisor emits the alert code to the computer controlling the process tool to flag an alarm and it takes an immediate and appropriate action.” *Id.* As background, Coronel teaches, that in-situ monitoring of semiconductor manufacturing, including of data relating to physical process parameters, involves a “huge quantity of data of various types.” *Id.* at 1:56–2:11.

Fox discloses an embodiment in which a plasma etching tool is monitored in real time, providing data that is separated into eleven components and stored as digital data in a data storage memory. Ex. 1005, 2:35–46, 2:61–3:14, 3:26–32. The eleven components are then used to calculate a T^2 value. *Id.* at 4:51–57 (“[T]he present invention generates a control signal based on the multivariate analysis of the eleven components of the RF spectra. In the preferred embodiment, this is achieved in software by

generating an algorithm for calculating Hotelling's T^2 multivariate control equations.”). Fox then sends the T^2 value to a controller for comparison to a known range of values stored in memory to determine if a deviation occurred. *Id.* at 5:46–6:11, 7:7–8:10; *see also* Ex. 1002 ¶ 76.

Fox discloses that applying multivariate analysis to fault detection is advantageous. Ex. 1005, 3:49–51, 3:63–67, 4:25–40; *see also* Ex. 1002 ¶ 73 (Dr. Hatalis’s testimony discussing benefits of multivariate analysis taught in Fox). More specifically, Fox discloses that “analyzing all of the eleven component values [of an RF sensor monitoring plasma processing tool] independently” can be a “problem” because the “values are not truly independent in their relationship to each other” and that “a multivariate approach to analyzing the eleven components . . . is superior in determining the acceptable limits of the plasma process than looking at any one component . . . or alternatively, all eleven components independently of one another.” Ex. 1005, 3:49–51, 3:63–67, 4:25–40.

In view of these teachings, we agree with Petitioner and Dr. Hatalis that “[a] POSA would have recognized that applying the teachings of Fox to the system of Coronel, . . . would have promoted the desired objective of increasing process yields by combining fault detection based on multivariate analysis of tool state data with fault detection based on data received from the monitoring equipment of Coronel.” Ex. 1002 ¶ 74; Pet. 35–36.

The record supports Dr. Hatalis’s testimony that “applying the methods disclosed in Fox to the system of Coronel would have been straightforward and an application of known techniques to improve a comparable system in the same way.” Ex. 1002 ¶ 75. In this regard, the

record supports that multivariate analysis was known and used in the art. *Id.* ¶ 71 (Dr. Hatalis’s testimony, citing Ex. 1013, 56–57 (article entitled “Practical issues in the deployment of a run-to-run control system in a semiconductor manufacturing facility,” (*id.* at 52) teaching that “FDC [fault detection and classification] can take many forms in ProcessWORKS, from traditional process monitoring techniques such as statistical process control (SPC) to advanced multivariate analysis based on trace data”)); *see also* Ex. 1005, 4:7–9 (“The use of the Hotelling’s T^2 multivariate analysis is a statistical method well known in the prior art.”). In addition, as Dr. Hatalis explains, “because the methods described in Fox are executed using a computer, they would have been readily applied to the computer, database, and supervisor of Coronel.” Ex. 1002 ¶ 76. Further, “performing fault detection by using T^2 values . . . had been previously implemented on an AME 5000 system, which is the same system referenced in Coronel,” and “Fox implements the T^2 analysis with the same kind of tool used in Coronel, a plasma etcher.” *Id.* ¶ 78 (Dr. Hatalis’s testimony).

In view of the evidence that multivariate analysis was well-known and in view of the similarities between Coronel and Fox, we agree with Petitioner that a POSA would reasonably have expected success in combining Coronel and Fox. As Dr. Hatalis explains, modifying Coronel’s method to include Fox’s multivariate analysis would have “simply involved adapting the software in the supervisor of Coronel, which already has computing capabilities and storing in its database the T^2 values and UCL and LCL boundary values as taught by Fox.” *Id.* ¶ 83. And we find no evidence that applying Fox’s algorithms or methods to Coronel’s computer would

have been uniquely challenging or difficult for one of ordinary skill in the art. *KSR* 550 U.S. at 417 (“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 application is beyond his or her skill”).

Patent Owner argues that Petitioner’s motivation to combine Coronel and Fox is contrary to the teachings of Coronel of structures “without defect” and its disclosure of “an etch process perfectly conducted.” PO Resp. 24 (citing Ex. 1006, 5:45–47, 11:35–45). This argument is not persuasive. The language quoted by Patent Owner is used by Coronel to describe Figure 4. Figure 4 is a “plot of signals displayed by an EPD controller monitoring step A of the ‘AB ETCH’ process . . . when the structure is without defect and when the etch process of step A is performed correctly.” Ex. 1006, 11:35–39. Coronel uses Figure 4 to provide a comparison to Figure 8, which provides a “plot of signals displayed by an EPD controller” for a wafer that was not etched properly, as a way to illustrate how process engineers identify faults. *Id.* at 11:55–58, 14:44–15:11. Coronel does not use Figure 4 to illustrate, as Patent Owner seems to suggest, that wafer processing can be conducted perfectly, obviating the need for improved fault detection. Accordingly, we disagree with Patent Owner that Petitioner’s asserted motivation to combine Coronel and Fox is contrary to the teachings of Coronel.

Patent Owner argues that Petitioner’s asserted “motivation is generic and could apply to almost any manufacturing process, making it insufficiently related to specific problems in the art. *Id.* We disagree.

Petitioner provides specific reasons why the POSA would have combined Coronel and Fox. These reasons are grounded in the asserted art, as well as the knowledge of the POSA, and supported by testimonial and documentary evidence that remains un rebutted. *See* Pet. 32–42 (citing evidence); Ex. 1002 ¶¶ 67–85; PO Resp. 24 (addressing motivation to combine Coronel and Fox without specifically challenging reasons proffered by Petitioner).

For example, Petitioner and Dr. Hatalis point out that fault detection using T^2 values had previously been carried out using the same type of system as in Coronel, and that Fox implements a T^2 analysis with the same kind of tool used in Coronel, a plasma etcher. Pet 37–38 (citing Ex. 1020, 308, 316; Ex. 1021, 384–385, 387; Ex. 1006, 2:21–28, 5:25–27, 6:29–31; Ex. 1005, 2:35–45); Ex. 1002 ¶ 78 (citing same evidence). Petitioner also directs us to Fox’s teaching that “analyzing all of the eleven component values [of an RF sensor monitoring plasma processing tool] independently” can be a “problem” because the “values are not truly independent in their relationship to each other.” Ex. 1005, 3:49–51 (cited at Pet. 35–36); *see also* Ex. 1002 ¶ 73 (Dr. Hatalis’s testimony discussing this teaching). And Petitioner also directs us to Fox’s teaching that “a multivariate approach to analyzing the eleven components . . . is superior in determining the acceptable limits of the plasma process than looking at any one component . . . or alternatively, all eleven components independently of one another.” Ex. 1005, 4:45–40 (cited at Pet. 36); *see also* Ex. 1002 ¶ 74 (Dr. Hatalis’s testimony discussing this teaching). In view of these teachings, we agree with Dr. Hatalis that “[a] POSA would have recognized that applying the teaching of Fox to the system of Coronel, . . . would have promoted the

desired objective of increasing process yields by combining fault detection based on multivariate analysis of tool state data with fault detection based on data received from the monitoring equipment of Coronel.” Ex. 1002 ¶ 74.

Accordingly, we find that Petitioner has established by a preponderance of the evidence that the POSA would have had reason to use combine Fox and Coronel in the manner set forth in the Petition and would reasonably have expected success in doing so.

2. Analysis of independent claim 1

- a) *“A method comprising receiving at a first interface operational state data of a processing tool related to the manufacture of a processing piece”*

Petitioner contends that Coronel discloses “[a] method comprising receiving at a first interface operational state data of a processing tool related to the manufacture of a processing piece,” as recited in claim 1. Pet. 42. We agree.

Coronel discloses that its computer receives tool data from data bus 13. Ex. 1006, 2:39-54, 3:49-51, 4:25-31, 13:41–45; Ex. 1002, ¶ 86. Petitioner contends, and we agree, that the POSA “would recognize that the portion of the computer hardware and software receiving operational tool state data over data bus 13 . . . acts as a first interface.” Pet. 42 (citing Ex. 1002 ¶ 86). Patent Owner does not dispute that Coronel discloses this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that Coronel discloses a “method comprising receiving at a first interface

operational state data of a processing tool related to the manufacture of a processing piece,” as recited in claim 1.

- b) *“sending the state data from the first interface to a fault detection unit, wherein the act of sending comprises: sending the state data from the first interface to a data collection unit”*

Petitioner contends that the combination of Coronel and Fox teaches “sending the state data from the first interface to a fault detection unit, wherein the act of sending comprises: sending the state data from the first interface to a data collection unit,” as recited in claim 1. Pet. 42–43. We agree.

