

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION

Petitioner,

v.

TELEFONAKTIEBOLAGET LM ERICSSON,

Patent Owner.

Case No. IPR2024-01009

U.S. Patent 10,142,659

PATENT OWNER'S PRELIMINARY RESPONSE

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LIST OF EXHIBITS

Exhibit No.	Description
Ex-2001	Declaration of Dr. Iain Richardson
Ex-2002	CV of Dr. Iain Richardson
Ex-2003	ITU Webpage showing ITU-T Rec. H.261, first published in 1988, https://www.itu.int/rec/T-REC-H.261-198811-S/en
Ex-2004	PDF Print of FiltScript2.m
Ex-2005	PDF Print of TestFilt2.m
Ex-2006	PDF Print of FiltBlocksAltThr_2a.txt
Ex-2007	PDF Print of FiltBlocksAltThr_2b.txt
Ex-2008	PDF Print of FiltBlocksThr1Thr2_2a.txt
Ex-2009	PDF Print of FiltBlocksThr1Thr2_2a.txt
Ex-2010	PDF Print of FiltStatsAltThr_2a.txt
Ex-2011	PDF Print of FiltStatsAltThr_2b.txt
Ex-2012	PDF Print of FiltStatsThr1Thr2_2a.txt
Ex-2013	PDF Print of FiltStatsThr1Thr2_2b.txt
Ex-2014	PDF Print of TestUInt8.c
Ex-2015	PCT/FI01/00049 (“Aksu”)
Ex-2016	Sullivan et al., <i>HEVC: Algorithms and Architectures</i> (2014)

LISTING OF CLAIMS

Reference	Claim Limitation
Claim 1	
1[pre]	A method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, said method comprises:
1[a]	calculating a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4,$ wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels;
1[b]	modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels; and
1[c]	modifying said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.
Claim 2	
2[a]	The method according to claim 1, further comprising clipping said first offset to be within an interval of $-t_c$ and t_c by setting said first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting said first offset to be equal to t_c if said first offset is larger than t_c .

Reference	Claim Limitation
2[b]	wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.
Claim 3	
3[a]	The method according to claim 1, further comprising: clipping said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value; and
3[b]	clipping said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.
Claim 4	
4[a]	The method according to claim 1, further comprising: calculating a second offset to be based on $(p2+p0-2 \times p1+2 \times \Delta)/4$, wherein $p2$ denotes a pixel value of a pixel second next closest to said block boundary in said line of pixels and Δ denotes said first offset;
4[b]	calculating a third offset to be based on $(q2+q0-2 \times q1-2 \times \Delta)/4$, wherein $q2$ denotes a pixel value of a pixel second next closest to said block boundary in said corresponding line of pixels;

Reference	Claim Limitation
4[c]	modifying said pixel value p1 of said pixel next closest to said block boundary in said line of pixels by adding said second offset to said pixel value p1 of said pixel next closest to said block boundary in said line of pixels to form a modified pixel value p1' of said pixel next closest to said block boundary in said line of pixels; and
4[d]	modifying said pixel value q1 of said pixel next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value q1 of said pixel next closest to said block boundary in said corresponding line of pixels to form a modified pixel value q1' of said pixel next closest to said block boundary in said corresponding line of pixels.
Claim 5	
5[a]	The method according to claim 4, wherein calculating said second offset comprises calculating said second offset to be equal to $((p2+p0+1)>>1)-p1+\Delta>>1$, wherein $>>$ denotes a right shift operation; and
5[b]	calculating said third offset comprises calculating said third offset to be equal to $((q2+q0+1)>>1)-q1-\Delta>>1$
Claim 6	
6[a]	The method according to claim 4, further comprising: clipping said second offset to be within an interval of $-t_{c2}$ and t_{c2} by setting said second offset to be equal to $-t_{c2}$ if said second offset is smaller than $-t_{c2}$ and by setting said second offset to be equal to t_{c2} if said second offset is larger than t_{c2} ,
6[b]	wherein $-t_{c2}$ is a threshold value that is dependent on a quantization parameter value assigned to said block; and
6[c]	clipping said third offset within an interval of $-t_{c2}$ and t_{c2} by setting said third offset to be equal to $-t_{c2}$ if said third offset is smaller than $-t_{c2}$ and by setting said third offset to be equal to t_{c2} if said third offset is larger than t_{c2} .
Claim 7	
7[a]	The method according to claim 4, further comprising: clipping said modified pixel value p1' of said pixel next closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p1' of said pixel next closest to said block boundary in said line of pixels to be equal to zero if said