As discussed *supra* § II.E.2.b, the Coronel computer, acting as a first interface, receives operational state data from a processing tool. We agree with, and credit, Dr. Hatalis’s testimony that a POSA would have been motivated to use “the data storage memory, data processing, and memory components of a computer to calculate a T^2 value for facilitating an increase in the quality and reliability of wafer production through multivariate analysis fault detection,” as taught by Fox. Ex. 1002 ¶ 87 (citing Ex. 1020, 308; Ex. 1024, 351; Ex. 1005, 2:6–9). With this modification, the Coronel computer, acting as a first interface, “would send the state data received from the processing tool via data bus 13 to a data storage memory (i.e., a data collection unit), which as per the teachings of Fox ‘can be a variety of memory storage devices,’ including ‘a part of a hard disk in a personal computer PC.” Pet. 42 (citing Ex. 1005, 3:26–32, 7:5–10; Ex. 1006, 2:39–54, 3:49–51, 4:25–31, 13:41–45). Thus, we agree with Petitioner that, in the

method suggested by the combination of Coronel and Fox, “[t]he operational state data would . . . be sent from the first interface to a data collection unit.” Pet. 43.

Patent Owner does not dispute that the cited art teaches this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches “sending the state data from the first interface to a fault detection unit, wherein the act of sending comprises: sending the state data from the first interface to a data collection unit.”

c) *“accumulating the state data at the data collection unit”*

Petitioner contends that the combination of Coronel and Fox teaches “accumulating the state data at the data collection unit,” as recited in claim 1. Pet. 43. We agree.

Fox teaches that the state data is “stored as digital data in data storage memory,” which can be “a variety of memory storage devices,” including “part of a hard drive in a personal computer (PC).” Ex. 1005, 3:26–32. Dr. Hatalis explains that in the method suggested by the combination of Coronel and Fox, “the state data . . . would be accumulated as ASCII data files in the data storage memory device, which . . . would include part of the hard disk in the computer of Coronel.” Ex. 1002 ¶ 88. We agree with Dr. Hatalis that the art supports storing the state data Coronel’s memory device. Patent Owner does not dispute that the cited art discloses this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that the

combination of Coronel and Fox discloses “accumulating the state data at the data collection unit,” as recited in claim 1.

d) *“translating the state data from a first communications protocol to a second communications protocol compatible with the fault detection unit”*

Petitioner contends that the combination of Coronel and Fox suggests “translating the state data from a first communications protocol to a second communications protocol compatible with the fault detection unit.” Pet. 44–45. We agree.

Petitioner contends that after the state data is accumulated in the memory of Coronel’s computer (according to Fox’s teachings) it would be sent to the supervisor. Pet. 44. In the Coronel computer, “[s]upervisor 35 is connected . . . to the computer 12 via a bidirectional data bus 36, typically a SECS II link.” Ex. 1006, 13:25–29; *see also* Ex. 1002 ¶ 89. In Fox, the accumulated tool state data is stored as ASCII data files. Ex. 1005, 3:26–32; *see also* Ex. 1002 ¶ 89. Petitioner contends, and we agree, that a POSA would have understood that Coronel’s computer could use the SECS II link to transmit tool state data to the supervisor for fault detection. Pet. 44; Ex. 1002 ¶ 90. We also agree with Petitioner and Dr. Hatalis that “because the SECS II link between the computer and supervisor in Coronel would transmit ASCII formatted tool data or T² values to the supervisor, the computer must first translate the data or values to the SECS II format” and that such translation techniques were “well-known to a POSA.” Pet. 44; Ex. 1002 ¶ 90. Accordingly, we agree with Petitioner that the POSA would

have found it obvious to translate the state data from a first communications protocol to a second communications protocol.⁷ We address Patent Owner’s arguments relating to this limitation below.

Patent Owner argues that neither Coronel nor Fox teaches the translation element. PO Resp. 22; *see also id.* at 23 (“Petitioner has not identified any disclosure of translation between two separate communications protocols in either Fox or Coronel.”). We do not find this persuasive. We credit the unrebutted testimony of Dr. Hatalis that a POSA would have recognized that Coronel’s computer could use the bidirectional data bus to transmit tool state data to the supervisor for fault detection, and that the POSA would have understood that “the computer *must* first translate the data from ASCII format or T² values from numeric data to the SECS II communications protocol.” Ex. 1002 ¶ 90 (emphasis added). Accordingly, we agree with Petitioner that the combination of Coronel and Fox suggests the translation element.

⁷ Petitioner asserts that, in the alternative, “translation could be considered to occur when the computer calculates the T² value, as this results in translating the state data to a format compatible with the fault detection algorithm taught by Fox, which a POSA would understand to be present in the Coronel supervisor.” Pet. 45. We do not address this alternative theory because we find that the evidence supports Petitioner’s other theory for why translation would have been obvious. We note, however, that Petitioner appears to be correct that this alternative theory is unrebutted. Pet. Reply 9 (asserting that Patent Owner “does not contest that calculation of the T² value by the Coronel computer results in translating the state data to a format compatible with the fault detection algorithm taught by Fox”).

Patent Owner argues that the question is not whether “the technique for transmitting ASCII or numeric data using the SECS II communications protocol was well-known . . . but *whether it would be possible to harmonize a combined system based on the disclosures of Coronel and Fox without incurring delays in reporting of faults when they occur.*” PO Resp. 22 (citing Ex. 2040 ¶ 68). Patent Owner points out that the ’402 patent “identifies such delays as a drawback in prior art systems.” *Id.* Patent Owner then explains that while “Coronel teaches ‘a bidirectional data bus, typically a SECS II link’ which connects the supervisor 35 to the computer[,] . . . Fox teaches the use of a different communications protocol, ASCII, for storing data in a memory storage device.” *Id.* at 22–23. According to Patent Owner, this is a problem because a POSA “would have recognized that the addition of an ulterior software element capable of translating different data protocols in use within the combined systems of Coronel and Fox would have brought an additional degree of complexity to the system and compromised its ability to efficiently report faults.” *Id.* at 23 (citing Ex. 2040 ¶ 70).

We are not persuaded by Patent Owner’s translation delay arguments. Patent Owner cites the testimony of Mr. Humphrey to support that translating between the different protocols of Coronel and Fox would have brought “an additional degree complexity to the system and compromised its ability to efficiently report faults.” Ex. 2040 ¶ 70. However, the persuasiveness of Mr. Humphrey’s testimony is diminished by the absence of explanation and by the absence of citation to supporting evidence. *See In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) (“[T]he

Board is entitled to weigh the declarations and conclude that the lack of factual corroborations warrants discounting the opinions expressed in the declarations.”); 37 C.F.R. § 42.65 (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

Although Mr. Humphrey testifies that translation adds complexity, the evidence of record supports that the translation technique on which Petitioner relies was routine. Ex. 1002 ¶ 90 (Dr. Hatalis testimony that “[i]t was well-known in the art how to transmit data in ASCII format or as numeric data via the SECS II communications protocol”); Ex. 1001, 5:26–33 (explaining that translation between the communication protocol used by “equipment interface 110” and “Common Object Request Broker Architecture Interface Definition Language (COBRAIDL)” is “well known to those of ordinary skill in the art” and, thus will “not be discussed . . . to avoid unnecessarily obscuring the present invention”); *see also* Ex. 1018, 172 (article cited by Dr. Hatalis describing transmission of ASCII data over SECS II protocol). To the extent Mr. Humphrey’s testimony that translation adds “an additional degree complexity to the system and compromised its ability to efficiently report faults” contradicts Dr. Hatalis’s testimony, we credit Dr. Hatalis over Mr. Humphrey.

Moreover, as discussed above, we credit Dr. Hatalis’s testimony that a POSA would have understood that it was necessary to translate from ASCII to SECS II in order to transmit tool state data to the supervisor for fault detection. Ex. 1002 ¶ 90. Given the evidence that the asserted translation was both necessary and routine, we find that the potential for delays that

Patent Owner argues would be introduced by translating between the communication protocols of Fox and Coronel would not have discouraged the POSA from translation. *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 (Fed. Cir. 2000) (“[T]he benefits, *both lost and gained*, should be weighed against one another.”).

In its Sur-reply, Patent Owner argues that “ASCII is a data type whereas SECS II is a communications protocol.” Sur-reply 8. Patent Owner supports this assertion by citing to a URL.⁸ *Id.* Based on this assertion, Patent Owner argues: “[b]ecause ASCII is defined as a data type within the SECS II communication protocol, there is no factual basis for Petitioner to allege that the claimed translation step is necessitated by virtue of the combined use of ASCII data and SECS II communication protocol.” *Id.* Petitioner contends that this is a new argument, and moves to strike it on that basis. *See* Mot.

We agree that this is a new argument. The Petition clearly asserts that translating between ASCII and SECS II meets the limitation requiring “translating the state data from a first communications protocol to a second communications protocol compatible with the fault detection unit.” Pet. 44. Patent Owner’s Response did not challenge that translating between ASCII and SECS II was a translation between two different communication protocols. PO Resp. 22–23 (addressing “translation” limitation without

⁸ Petitioner has moved to exclude and to strike the URL. Mot; Mot. Excl. We address Petitioner’s Motion to Exclude and Motion to Strike *infra* §§ III & IV.

making this argument). Petitioner’s Reply relied on the absence of a challenge to this issue. Pet. Reply 8–9 (Noting that Patent Owner “does not question the fact that conversion from ASCII format to SECS II . . . constitutes a translation” and that Patent Owner does not “dispute that a POSA would have understood the need for such a translation when combining the teachings of Coronel with Fox.”). Accordingly, we determine that Patent Owner has waived its argument that translating between ASCII and SECS II does not involve translating between two different communications protocols. Paper 15, 9 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived”).

Even if we were to consider Patent Owner’s argument that ASCII is not a communications protocol and, thus, translation from ASCII to SECS II does not meet the limitation requiring “translating the state data from a first communications protocol to a second communications protocol compatible with the fault detection unit,” we would not find it persuasive in view of Patent Owner’s and Mr. Humphrey’s admissions to the contrary. *See e.g.*, 2040 ¶ 70 (Mr. Humphrey testifying that “Fox teaches the use of a different communications protocol, ASCII” and noting the “different data protocols in use within the combined systems of Coronel and Fox”); PO Resp. 22–23 (making arguments identical to the quoted testimony from Mr. Humphrey); Sur-reply 9 (“the fact that the Coronel and Fox systems employ different data communications protocols is indicative of an absence of a motivation to combine the two systems”); *see also* Ex. 2044, 85:19–22 (testimony of Dr. Hatalis: “Fox is referring to ASCII, the data files in memory. But a person

skilled in the art would also know that ASCII is also a form of – or a protocol in data communications.”).

Accordingly, we find that Petitioner has established, by a preponderance of the evidence, that a POSA would have found it obvious to translate the state data from a first communications protocol to a second communications protocol.

e) *“sending the translated data from the data collection unit to the fault detection unit”*

Petitioner contends that the combination of Coronel and Fox teaches “sending the translated state data from the data collection unit to the fault detection unit,” as recited in claim 1. Pet. 45. We agree.

Fox teaches sending the calculated T^2 value from the data processing unit in the computer to a controller that acts as a fault detection unit (“FDU”). Ex. 1005, 5:52–65 (“the algorithm for calculating the T^2 is retained as a software program in block 20;” “the output of block 20 is the T^2 value . . . [t]his T^2 value is then used as an input to the controller block 22;” “[b]lock 22, in essence determines the value of the T^2 which is acceptable for a given process being run in tool 10”); *see also id.* at 7:5–8:4; Ex. 1002 ¶ 92. In Coronel, a bidirectional data bus connects the computer to a supervisor that acts as an FDU. Ex. 1006, 10:25–39 (teaching that the supervisor monitors “selected parameters” and “[i]f a deviation is detected, . . . emits the alert code to the computer controlling the process tool to flag an alarm”), 13:25–27 (“Supervisor 35 is connected on the one hand to the computer 12 via a bidirectional data bus 36, typically a SECS II link”), 18:50–55 (“If an anomaly (i.e. a deviation) is detected, supervisor 35

provides an alert code to the computer 12, so that the adequate action can be immediately taken (step 54)"); Ex. 1002 ¶¶ 92–93.

We agree with Dr. Hatalis that “A POSA would have had the motivation to keep a similar connection in the method of Coronel combined with the teachings of Fox in view of Coronel already employing the supervisor as a fault detection unit.” Ex. 1002 ¶ 92. We further agree that a POSA would have recognized that bidirectional data bus 36, which is typically a SECS II link, would have been “capable of transmitting the T^2 value calculated by the computer’s data processing and memory components” and that the supervisor would have been “capable of analyzing the T^2 values obtained from the data processing unit in the computer of Coronel.” *Id.* ¶¶ 93–94. We credit the testimony of Dr. Hatalis and further, we agree that in the combination of Coronel and Fox, a POSA would have understood that “once the state data is translated by the computer of Coronel, [it] would then be sent to the fault detection unit, i.e., supervisor, for analysis.” *Id.* ¶ 92.

Patent Owner does not dispute that the cited art teaches this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches “sending the state data from the first interface to a fault detection unit, wherein the act of sending comprises: sending the state data from the first interface to a data collection unit.”

- f) *“determining if a fault condition exists with the processing tool based upon the state data received by the fault detection unit”*

Petitioner contends that the combination of Coronel and Fox teaches “determining if a fault condition exists with the processing tool based upon the state data received by the fault detection unit.” Pet. 47–48. We agree.

Coronel’s supervisor includes an internal database which contains “alarm” related data corresponding to “normal” and “abnormal” situations. Ex. 1006, 13:56–14:34 (“All the data . . . which are representative of the normal situation and of the identified abnormal situations . . . are stored in the database of supervisor 35”), 18:33–19:7 (“Upon occurrence of any selected process parameter drift, the supervisor 35 tests if any of the rejection criteria set up by the process engineers is met”); *see also* Ex. 1002 ¶ 96.

Fox discloses a similar approach. Fox first determines a baseline for “ideal Hotelling’s T^2 values” and “the upper control limit (UCL) and the lower control limit (LCL).” Ex. 1005, 6:8–11 (“The ideal Hotelling’s T^2 values for a process are determined by running a number of samples and developing a baseline for that particular process.”), 6:64–65 (“Subsequently, the UCL and the LCL limits can be established.”). The T^2 values and the UCL and LCL limits are stored in memory. *Id.* at 7:5. Then Fox’s system compares T^2 values derived from an ongoing process to the baseline data stored in memory, generating an “out of tolerance signal” if the T^2 value is “not within the acceptable UCL/LCL tolerance.” *Id.* at 7:5–17.

We agree with Petitioner and Dr. Hatalis that in the method suggested by the combination of Coronel and Fox, a POSA would have been motivated

to use “[t]he Coronel supervisor, which has ‘both computing and data storage capabilities,’” to “determine if a fault condition exists based on T^2 values,” as taught by Fox. Pet. 47; Ex. 1002 ¶ 96. In this modified method, the database of Coronel’s supervisor would store a “baseline of ‘ideal Hotelling’s T^2 values’ and ‘the upper control limit (UCL) and the lower control limit (LCL).’” Pet. 47. The supervisor would then “analyze the T^2 values received from the computer data processing unit . . . by comparing them to the ‘ideal Hotelling’s T^2 values’ and acceptable UCL/LCL range for the given process, as taught by Fox.” *Id.* If the T^2 value received from the computer data processing unit was not within acceptable tolerance, the Coronel supervisor would generate an alarm, thus acting as an FDU. *Id.* at 47–48; Ex. 1002 ¶ 97.

Patent Owner does not dispute that the cited art teaches this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches “determining if a fault condition exists with the processing tool based upon the state data received by the fault detection unit.”

g) “performing a predetermined action on the processing tool based upon the state data received by the fault detection unit”

Petitioner contends that the combination of Fox and Coronel teaches “performing a predetermined action on the processing tool based upon the state data received by the fault detection unit” because Fox teaches that “the controller generates an out-of-tolerance signal if the T^2 values it receives are

not within the acceptable UCL/LCL range.” Pet. 48 (citing Ex. 1005, 7:13–17; Ex. 1002 ¶ 98). The evidence supports Petitioner’s contention.

Fox discloses that its “out-of-tolerance control signal can be utilized . . . to terminate the ongoing process . . . [or] to inform the data collection system to identify the component or components which may be causing the out-of-tolerance condition.” Ex. 1005, 7:18–8:4; Ex. 1002 ¶ 98. Petitioner and Dr. Hatalis assert, and we agree, that a POSA would have been motivated “to use a similar technique when combining Coronel with the teachings of Fox because Coronel already discloses connecting the supervisor and computer to function in the same manner.” Ex. 1002 ¶ 98 (citing Ex. 1006, 10:25–38, 18:50–55); Pet. 48. More specifically, Coronel’s supervisor emits an alert to the computer to take immediate and appropriate action when it identifies a deviation from monitoring equipment data. Ex. 1006, 10:34–38, 18:50–55; Ex. 1002 ¶ 99. As explained by Dr. Hatalis, in the method suggested by Coronel and Fox, “the supervisor, upon detecting a deviation in the tool state data from comparing the T^2 values to the acceptable UCL/LCL range, would emit an alert to the computer to take immediate and appropriate action on the processing tool.” Ex. 1002 ¶ 99 (citing Ex. 1005, 7:14–8:4; Ex. 1006, 10:34–38; 18:50–55, 19:56–20:1).

Patent Owner does not dispute that the cited art teaches this claim element. Having reviewed the evidence and argument of record, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches “performing a predetermined action

on the processing tool based upon the state data received by the fault detection unit.”

- h) *“sending an alarm signal indicative of the fault condition to an advanced process control framework from the fault detection unit providing that a fault condition of the processing tool was determined by the fault detection unit”*

Petitioner contends that the combination of Coronel and Fox teaches “sending an alarm signal indicative of the fault condition to an advanced process control framework from the fault detection unit providing that a fault condition of the processing tool was determined by the fault detection unit,” as recited in claim 1. Pet. 49–51. More specifically, Petitioner contends:

Coronel discloses that its computer can stop a process if the supervisor detects a deviation, including stopping the processing tool. A POSA would therefore have understood that the portion of the hardware and software of the Coronel computer (e.g., a program residing in part of the computer memory) also functions as an APC that receives an alarm signal from the supervisor, upon the supervisor detecting a fault, and then acts upon receiving the signal.