Reference	Claim Limitation
	modified pixel value $p1'$ of said pixel next closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p1'$ of said pixel next closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p1'$ of said pixel next closest to said block boundary in said line of pixels is larger than said defined maximum value; and
7[b]	clipping said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.
Claim 10	
10[pre]	A user equipment comprising a deblocking filter unit for reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, wherein the deblocking filter unit comprises:
10[a]	a first offset calculator configured to calculate a first offset to be equal to $(9 \times (q0 - p0) - 3 \times q1 - p1) + 8 \gg 4$, wherein $\gg$ denotes a right shift operation, $p0$ denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, $p1$ denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, $q0$ denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary, and $q1$

Reference	Claim Limitation
	denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels; and
10[b]	a pixel value modifier configured to modify said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels
10[c]	and to modify said pixel value q_0 of said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.
Claim 11	
11[a]	The user equipment according to claim 10, wherein the deblocking filter unit further comprises a first clipping unit configured to clip said first offset within an interval of $-t_c$ and t_c by setting a first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting a first offset to be equal to t_c if said first offset is larger than t_c ,
11[b]	wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.
Claim 12	
12[a]	The user equipment according to claim 10, wherein the deblocking filter unit further comprises a second clipping unit configured to clip said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value of p_0' of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value and

Reference	Claim Limitation
12[b]	to clip said modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

I. INTRODUCTION

Intel Corporation (“Petitioner” or “Intel”) filed a petition for *inter partes* review of claims 1-7 and 10-12 of U.S. Patent No. 10,142,659 (the “’659 Patent”) (collectively, the “Challenged Claims”), which is owned by Telefonaktiebolaget LM Ericsson (“Patent Owner” or “Ericsson”). The ’659 Patent is directed to an improved deblocking filter that achieves an improved frequency response such that the filter design does not modify pixel values over a block boundary if the pixel values form a ramp in local structure, but smooths pixel values with other artifacts in the images, such as steps, in a specific way.

The Petition does not identify a single reference or combination of references that discloses the deblocking filter of the ’659 Patent. Instead, the Petition argues that a POSITA could have derived the ’659 Patent’s deblocking filter because there had been a number of previous attempts to design allegedly similar filters. These numerous attempts to design a deblocking filter, however, show that there are many design choices, each with its own benefits and disadvantages, that a POSITA would consider in designing a deblocking filter. And despite decades of research, no one had thought of the novel filter claimed in the ’659 Patent. The Petition fails to disclose a specific motivation to alter the prior art deblocking filters to use the specific offsets of the ’659 Patent, and thus, as will be described in more detail below, Petitioner has failed to meet its burden to show a reasonable likelihood of

unpatentability of any of the challenged claims. *See* 37 C.F.R. § 42.108(c). Accordingly, Patent Owner requests that the Board deny institution of *inter partes* review.

II. BACKGROUND

A. Goal of Deblocking Filters

Video coding is the process of compressing (encoding) video prior to transmission or storage and decompressing (decoding) compressed video so that it can be displayed. Ex-2001, ¶44. Video coding is important because uncompressed video takes up a significant amount of storage space and would require an impractical amount of bandwidth to transmit in real time. *Id.*, ¶46. Modern video codecs utilizing coding schemes are all block-based. Block-based coding can create discontinuities referred to as blocking artifacts at block boundaries, causing the resulting images to appear “blocky.” *Id.*, ¶¶59, 64.