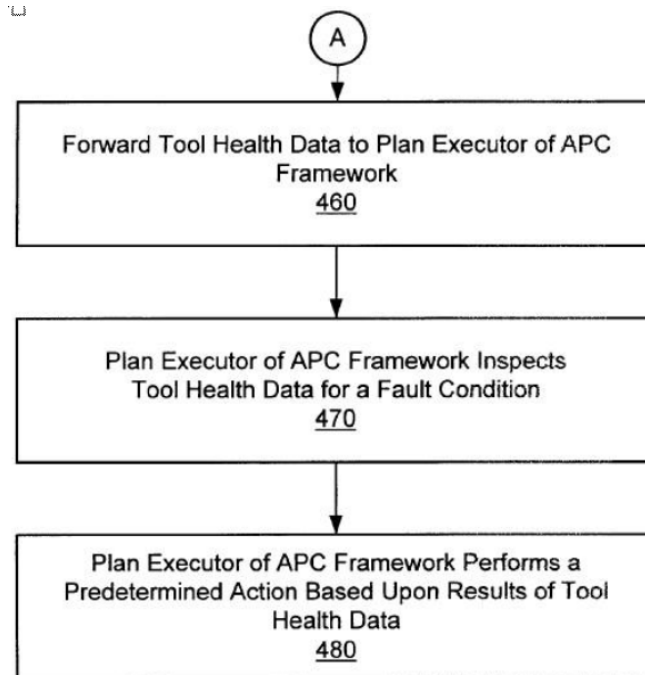
Id. at 50 (internal citations omitted).

Patent Owner argues that the combination of Coronel and Fox does not teach an “advanced process control framework” as recited in claim 1. PO Resp. 17–20. Patent Owner points to the specification of the ’402 patent which discloses:

A plan executor (PE) 330 (i.e., a process controller) manages the APC framework 135 and provides possible solutions to problems found with the tool health data that was forwarded by the fault detection system 120. The framework 135 further

includes an applications interface (AI) 340 for interfacing with third-party applications that run on the fault detection system 120.

Ex. 1001, 4:61–67 (cited at Ex. 2040 ¶ 65 (Mr. Humphrey’s testimony), which itself is cited at PO Resp. 18). Patent Owner then argues that “[n]either Fox nor Coronel (alone or in combination) teaches a similar system that includes a process controller, i.e., plan executor, that manages an APC framework, i.e. an APC framework that provides solutions to model-based tool health data.” PO Resp. 18–19. According to Patent Owner, the “distinction between the ’402 patent methods and those of Fox and Coronel are detailed in Steps 460–480 in Figure 4B” (PO Resp. 19), which is reproduced below.



Ex. 1001, Fig. 4. Figure 4B is a flowchart, including three steps. *Id.* The first step in Figure 4B, step 460, is to “Forward Tool Health Data to Plan Executor of APC Framework.” *Id.* The second step, step 470, is: “Plan Executor of APC Framework Inspects Tool Health Data for a Fault Condition.” *Id.* And the third and final step in Figure 4B, step 480, is: “Plan Executor of APC Framework Performs a Predetermined Action Based Upon Results of Tool Health Data.” *Id.* Patent Owner does not articulate how or why these steps distinguish the method of the ’402 patent from that of Coronel and Fox. *See* PO Resp. 19.

We agree with Petitioner that the combination of Coronel and Fox teaches sending an alarm signal to an advanced process control framework.

Coronel discloses that its computer controls the response when a “deviation” is detected and can stop a process or a process tool upon receipt of an alarm signal from the supervisor. Ex. 1006, 10:34–38 (“If a deviation is detected, the supervisor emits the alert code to the computer controlling the process tool to flag an alarm and it takes an immediate and appropriate action.”), 18:50–55 (“If an anomaly (i.e. a deviation) is detected, supervisor 35 provides an alert code to the computer 12, so that the adequate action can be immediately take.”), 19:54–20:1 (Coronel teaching that “[i]f an anomaly is detected . . . the corresponding alert code is sent to the computer 12 to take the appropriate action” and that “depending upon the seriousness of the deviation, either the process or the tool can be stopped.”). Dr. Hatalis testifies that based on this disclosure, a POSA would have understood that a “portion of the hardware and software of the computer in Coronel (e.g., a program that resides in a portion of the computer memory) would also act as

an APC that receives an alarm signal from the supervisor upon the supervisor detecting a fault and then acts upon receiving it.”

Ex. 1002 ¶ 100; *see also id.* ¶ 56. This testimony is consistent with the disclosure in Coronel and we credit it accordingly.

Patent Owner relies on the testimony of Mr. Humphrey to counter Dr. Hatalis’s testimony. PO Resp. 18–19 (citing Ex. 2040 ¶ 65). Mr. Humphrey describes the APC framework of the ’402 patent and then testifies that Coronel does not teach an APC like that described in the ’402 patent. More specifically, Mr. Humphrey states: “Neither Fox nor Coronel (alone or in combination) teaches a similar system that includes a process controller, i.e. plan executor, that manages an APC framework, i.e. an APC framework that provides possible solutions to model-based tool health data.” Ex. 2040 ¶ 65. Mr. Humphrey does not expressly assert that Coronel lacks an APC altogether. Rather, Mr. Humphrey asserts that Coronel lacks an APC that includes a “process controller, i.e. plan executor.” *Id.* This leaves some ambiguity on whether Mr. Humphrey disputes that Coronel has an APC or disputes only that Coronel’s APC lacks a process controller. We find it helpful to address both possibilities separately.

We begin by considering the possibility that Patent Owner and Mr. Humphrey contend that Coronel lacks an APC altogether. As discussed above, Dr. Hatalis testifies that a portion of Coronel’s computer acts as an APC. Ex. 1002 ¶ 100; *see also id.* ¶ 56. This testimony is unambiguous and consistent with Coronel. In addition, the evidence supports that APCs were known to be standardized, commercially-available, software components. Ex. 1040, 14:4–19 (testimony of Mr. Humphrey that APC systems were

available for purchase from commercial vendors component during the time when he worked at Rockwell); Ex. 2041, 2 (Mr. Humphrey's CV, representing that he was employed at Rockwell Semiconductor Systems from 1995–99); Ex. 1001, 4:40–44 (specification of the '402 patent describing an APC framework as a “component-based architecture comprised of interchangeable, standardized software components enabling run-to-run control of the processing tool”). The ready availability of APCs at the time Coronel is consistent with and tends to support Dr. Hatalis's testimony. Countering this is the ambiguous testimony of Mr. Humphrey that Coronel does not have an APC like that described in the '402 patent, “that includes a process controller, i.e. plan executor, that manages an APC framework.” Ex. 2040 ¶ 65. To the extent Mr. Humphrey's testimony is that Coronel lacks an APC altogether, we credit the unambiguous, well-supported testimony of Dr. Hatalis (Ex. 1002 ¶¶ 56, 100) over the ambiguous testimony of Mr. Humphrey (Ex. 2040 ¶ 65). In light of the above, we find that Coronel has an APC.

We next consider whether Coronel's APC can be differentiated from the claimed APC on the basis suggested by Mr. Humphrey, i.e., that it lacks process controller/plan executor. Coronel teaches that its computer controls the process tool, takes immediate action in response to an alert code, and can stop either the process or the tool. Ex. 1006, 10:34–38, 18:50–55, 19:54–20:1. This supports that Coronel's computer can act as a process controller. In addition, as reflected in the deposition testimony of Mr. Humphrey, the evidence supports that including a process controller/plan executor in an APC was both necessary and an industry standard:

[Petitioner's counsel]: So in this paragraph, you note that the APC framework of the '402 patent includes a plan executor, correct?

[Mr. Humphrey]: Yes.

[Petitioner's counsel]: Does every APC have a plan executor?

[Mr. Humphrey]: Generally speaking, yes, APC frameworks include a plan executor or a module or component that serves that function.

[Petitioner's counsel]: And that's what the understanding would be in industry?

[Mr. Humphrey]: Yes.

[Petitioner's counsel]: Is it possible to have an APC without a plan executor?

[Mr. Humphrey]: No. I believe the -- if you want to be compatible with the semistandards associated with APC frameworks, then a plan executor or similar component or function is more or less a part of the definition of the framework.

[Petitioner's counsel]: So a person having ordinary skill in the art would have understood, then, that an APC would include a plan executor. Is that right?

[Mr. Humphrey]: It's part of the industry standard.

Ex. 1040, 100:14–101:16 (objections omitted for readability). This testimony supports that, because Coronel has an APC, that APC must include a plan executor. To the extent Mr. Humphrey's declaration testimony is to the contrary (*see* Ex. 2040 ¶ 65), we give it little weight. Consistent with Mr. Humphrey's deposition testimony, and the disclosures in Coronel regarding the computer's ability to exert control, Dr. Hatalis testifies that the portion of the computer that acts as an APC "send[s] control signals, such as a shutdown signal" and "acts upon receiving" and alarm signal from the supervisor. Ex. 1002 ¶¶ 56, 100. Considering the totality of the evidence, including the disclosures of Coronel, and the testimony of

Dr. Hatalis and Mr. Humphrey, we find that the portion of Coronel's computer that acts as an APC has a plan executor.

As to Patent Owner's argument that Figure 4B of the '402 patent (reproduced above) reflects a distinction between the APC described in the '402 patent and in Coronel, we disagree. Figure 4B identifies the actions taken by the process controller/plan executor component of the APC of the '402 patent. Ex. 1001, Fig. 4B. It, reflects the same process control functionalities described in Coronel. In Figure 4B: 1) the "plan executor" of the APC receives health data, 2) the plan executor inspects the health data for a fault condition, and 3) the plan executor performs a predetermined action. *Id.* Coronel teaches that "[i]f a deviation is detected, the supervisor [i.e., the fault detection unit] emits the alert code to the computer controlling the process tool [i.e., the APC] to flag an alarm and it takes an immediate and appropriate action [i.e., a predetermined action]." Ex. 1006, 10:34–39. Patent Owner does not articulate how the method described in Figure 4B differentiates the claimed APC from the APC in Coronel (PO Resp. 19) and we do not find a meaningful difference between the APC described in Figure 4B and that described in Coronel.

In its Sur-reply, Patent Owner points to the deposition testimony of Dr. Hatalis that an APC framework has specific hardware and software components and argues that "Petitioner has never at any point identified, except in the most general terms, how Coronel and/or Fox disclose(s) the full panoply of software functions and hardware elements that Dr. Hatalis has identified in an APC." Sur-reply 3–4. We find that this argument was waived because it was not included in Patent Owner's Response.

To the extent Patent Owner’s argument is grounded in claim construction – i.e., that the term “advanced process control framework” in claim 1 must be construed to include the specific hardware and software components identified by Dr. Hatalis in his deposition, both parties have made very clear that there is no need to construe the APC term. Pet. 15 (“No term needs to be construed.”); PO Resp. 6 (“Patent Owner does not presently believe that claim construction is necessary.”). In its Reply, following the guidance set forth in the Consolidated Trial Practice Guide (“CTPG”) that “[p]arties should submit a prior claim construction determination by a federal court . . . as soon as it becomes available,” Petitioner submitted the claim construction provided by the Eastern District of Texas in *Ocean Semiconductor LLC v. Huawei Device USA, Inc.*, 4:20-CV-00991 ALM. Pet. Reply 4; CTPG, 47.⁹ But Petitioner did not request that we adopt this construction or otherwise ground its argument in the district court’s claim construction. Pet. Reply 4. Accordingly, we do not agree with Patent Owner that Petitioner’s submission of the district court’s claim construction raised the issue of how the APC term should be construed. Mot. Opp. 4.

Moreover, as stated *supra* § II.C, we determine that we do not need to construe any claim terms in order to resolve this dispute. As Patent Owner itself admits, the term “advanced process control” was well understood in

⁹ The district court construed APC to mean “a component-based architecture comprised of interchangeable, standardized software components enabling run-to-run control of the processing tool,” a definition taken word for word from the specification of the ’402 patent. Ex. 1042, 38; Ex. 1001, 4:40–44.

the art. Sur-reply, 3 (“The fact that none of the six defendants in the underlying WDTX actions requested that this term be construed (which Petitioner ignored and failed to mention in its Petition and Reply) further reinforces that this term [advanced process control] is an industry coined term and well-known in the art with a defined meaning.”). Here, as discussed above, the evidence supports that Coronel has an advanced process control and we do not need to construe the term to address those arguments that were timely raised by Patent Owner – i.e., that Coronel lacks an APC with a process controller/plan executor and that Figure 4B of the ’402 patent distinguishes the claimed APC from Coronel’s APC.

As to the factual aspects of Patent Owner’s belated argument that Coronel lacks the “full panoply of software functions and hardware elements that Dr. Hatalis has identified in an APC” (Sur-reply 3–4), we will not resolve these issues on an incomplete record. We note however that Patent Owner’s assertions that Coronel lacks a “fault detection or diagnosis of maintenance” component, “a controller,” “a component that modifies tool settings,” and “interfaces that receive and send signals,” appear to be contrary to the disclosure of Coronel. *See, e.g.*, Ex. 1006, 10:34–38, 18:50–55, 19:54–20:1.

Patent Owner argues that Coronel “attributes key functions such as fault detection and alarms to the supervisor rather than the computer.” Sur-reply 5. This argument is also waived because it was not included in Petitioner’s Response. *See* PO Resp. 17–20 (addressing the “advanced process control limitation” without making this argument). But even if we were to consider it, we would not find it persuasive because this is exactly

what is recited in the claim 1 and what is described in the specification of the '402 patent: a fault detection unit detects a fault and sends an alarm to the APC. *See e.g.*, Ex. 1001, 7:31–33 (claim 1 reciting, “sending an alarm signal indicative of the fault condition to an advanced process control framework from the fault detection unit”); 4:19–28 (“The fault detection system 120 . . . sends the results of potential faults and/or proper operation of the tool 105 in the form of tool ‘health’ data to the Advanced Process Control (APC) framework 135”).

Accordingly, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches “sending an alarm signal indicative of the fault condition to an advanced process control framework from the fault detection unit providing that a fault condition of the processing tool was determined by the fault detection unit.”

- i) *“wherein performing a predetermined action further comprises sending a signal by the framework to the first interface reflective of the predetermined action.”*

Petitioner contends that a POSA would have understood that the portion of Coronel’s computer acting as an APC, “upon receiving the alarm signal from the supervisor, would also have sent a signal to the part of the computer acting as the first interface . . . to perform a predetermined action on the processing tool responsive to the fault detected because that part of the computer ‘has the role of controlling the physical process parameters of tool[s] during the wafer processing.’” Pet. 50 (quoting Ex. 1006, 13:42–44).

Patent Owner points out that Petitioner's position has the computer functioning as both the APC and the first interface and argues that "[i]t is simply illogical that the computer 12 of Coronel would send a signal *to itself* reflective of information that it already possesses." PO Resp. 21. Patent Owner asserts that "[t]he computer cannot simultaneously represent both the framework and the first interface of the '402 patent." *Id.* According to Patent Owner, "[n]othing in Coronel indicates that the computer 12 is divided into different portions, such that these portions independently interact with other elements in the process flow or handle individual steps." *Id.* Finally, Patent Owner argues that "[b]ecause claims should not be construed so as to render terms superfluous, Petitioner's assertion that sending an 'alert code *to the computer*' meets 'sending a signal by the [APC] framework *to the first interface* reflective of the predetermined action' is factually and legally incorrect." Sur-reply 7 (alteration in original).

We agree with Petitioner that the combination of Coronel and Fox teaches that the APC sends a signal to the first interface reflective of a predetermined action.

We have already found that a portion of Coronel's computer acts as a first interface and a portion of Coronel's computer acts and an APC. *See supra* §§ II.E.2.a, II.E.2.h. Other than Mr. Humphrey's unpersuasive argument (addressed *supra* § II.E.2.h) that Coronel lacks an APC with a process controller/plan executor and that Coronel lacks an APC that is distinct from that depicted in Figure 4B of the '402 patent, Dr. Hatalis's testimony that a POSA would recognize that a portion of Coronel's

computer acts as a first interface and a portion acts as an APC is un rebutted. *See* Ex. 1002 ¶¶ 56, 86, 100–102. We credit this testimony. For this reason we are not persuaded by Patent Owner’s argument that nothing in Coronel indicates that its computer is divided into different portions.¹⁰ We also find that Dr. Hatalis’s testimony was sufficiently specific, and thus reject Patent Owner’s argument that Petitioner failed to “define with any specificity where the boundaries between the ‘portions’ of the computer that it posits lie.” Sur-reply 7.

Moreover, we do not agree with Patent Owner that it would be illogical for a computer to have different portions (for example, programs residing in memory) that interact with each other.¹¹ As discussed above, Dr. Hatalis testifies that this is what happens in Coronel’s computer and Patent Owner does not direct us to persuasive evidence to the contrary. *See, Johnston v. IVAC Corp.*, 885 F.2d 1574, 1581 (Fed. Cir. 1989) (“Attorneys’ argument is no substitute for evidence.”); *In re Pearson*, 494 F.2d 1399, 1405 (CCPA 1974). As to Patent Owner’s argument that Petitioner’s reliance on Coronel’s computer renders the claim language superfluous, we

¹⁰ This argument is also inconsistent with Coronel’s Figure 7, which depicts the computer as having three interfaces in the form of data busses 13, 18, and 36. Ex. 1006, Fig. 7.

¹¹ We made this same point in our institution decision (Inst. Dec. 29), and Patent Owner does not persuasively address it here (*See* PO Resp. 20–21 (asserting that Petitioner’s position is illogical, but relying only on attorney argument and not providing persuasive explanation why it would be illogical); Sur-reply 6–8 (same)).

do not agree because, as discussed above, we consider Coronel's computer to be comprised of two different portions that interact with each other.

Accordingly, we find that Petitioner has established, by a preponderance of the evidence, that the combination of Coronel and Fox teaches "wherein performing a predetermined action further comprises sending a signal by the framework to the first interface reflective of the predetermined action."

j) Conclusion as to claim 1

For the reasons set forth above, we find that the combination of Coronel and Fox renders obvious the method of claim 1. We also find that one of ordinary skill in the art would have been motivated to combine Coronel and Fox with a reasonable expectation of arriving at the challenged claims. Accordingly, we find that Petitioner has established, by a preponderance of the evidence, that at the time of the invention of the '402 patent, claim 1 would have been obvious over the combination of Coronel and Fox.