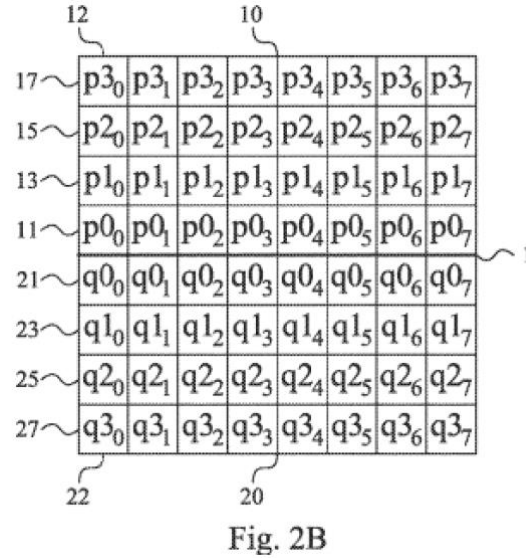
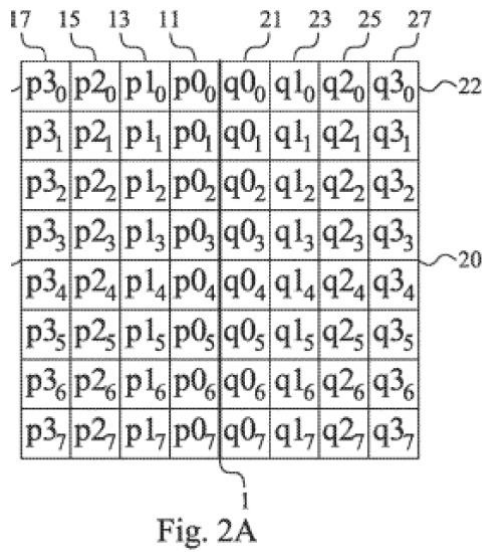
A deblocking filter is applied to an image to address blocking artifacts created by the coding process. A design goal of these deblocking filters is to remove blocking artifacts created by the coding process while leaving natural edges or other natural features of the picture intact. *Id.*, ¶¶65-67. The challenge with deblocking filters is that they are recognized to be particularly computationally intensive. *Id.*, ¶68. For example, the List Reference, cited in the ’659 Patent, acknowledges that

the H.264 loop filter, which includes the deblocking filter, “can easily account for one-third of the computational complexity of a decoder.” Ex-1024 at 614.

Given the complexity, video coding experts have not agreed on a uniform approach to deblocking filter design. *Id.*, ¶69. As will be described in more detail below, the history of deblocking filter design shows that even minor changes to filter design can have a material effect on performance and the visual appearance of an image, and, as a result, there has been a continuous effort to change and improve on existing deblocking filters.

B. Naming Conventions for Pixels in the '659 Patent

The following outlines the naming conventions used to identify pixels and pixel blocks in the '659 Patent, which is necessary to understand the scope of the claims and the invention. Specifically, Figures 2A and 2B, which show a vertical block boundary (Fig. 2A) and a horizontal block boundary (Fig. 2B), show the naming convention for pixels within each block on a given side of the block boundary, with one side referenced as the “p” block and the other side of the boundary referenced as the “q” block.



Ex-1001, Figs. 2A, 2B; Ex-2001, ¶72.

Each pixel is given (i) a letter (*i.e.* “p” or “q”) based on which side of the boundary the pixel is on, (ii) a number referencing how many pixels are between a given pixel and the block boundary, and (iii) another subscript number referencing which row or column the pixel is in (based on whether the boundary is vertical or horizontal). For example, a pixel denoted by p0₂ in Figure 2A for a vertical boundary would reference the pixel within the left (“p” block), in the column 0 closest to the block boundary, and in the second row from the top. Ex-2001, ¶72.