3. Analysis of independent claims 8 and 15

Independent claim 8 recites a system for fault detection and independent claim 15 recites an apparatus for fault detection. Ex. 1001, 8:1–30, 8:55–9:2. Petitioner contends that "[t]he method of [c]laim 1 is implemented using the system and apparatus of claim 8 and 15, respectively." Pet. 51. Petitioner provides a detailed element by element comparison showing how the elements of claim 1 correspond to the elements

of claims 8 and 15. *Id.* at 52–57. Petitioner then asserts that claims 8 and 15 would have been obvious for the same reasons as claim 1. *Id.*

Patent Owner agrees that claims 8 and 15 are analogous to claim 1. PO Resp. 24 (“Independent claims 8 and 15 recite, respectively, a system and apparatus for fault detection that include elements analogous to those of claim 1.”). Patent Owner argues that Petitioner’s arguments for claim 8 “share the same weaknesses” as its arguments for claim 1. *Id.* at 25. More specifically, Patent Owner argues that Petitioner’s arguments for claim 8 fail because “as shown above [referencing its arguments with respect to claim 1] Coronel’s computer cannot be both an interface and a data collection unit, neither Fox nor Coronel disclose data translation or sending of translated data, and neither Fox nor Coronel disclose a fault detection unit.” *Id.*

Patent Owner’s summary of its arguments does not align perfectly with the arguments it actually made with respect to claim 1. For example, Patent Owner argued that Coronel’s computer could not be both a “first interface” and an “advanced process control,” not that it could not be “both an interface and a data collection unit.” *See* PO Resp. 20–21. Similarly, Patent Owner did not challenge that Coronel discloses a fault detection unit, i.e., its supervisor. *See generally, id.* Nonetheless, it is clear that in its discussion of claim 8, Patent Owner intended to rely on the arguments already made, not to make new arguments. We deem Patent Owner’s imprecise summary to be harmless error and find Patent Owner to have incorporated and applied all of the arguments it made with respect to claim 1 in its discussion of claim 8.

For the reasons discussed with respect to claim 1, we do not find these arguments persuasive. We find that Petitioner has shown, by a preponderance of the evidence, that the combination of Coronel and Fox teaches each of the elements of claim 8.

With respect to claim 15, Patent Owner argues that “Petitioner compounds the weaknesses in its arguments for claims 1 and 8 by arguing that the ‘controller’ in claim 15 is equivalent to the computer *and* the supervisor of Coronel at the same time as the computer operates as both the first interface and the APC framework.” PO Resp. 25. The relevant portion of claim 15 recites a “a controller adapted to: . . . determine if a fault condition exists with the processing tool . . . ; and perform a corrective action.” Ex. 1001, 8:59–65. We do not find any basis in the claim language why the “controller” cannot be comprised of two separate components – in this case Coronel’s supervisor and its computer. Nor do we find any reason why the computer cannot have both a first interface and a portion that acts as an APC framework.¹² *See supra* § II.E.2.i (discussing the computer acting as both an interface and an APC).

In addition to this argument, we understand Patent Owner to have incorporated the arguments in made with respect to claim 1 as applying to claim 15. For the reasons discussed with respect to claim 1, we do not find these arguments persuasive. We find that Petitioner has shown, by a

¹² Patent Owner’s makes a similar argument for claim 18. PO Resp. 25–26. We assume this to be a typographical error because the ’402 patent only includes up to claim 17. We understand Patent Owner’s argument for claim 18 to apply to claim 15.

preponderance of the evidence, that the combination of Coronel and Fox teaches each of the elements of claim 15.

4. Dependent claims 6, 11, and 17

Claims 6 ultimately depends from claim 1, and additionally requires that “comparing comprises comparing the state data received to fault model data that is derived from other similar-type wafers, where it was previously known that such wafers were processed within acceptable operational limits.” Ex. 1001, 7:57–61. Claim 11 ultimately depends from claim 8, and recites essentially the same additional limitation as claim 6. *Id.* at 8:40–44. Claim 17 includes a similar, although not identical, limitation. It depends from claim 15 and additionally requires that the “controller is adapted to compare at least a portion of the operational data to model data to determine if a fault condition exists.” *Id.* at 10:1–3.

Petitioner contends that the combination of Coronel and Fox discloses the additional limitations of claims 6, 11, and 17. Pet. 60–61. We agree.

Coronel discloses that a “preliminary but essential step” of its method is to “establish an adequate database.” Ex. 1006, 9:54–55. Coronel’s database is comprised of “data relative to the evolution of selected process parameters during a determined step of the wafer fabrication process when this step takes place normally and . . . in the case of identified deviations.” *Id.* at 9:58–10:5. This data is used by “process engineers” to “define a set of analysis rules that permit to characterize these deviations and establish corresponding rejection criteria.” *Id.* at 10:7–10. The rules are “coded in the form of algorithms that are also stored in the database” and that are

“adapted to subsequently monitor said selected process parameters . . . and detect any identified deviations.” *Id.* at 10:10–14. Thus, Coronel discloses the use of data, derived from a step of the wafer fabrication process that takes place normally, as a reference for comparison to determine whether a fault has occurred.

Similarly, Fox discloses obtaining a “bench mark” of “baseline numbers” by processing a “statistically acceptable number of wafers in order to collect the mean, variance and covariance values for . . . eleven RF components.”¹³ Ex. 1005, 6:12–15; *see also id.* at 6:8–11 (“The ideal Hotelling’s T^2 values for a process are determined by running a number of samples and developing a baseline for that particular process”). “The parameter(s) which are used to measure the test wafers to develop the T^2 values is a design choice.” *Id.* at 6:29–31. “[A]fter all test wafers are run and component values recorded, . . . n sets of values are used to calculate μ_0 for each component.” *Id.* at 6:20–22. “Once the established baseline number of wafers are run, a baseline will exist in which the T^2 value can be calculated for each periodic time interval” and “the UCL and the LCL limits can be established for each time period.” *Id.* at 6:60–65. The baseline numbers are stored in memory and used to “control the ongoing process of a production wafer.” *Id.* at 7:5–7. Thus, like Coronel, Fox discloses the use of data, derived prior wafer fabrications, as a reference for comparison to determine whether a fault has occurred.

¹³ The eleven RF component values are values from an RF sensor monitoring a plasma processing tool. Ex. 1005, 2:35–37, 47–52, 67–3:14.

In view of these teachings, we agree with Dr. Hatalis that combining Coronel and Fox would have led a POSA to “compar[e] the operational state data to predetermined state data that would be derived from other similar-type wafers known to be processed within acceptable operational limits,” and that the POSA would reasonably have expected success in doing so. Ex. 1002 ¶¶ 120–121. We address Patent Owner’s arguments below.

Much of the argument in Patent Owner’s Response focused on MRF, MAF, and TAF files.¹⁴ Patent Owner explained at length how MRFs, MAFs, and TAFs are used in an embodiment of the ’402 patent. PO Resp. 8–11. Patent Owner then argued that Coronel does not disclose “the creation of the MRF, MAF and TAF files that could be construed as state data or their comparison to fault model data.” *Id.* at 12.

We do not find this persuasive. On its face, the language of claims 6, 11, and 17 does not require any particular type of “fault model data,” and Patent Owner has not asked us to construe the term as limited to models that use MRFs, MAFs, and/or TAFs.¹⁵ In addition, Mr. Humphrey confirmed

¹⁴ A model reference file (MRF) “provides the current state of the tool 105 on a near real-time basis for each wafer that is being processed.” Ex. 1001, 3:60–62. A model archive file (MAF) is a compilation of the MRF for each wafer of a completed lot. *Id.* at 3:62–65. A tool alarm file (TAF) is prepared by comparing the MRF of a wafer currently being produced to fault model data, provided that the [MRF] data differs from the fault model data by a predetermined amount. *Id.* at 3:65–4:3.

¹⁵ The ’402 patent states that descriptions of Figure 2 regarding MRF, MAF, and TAF files are made “[i]n accordance with *one embodiment* [in which] the server 205 runs ModelWare®, a commercially available software

that the claims do not require MRFs, MAFs, or TAFs. Ex. 1040, 106:2–107:11. In its Sur-reply, Patent Owner backed away from this argument asserting, “[Patent Owner] has never claimed that the MRFs disclosed in the ’402 Patent are the only type of fault model data, or that other fault models do not fall within the claims of the ’402 Patent,” explaining that “the comparison of MRFs and MAFs to fault model data is exemplary and indicative of how a [POSA] would conceive of fault model data or model data.” Sur-reply 13; *see also* Tr. 24 (Patent Owner’s counsel conceding that model data does not need to be a MRF, MAF, or TAF file). With this clarification in mind, it is clear that the absence of MRFs, MAFs, and/or TAFs does not preclude Coronel from disclosing fault model data.

Patent Owner argues that “Coronel’s singular reference to predictive maintenance (i.e. ‘In turn, the “batch history” of a plurality of batches can be exploited, in particular for statistics purposes, for instance for preventive/predictive maintenance’; see Ex. 1006 at [0038] 2-5)¹⁶ points to statistical control methods, not a model-based approach.” PO Resp. 12. We do not find this argument persuasive. As discussed above, Coronel describes preparing a model for “selected process parameters during a determined step

package that provides fault detection analysis” and makes clear that “other types of fault detection software may also be used in lieu of ModelWare® without departing from the spirit and scope of the present invention.” Ex. 1001 at 3:45-56, *see also id.* at 4:64–5:2, 5:52–58, 6:30–35. This supports that, had Patent Owner sought such a limiting construction, it would not have found support in the specification.