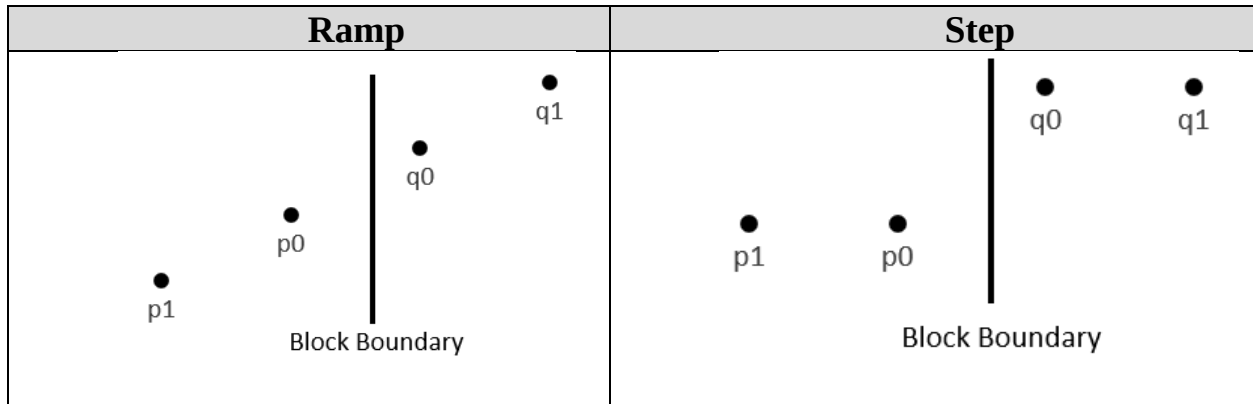
C. Problems with Prior Art Filters Identified in the ’659 Patent

The inventors of the ’659 Patent were involved in the development of the H.265 Standard (also referred to as the High Efficiency Video Codec or HEVC Standard) and developed their novel deblocking filter based on problems that they identified in prominent deblocking filters. Ex-2001, ¶74. The ’659 Patent explains

how the inventors identified problems with the H.264 Standard and the draft of the HEVC Standard that was being developed (referred to as “B205” by Petitioner). For example, the ’659 Patent explains that the weak deblocking filter in B205 does not have “good low-pass characteristics,” “cannot remove high frequencies that can appear near the block border and cannot remove ringing,” and “does not adapt well to the local structure of the side of the block boundary.” Ex-1001, 3:18-33.

D. Novel Deblocking Filter of the ’659 Patent

The inventors of the ’659 Patent solved these problems in the prior art through a more complex, but more adaptable, deblocking filter that also improved compression efficiency. Specifically, the deblocking filter of the ’659 Patent does not “modify the pixel values over a block boundary if these pixel values form a ramp but smooth the pixel values if they instead are in the form of a step. This implies that the deblocking filter will have good lowpass characteristics and can remove high frequencies that can appear near the block boundary.” Ex-1001, 8:57-63. As illustrated below, a ramp is a series of linearly increasing or decreasing pixels. Ex-1001, 13:21-24. A step occurs when there is a sudden or instantaneous change from one constant value to another in the values of adjacent pixels (i.e. a step increase or decrease). Ex-1001. 13:26-27.



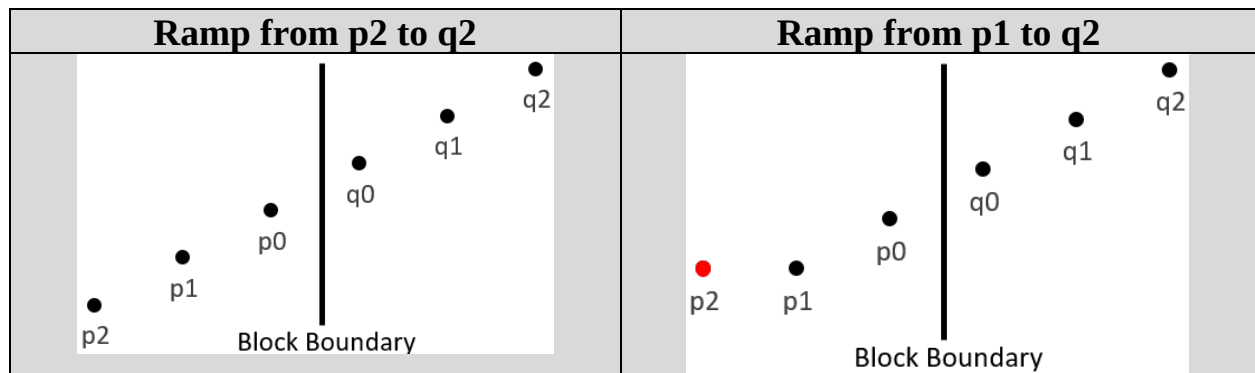
Ex-2001, ¶79. The deblocking filter of the 659 Patent is designed such that “[w]hen applied to a ramp signal, the deblocking filter will not modify it,” but “when applied to a step signal, i.e. a deblocking artifact, the deblocking filter will smooth it, i.e. reduce the blocking artifact. . . . [T]he proposed deblocking filter will smooth and thereby attenuate small ripples on the sides of the block boundary.” Ex-1001, 13:61-14:3; *see also id.*, 17:15-45; Ex-2001, ¶80.