¹⁶ This citation appears to be incorrect. The quoted language appears in paragraph 40 of Coronel. Ex. 1006, 11:2–5.

of the wafer fabrication process.” Ex. 1006, 9:57–10:5. This model is separate from the “batch history” that Patent Owner argues points to a statistical analysis. The “batch history” is the “sum of the ‘wafer history’ of all of the wafers of a batch.” *Id.* at 10:58–11:2. The “wafer history,” in turn, is the “sum of all the step reports for a determined process and a determined wafer.” *Id.* at 10:55–57. And the “step report” is “[a]ll the important data that are representative of the processing for [a particular] step.” *Id.* at 10:52–55. We do not read Coronel’s disclosure that its batch report can be used for statistical purposes to support (*id.* at 11:2–5) to support that Coronel does not create a model derived from normal fabrication processes to detect faults (*id.* at 9:54–10:24).

With respect to Fox, Patent Owner argues: “Fox . . . discloses the application of statistical analysis to a single process parameter,” using Hotelling’s T^2 algorithm to process RF component values. PO Resp. 11. At oral argument, counsel for Patent Owner elaborated on this argument, explaining that Fox’s T^2 value was a “data point” and lacked sufficient granularity to constitute a model. Tr. 22–23. We do not find this persuasive because the language of claims 6, 11, and 17 does not require the model data to have any particular level of complexity. And Patent Owner has not asked us to construe the term “fault model data” or “model data” as requiring a model of any particular complexity. Moreover, we do not see any reason why a baseline T^2 value derived from eleven sensor measurements, as disclosed in Fox (Ex. 1005, 8:18–21), would not constitute a model. To the contrary, we find that Fox teaches a model. *See e.g.*, Ex. 1005, 6:12–28.

Patent Owner also argues that Fox does not disclose fault model data because it “does not mention tool health or machine health, which a [POSA] would have understood as a determination made based on process modelling and the use of fault model data.” PO Resp. 12. We do not find this persuasive because the language of claims 6, 11, and 17 does not require the use of model data include tool health or machine health. And Patent Owner has not asked us to impose such a limiting construction. Moreover, the example of a baseline T^2 value derived from eleven measurements of a plasma etching tool (Ex. 1005, 2:35–37, 47–52, 67–3:14, 8:18–21), as disclosed in Fox, relates to the health of that plasma etching tool.

Patent Owner argues:

Petitioner identifies nothing in either Coronel or Fox that teaches ***comparison to a fault model*** as taught by the '402 Patent. Instead, Petitioner cites to examples of “rules for rejection criteria that are coded into algorithms” in Coronel and “benchmarking” in Fox, together with comparison of process data to those rules or benchmarks, and ***infers*** that these types of monitoring involves the use of models. Petitioner presents no explicit evidence that such models were contemplated in either reference, and presents no expert testimony that would suggest that “fault models” are somehow implicit[l]y present in either disclosure.

Sur-reply 14. We do not find this argument persuasive.

We acknowledge that Coronel and Fox do not use the term “model.” But the law does not require *ipsissimis veris* disclosure. *In re Bond*, 910 F.2d 831, 832–33 (Fed. Cir. 1990). And both Coronel and Fox compare what is happening in real time in a wafer fabrication process to a data derived from prior wafer fabrications to identify faults. In Coronel, the comparison is to “analysis rules” that are “coded in the form of algorithms.”

Ex. 1006, 10:7–11. In Fox, the comparison is to “ideal Hotelling’s T2 values” obtained using a “bench mark” of “baseline numbers.” Ex. 1005, 6:8–15. The data used in the comparisons in Coronel and Fox is similar to what is described and claimed in the ’402 patent. For example, the specification of the ’402 patent states: “The fault model data includes model reference files (MRFs) derived from the tool state data of other similar-type wafers, where it was previously known that such wafers that were processed by the tool within acceptable operational limits.” Ex. 1001, 4:3–8, 7:57–61, 8:40–44. We find that the data used in Coronel’s and Fox’s comparisons is fault model data.

In addition, as discussed above, we credit Dr. Hatalis’s testimony that combining Coronel and Fox would have led the POSA to “compar[e] the operational state data to predetermined state data that would be derived from other similar-type wafers known to be processed within acceptable operational limits.” Ex. 1002 ¶ 120. We find that data derived from wafers known to be processed acceptably and used as a comparator to identify faults meets the claim requirement for “fault model data” and/or “model data.” Patent Owner’s argument that the doctrine of claim differentiation compels a different conclusion (Sur-reply 14) is unpersuasive the doctrine does not support that the claims must be interpreted such data “derived from other similar-type wafers, where it was previously known that such wafers were processed within acceptable operational limits” and used as a comparator is something other than fault model data.

Patent Owner argues that “objective evidence indicates that at least claims 6, 11 and 17 of the ’402 Patent [were] novel and not obvious at the

time of its conception.” PO Resp. 17.¹⁷ Patent Owner argues that at the time of conception the head of Sematech, a “well known-consortium of U.S.-based semiconductor manufacturers,” stated that “[t]he goal of sensor-based process control is to provide real time fault detection and model based operation of process tools” but, at the same time, acknowledged that “[t]his community’s assessment is that *no sensor-based process control capability is fully-compliant with these protocols and standards.*” *Id.* at 16 & n.2 (citing Ex. 2040 ¶¶ 54, 56) (alterations in original). Patent Owner contends that “the ’402 Patent fulfilled [this] vision.” *Id.*

Patent Owner does not specify which objective indicia this evidence supports, complicating our ability to evaluate Patent Owner’s argument. We interpret it as most analogous to long-felt need and we address it as such. To establish a long-felt need, three elements must be proven: First, the need must have been a persistent one that was recognized by ordinarily skilled artisans. *In re Gershon*, 372 F.2d 535, 538 (CCPA 1967). Second, the long-felt need must not have been satisfied by another before Patent Owner’s invention. *See Newell Companies, Inc. v. Kenney Mfg. Co.*, 864 F.2d 757, 768 (Fed. Cir. 1988). Third, the invention must, in fact, satisfy the long-felt need. *In re Cavanagh*, 436 F.2d 491, 496 (CCPA 1971).

We begin by considering whether there was a persistent need recognized in the art. Mr. Humphrey testifies that the claimed methods and

¹⁷ Patent Owner does not argue objective indicia with respect to the other challenged claims. Accordingly, we consider objective indicia only with respect to claims 6, 11, and 17.

systems addressed an “industry-wide expressed need for integrated solutions to semiconductor manufacturing fault detection and model based operation of process tools.” Ex. 2040 ¶ 56. As support, Mr. Humphrey relies on Ex. 2043, an article published in 1998, titled, “Metrology Needs for the Semiconductor Industry Over the Next Decade,” which states: “The goal of sensor-based process control is to provide real time fault detection and model based operation of process tools.” Ex. 2043, 15 (cited at Ex. 2040 ¶ 54). This provides some support for the existence of a need for real time fault detection and model-based operation of semiconductor manufacturing processes at the time of the article, i.e., in 1997.

We next consider whether this need was satisfied by another before Patent Owner’s invention. To established that the need for model-based operations had not been satisfied by another, Patent Owner and Mr. Humphrey rely on the following passage from Ex. 2043:

Presently, the conversion to 300 turn wafer capable tools is driving much of the factory control protocol and standardization activities for Advanced Process Control (APC)/Advanced Equipment Control (AEC). This community’s assessment is that no sensor-based process control capability is fully compliant with these protocols and standards.

Id. at 15. This passage supports that the industry was not yet fully compliant with “factory control protocol and standardization activities for Advanced Process Control (APC)/Advanced Equipment Control (AEC).” *Id.*

However, it is not clear from the record precisely what aspect of the “factor control protocol and standardization activities” the industry has been yet to comply with. Based on the context provided by the article, we infer that the factory control protocol and standardization activities that the industry has

not yet complied with includes model-based operation of process tools. *Id.* However, the record does not enable us to determine whether there are other aspects of the protocol and standardization activities that industry has yet to comply with. This diminishes the weight of Patent Owner's evidence that the long-felt need it identified had yet to be satisfied at the time of the claimed invention.¹⁸

Finally, we consider whether the method, system, and apparatus of claims 6, 11, and 17 satisfy the identified need. Here we credit the un rebutted testimony of Mr. Humphrey that the "innovative methods and systems disclosed in the '402 patent and depicted in Figures 1, 2, 3, 4A and 4B address the industry-wide expressed need for integrated solutions to semiconductor manufacturing fault detection and model based operation of process tools." Ex. 2040 ¶ 56.

Considering all of the evidence and arguments with respect to objective indicia of non-obviousness, we find some support for the existence of a long-felt need for real time fault detection and model-based operation of semiconductor manufacturing processes. However, we give this factor only modest weight.

Considering the totality of the evidence regarding claims 6, 11, and 17, including objective indicia of non-obviousness, we find that Petitioner has established, by a preponderance of the evidence, that claims 6, 11, and 17 would have been obvious over the combination of Coronel and Fox.

¹⁸ To simplify our analysis, we assume that neither Coronel nor Fox addressed the need identified by Patent Owner.