The ’659 Patent’s First Offset modifies pixels p0 and q0. To achieve this design, the ’659 Patent’s describes utilizing a first offset based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$. Ex-1001, 3:47-48, 12:18-28; Ex-2001, ¶¶75-76, 78, 94. The ’659 Patent explains that, when this offset is calculated in hardware, the offset is preferably equal to $(9x(q_0 - p_0) - 3x(q_1 - p_1) + 8) \gg 4$.¹ Ex-1001, 3:65-67, 12:51-69; Ex-2001, ¶¶76-77, 94. Once this improved first offset value is determined, the

¹ The ’659 Patent describes that $(X+8) \gg 4$ is used as an integer-expression of $X/16$.

deblocking filter will modify the pixel values of the pixels closest to the block boundary (p0 and q0) using the first offset. Ex-1001, 3:55-63; Ex-2001, ¶75. In modifying the pixel values, the deblocking filter will physically alter the pixels of a video frame making the block boundary less noticeable. *Id.*

It is important to the design of the '659 Patent that the pixels p0 and q0 be modified based on the structure of p1, p0, q1 and q0. Ex-2001, ¶94. In other words, the '659 Patent's first offset does not take into account any pixels outside of that window. *Id.* For example, the following structures illustrate two ramps:



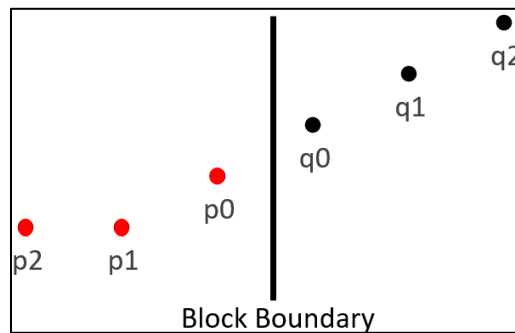
Id. The figure on the left includes a ramp that extends from pixel p2 through q2, but the ramp on the figure on the right only extends from pixels p1 through q1. The ramp in the figure on the right is more limited because the transition from pixel p2 and p1 does not form a ramp. Despite the difference between the figures, the offset for p0 and q0 will be 0 in both examples because the first offset of the '659 Patent ignores the pixel p2. *Id.*, ¶95.

The 659 Patent's Second and Third Offset provide localized modification of pixels p1 and q1. The '659 Patent also provides that pixels p1 and q1 can be modified by the deblocking filter. The '659 Patent explains that B205 “show[s] slight amplifications of higher frequencies when filtering the second pixel ($p1_i$ and $q1_i$) from the block boundary, which can result in worse rate-distortion (RD) performance of the coder.” Ex-1001 at 3:24-33; Ex-2001, ¶96. The '659 Patent also criticizes B205 for not allowing offsets of different magnitudes for different sides of the block boundary. *Id.* Ex-1001 at 3:24-33.

The '659 Patent is thus directed to “the filters for the coefficients that stand at the second position from the block boundary (p1, q1) are produced by using a combination of the first offset and a symmetrical low-pass filter.” Ex-2001, ¶97. An advantage of this embodiment is that the offsets for the pixels second next closest to the block boundary can have different values that allows for a better local adaptation.” Ex-1001, 14:4-10. Specifically, the '659 Patent discloses that the pixel p1 should be modified by a second offset calculated based on $(p2+p0-2\times p1+2\times\Delta)/4$, and the pixel q1 should be modified by a third offset calculated based on $(q2+q0-2\times q1-2\times\Delta)/4$. *See, e.g.*, Ex-1001, 14:38-47. Because different pixels are used for each offset, the two offsets can take into account the local structures on each side of the block boundary. Ex-1001, 8:5-7, 14:4-10 (“An advantage of this embodiment is that the offsets for the pixels second next closest to the block

boundary can have different values that allows for a better local adaptation.”). Notably, however, although the pixels used are different for each offset, the second and third offsets are designed such that they will always be 0 when a ramp is present. Ex-2001, ¶95,

The following figure shows how the second and third offsets can be different when the localized structures on each side of the block boundary are not the same.



Ex-2001, ¶97. As shown above, the second offset, which is based on the p-pixels highlighted in red, will be non-zero (i.e. a positive value) because the local structure is not a ramp. *Id.*, ¶98. The third offset, however, will be zero because the localized structure on the right side of the block boundary is still a ramp. *Id.* Thus, the '659 Patent provides for a specific deblocking filter that accounts for localized structures on each of the block, does not filter ramps within the localized structure, but smooths steps. *Id.*

E. Petitioner's Asserted Prior Art References

As described above, a deblocking filter is one of the most complex components of a decoder. As result, deblocking filters have been the subject of

research for at least 20 years prior to the '659 Patent. Ex-2001, ¶169. Petitioner attempts to use that work to argue that any deblocking filter is necessarily obvious, but the evidence, including the prior art cited by Petitioner, shows that the industry could not agree on a uniform approach for how to design a deblocking filter, and the industry was constantly researching deblocking filter designs that would better balance the need to eliminate blocking artifacts from images while reducing complexity. *Id.* For example, as shown below, the various deblocking filters use different offset equations that use different pixels in different combinations to achieve fundamentally different designs.

The following addresses each of the references cited by Petitioner, but the references are organized into the (i) the references related to development of the H.264 Standard, (ii) proposed changes to the H.264 Standard, and (iii) prior art deblocking filters that use fundamentally different designs that were not considered by Petitioner. The date that each reference was published is also noted.

1. H.264 Technical Submissions That Were Rejected

The Bjontegaard, Bjontegaard's Code, B118, and VCEG-M21 references are technical submissions that were submitted to the standards body developing the H.264 Standard. Ex-2001, ¶¶150, 162, 176, 185. Notably, the deblocking filter in each of these references was rejected as H.264 adopted a fundamentally different

deblocking filter. Ex-2001, ¶205. That filter is described in the List reference that is identified by Petitioner, which is addressed below.

a. May 2000 - Bjontegaard (Ex-1009) & Bjontegaard's Code (Exs-1010-1015)

Bjontegaard is H.26L Submission Document Q15-J-28 titled “Definition of the new coding elements form Telenor,” ITU-T-Q.15/SG16 dated May 16-18, 2000. Ex-1009. Bjontegaard describes the coding model proposed by Telenor in May 2000 for VCEG’s Tenth Meeting in Osaka, Japan. The filtering in Bjontegaard is fundamentally different from the ’659 Patent. *Id.* Specifically, contrary to the purpose of the deblocking filter in the ’659 Patent, Bjontegaard’s filters are not designed to avoid filtering ramps and to smooth step functions. Ex-2001, ¶267.

Bjontegaard calculates metrics it refers to as “Strength” and “Activity” metrics to determine what offset to apply to each pixel. Ex-1009 at 19. The following is a list of potential offsets (referred to as Diff) that Bjontegaard discloses could be applied to pixels P0, Q0, P1, and Q1:²

Pixel	Bjontegaard’s Potential Offset Calculations
P0	1. Diff=0 2. $\text{Diff} = (3(c - f) - 8(d - e))/16$ 3. $\text{Diff} = (b + c - 8(d - e) - f - g)/16$

² Pixels P0, Q0, P1, P2 correspond to pixels c, d, e, and f, respectively in Bjontegaard.