5. Dependent claims 2–5, 7, 9, 12–14, and 16

Petitioner contends that the combination of Coronel and Fox teaches or suggests each element of claims 2–5, 7, 9, 12–14, and 16, and sets forth an element-by-element comparison of the asserted art to the challenged claims. Pet. 57–63. Beyond challenging Petitioner’s showing with respect to claim limitations common to independent claims 1, 8, and 15, Patent Owner does not challenge any aspect of Petitioner’s showing with respect to claims 2–5, 7, 9, 12–14, and 16. PO Resp. 26. Having reviewed the argument and evidence of record, we find that Petitioner has shown by a preponderance of the evidence that claims 2–5, 7, 9, 12–14, and 16 would have been obvious over the combination of Coronel and Fox.

III. PETITIONER’S MOTION TO STRIKE

Petitioner moves to strike seven categories of evidence and argument. Mot. 1–12. We address each category in turn.

A. Alleged new evidence and arguments regarding SECS II

In its Sur-reply, Patent Owner cites to a URL¹⁹ to support its new argument that ASCII is a data type and, by implication, not a communication protocol. Sur-reply 8. Petitioner moves to strike the argument relying on the previously unidentified URL. Mot. 2–4.

For the reasons discussed *supra* § II.E.2.d, we find that the argument that the URL is cited as supporting is a new argument. As also discussed

¹⁹ <https://www.einnosys.com/integrationservices/robot-smif-integration/semi-equipment-communications-standard-2/>

supra § II.E.2.d, even if we were to consider this argument we would not find it persuasive. Petitioner’s motion is thus substantively moot. However, we do not dismiss the argument as moot because we find merit in Petitioner’s argument that Patent Owner did not follow the requirements of 37 C.F.R. § 42.63, which unequivocally states that “[a]ll evidence **must** be filed in the form of an exhibit.” Patent Owner’s failure to follow this procedure is problematic because, as Petitioner points out in its Motion to Exclude, “a URL is subject to change at any given point in time.” Mot. Excl. 3.²⁰ As the content of the URL is transitory, dismissing Petitioner’s motion as moot would leave ambiguity in our record.

In its Opposition to Petitioner’s Motion to Exclude, Patent Owner suggests that the problem that its URL is transitory can be cured if we permit it to file the URL as an exhibit or if we enter it as a Board Exhibit ourselves. *Id.* at 3. But our rules prohibit submission of any new evidence other than deposition transcripts of the cross-examination of any reply witness. *See* 37 C.F.R. § 42.23(b); CTPG at 73-74. We decline Patent Owner’s invitation to use its violation of our rule requiring all evidence to be entered as exhibits (37 C.F.R. § 42.63) as justification for allowing it to circumvent our rule prohibiting the submission of new evidence with sur-replies (37 C.F.R. § 42.23).

²⁰ Given the overlapping subject matter, we find it helpful to consider both parties’ arguments made in connection with the Motion to Exclude together with the arguments in connection with the Motion to Strike.

Accordingly, we grant Petitioner's motion to exclude the URL cited at page 8 of Patent Owner's Sur-reply. We do not strike the argument that the URL is cited as supporting, however, we note that absent citation to the stricken URL, such argument lacks evidentiary support.

B. Alleged new arguments regarding "translation"

Petitioner argues that Patent Owner "never disputed that translation includes conversion from ASCII format to SECS II format, or T² numerical values to SECS II" and did not "question that a POSA would have understood the need for translation when combining the teachings of Coronel with Fox." Mot. 4. We agree. *See* PO Resp. 21–23 (addressing Petitioner's proof on the translation element). However, we have already determined that Patent Owner waived these arguments and that even if we were to consider them, they are not persuasive. *See supra* § II.E.2.d. Accordingly, we dismiss Petitioner's motion to strike these arguments as moot.

C. Alleged undisclosed argument regarding objective indicia

Petitioner argues that Patent Owner's Sur-reply cites to a portion of Exhibit 2043 that was never previously cited or discussed. Mot. 5. In its Reply, Petitioner argued that the portions of Ex. 2043 cited by Patent Owner in the POR related only to 300mm wafer tools. Pet. Reply 20. In its Sur-reply, Patent Owner quoted from a separate portion of Ex. 2043. Sur-reply 16. Patent Owner explains that this quotation was justified to show that "***the rest of the relevant section of the article*** makes it clear that sensor-based process control ***had not yet been implemented across all relevant***

sectors of semiconductor production at the time.” Mot. Opp. 8. We agree with Patent Owner that this citation was reasonably responsive to the argument made by Petitioner in its Reply. Accordingly, we deny Petitioner’s motion to strike this argument.

D. Alleged belated argument addressing district court claim construction orders

Petitioner argues that Patent Owner’s Sur-reply “asserts for the first time that Coronel does not disclose the run-to-run control required in the construction of the term ‘advanced process control framework’ by the Eastern District of Texas. Mot. 7. Patent Owner argues that the claim construction arguments in its Sur-reply are merely responsive to Petitioner’s claim construction. Mot. Opp. 4. We discussed this issue *supra* § II.E.2.h, concluding that Petitioner’s submission of a district court claim construction, as contemplated by the CTPG, did not open the door to Patent Owner’s belated claim construction arguments, including the argument that Coronel does not disclose run-to-run control as purportedly required by the term “advanced process control framework.” Because we did not consider Patent Owner’s belated claim construction argument, or any related factual arguments, there is no need to strike them. Accordingly, we dismiss as moot Petitioner’s motion to strike this argument.

E. Alleged new arguments regarding fault detection by the APC

Petitioner argues that Patent Owner’s argument that an APC framework must include software components for fault detection is a new

argument that was not included in Petitioner's Reply. We agree. *See* PO Resp. 17–20 (addressing the limitation including the “advanced process control” term without making this argument). However, we have already determined that Patent Owner waived these arguments and that even if we were to consider them, they are not persuasive. *See supra* § II.E.2.h. Accordingly, we dismiss Petitioner's motion to strike these arguments as moot.

F. Alleged undisclosed argument regarding superfluous claim construction

For the claim limitation requiring “sending a signal by the framework to the first interface reflective of the predetermined action,” Petitioner points to one portion of Coronel's computer as the “framework” (i.e., the APC), and another portion of Coronel's computer as the “first interface.” Pet. 50. In its Response, Patent Owner points out that Petitioner's position has the computer functioning as both the APC and the first interface and argued that “[i]t is simply illogical that the computer 12 of Coronel would send a signal *to itself* reflective of information that it already possesses.” PO Resp. 21. In its Sur-reply, Patent Owner argued: “Because claims should not be construed so as to render terms superfluous, Petitioner's assertion that sending an ‘alert code *to the computer*’ meets ‘sending a signal by the [APC] framework *to the first interface* reflective of the predetermined action’ is factually and legally incorrect.” Sur-reply 7. Petitioner moves to strike this as a new argument. Mot. 10–11. We deny Petitioner's motion to strike this argument because we agree with Patent Owner that its superfluous argument is

“simply another way of saying the same thing” – i.e., that it would be illogical for the computer to send a signal to itself. Mot. Opp. 11. Thus, we do not consider it a new argument.

G. Alleged undisclosed argument differentiating “fault model data” from “model data”

Petitioner argues that in its Response, Patent Owner treated the terms “fault model data” recited in claims 6 and 11 and the term “model data” recited in claim 17 as equivalent. Mot. 11. We agree that Patent Owner treated these terms as equivalent. *See* PO Resp. 7–17. Petitioner then argues that Patent Owner makes a new argument attempting to differentiate “model data” from “fault model data.” Mot. 12. We do not agree because we do not understand Patent Owner to be arguing that “fault model data” and “model data” are different for purposes of this proceeding. Sur-reply 14–15. Rather, we understand Patent Owner to argue that the terms “fault model data” and “model data” (as recited in claims 6, 11, and 17) are different from “predetermined state data” (as recited in claims 5 and 10). Thus, we do not consider Patent Owner’s Sur-reply arguments to reflect a change in position. Accordingly, we deny Petitioner’s motion to strike these arguments.

IV. PETITIONER’S MOTION TO EXCLUDE

In its Sur-reply, Patent Owner cites to a URL²¹ to support its new argument that ASCII is a data type and, by implication, not a communication protocol. Sur-reply 8. Petitioner filed a Motion to Exclude, arguing that the URL should be excluded because “the Board’s Rules, the CTPG, and Board precedent . . . prohibit submission of any new evidence other than deposition transcripts of the cross-examination of any reply witness.” Mot. Excl. 1. We discussed this issue *supra* § III.A in connection with Patent Owner’s Motion to Strike and struck the offending URL. Because the URL has already been stricken, we dismiss Petitioner’s Motion to Exclude as moot.

V. CONCLUSION²²

For the reasons discussed above, we find that Petitioner’s has established, by a preponderance of the evidence, that claims 1–17 of the ’402 patent would have been obvious over the combination of Coronel and Fox. We dismiss-in-part as moot, grant-in-part, and deny-in-part,

²¹ <https://www.einnosys.com/integrationservices/robot-smif-integration/semi-equipment-communications-standard-2/>

²² 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).

Petitioner's Motion to Strike. We dismiss Petitioner's Motion to Exclude as moot.

In Summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–17	103(a)	Coronel, Fox	1–17	

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petitioner has proved by a preponderance of the evidence that claims 1–17 of U.S. Patent No. 6,725,402 B1 are unpatentable;

FURTHER ORDERED that Petitioner's motion to strike is granted in part, denied in part and dismissed in part as moot;

FURTHER ORDERED that Petitioner's Motion to Exclude is dismissed as moot; and

FURTHER ORDERED that 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.

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