Q0	1. Diff=0 2. $\text{Diff} = (3(c - f) - 8(d - e))/16$ 3. $\text{Diff} = (b + c - 8(d - e) - f - g)/16$
P1	1. Diff=0 2. $\text{Diff}^3 = 5(b - 2c + d)/16$ or $5(b - 2c + d_{\text{modified}})/16$ 3. $\text{Diff}^4 = 3(a + b - 4c + d + e)/16$ or $3(a + b - 4c + d_{\text{modified}} + e_{\text{modified}})/16$
Q1	1. Diff = 0 2. $\text{Diff}^5 = 5(e - 2f + g)/16$ or $5(e_{\text{modified}} - 2f + g)/16$ 3. $\text{Diff}^6 = 3(d + e - 4f + g + h)/16$ or $3(d_{\text{modified}} + e_{\text{modified}} - 4f + g + h)/16$

Ex-2001, ¶¶155-160; Ex-1009 at 20. Petitioner alleges that the claimed first offset used to modify p0 and q0 is rendered obvious by $\text{Diff} = (3(c - f) - 8(d - e))/16$. However, as Dr. Schonfeld demonstrates, the Bjontegaard offset is fundamentally

³ While Bjontegaard does not disclose that d_{modified} is used instead of d, Petitioner alleges that such a modification would have been obvious to a POSITA and for purposes of the analysis herein, Petitioner's modified Diff equation is listed.

⁴ While Bjontegaard does not disclose that d_{modified} or e_{modified} is used instead of d or e, Petitioner alleges that such a modification would have been obvious to a POSITA and for purposes of the analysis herein, Petitioner's modified Diff equation is listed.

⁵ See *supra*, n.4.

⁶ See *supra*, n.4.

different than the first offset of the '659 Patent because it is designed to filter ramps while the '659 first offset is specifically designed not to do so. Ex-2001, ¶267. Further, Bjontegaard does not perform the same smoothing as the '659 Patent for other structures, such as Step and Line. The following table illustrates the differences between the first offsets and specifically highlights where Dr. Schonfeld admits that Bjontegaard is designed to filter a ramp structure.

p2	p1	p0	q0	q1	Type	'659 Patent	Bjontegaard
						$\frac{9(q0 - p0) - 3(q0 - p0)}{16}$	$\frac{8(q0 - p0) - 3(q0 - p0)}{16}$
200	150	150	150	150	Step (p1)	0	0
200	200	150	150	150	Step (p0)	9	9
200	200	200	150	150	Step (q0)	-19	-16
150	160	170	180	190	Ramp (10)	0	-1
125	150	175	200	225	Ramp (25)	0	-2
200	250	200	250	200	Alternating	38	34
255	50	50	255	255	Line	77	64
255	255	50	50	255	Line	0	0
175	200	150	150	175	Random	5	5
50	125	100	150	125	Random	28	25
75	100	150	75	125	Random	-47	-42

Ex-1003, ¶489 (annotated); Ex-2001, ¶¶267-268.

As will be described below, these differences are not inconsequential. Specifically, Dr. Richardson's testing shows that the two offsets were different in nearly 40% of his tests, which is significant and unaddressed by the Petition. Ex-2001, ¶145.

b. March 2002 - B118 (Ex-1023)

The B118 reference is the Working Draft Number 2 (WD-2) released by the Joint Video Team (JVT) that described the draft standard developed for H.26L, which eventually became H.264. Ex-1023 at 1; Ex-2001, ¶176. B118 was generated on March 15, 2002 as part of the working draft H.26L Standard (which later became the H.264 Standard) in 2002.

B118 discloses a deblocking filter that determines the boundary strength for the block boundary between two neighboring blocks wherein filtering is based on boundary strength, and is either filtering for the default case or stronger filtering for intra coded blocks. Ex-1023 at 47-48; Ex-2001 ¶178. In the default case, the following is a list of potential offsets that B118 discloses could be applied to pixels P0, Q0, P1, and Q1:⁷⁸

Pixel	B118's Offset Calculations
P0	$\Delta = ((q1 - p1) < 2 + (p2 - q2) + 4) > 3$

⁷ Pixels P0, Q0, P1, P2 correspond to pixels p1, q1, p2, and q2 in B118.

⁸ This table does not include clipping operations.

Q0	$\Delta = ((q1 - p1) \ll 2 + (p2 - q2) + 4) \gg 3$
P1	$(p3 + p1 + \Delta - p2 \ll 1) \gg 1$
Q1	$(q3 + q1 - \Delta - q2 \ll 1) \gg 1$

Ex-1023 at 48; Ex-2001 ¶¶179-182. In some cases, the deblocking filter in B118 performs stronger filtering instead of default filtering, which uses different offsets applied to P0, P1, Q0, and Q1. Ex-2001, ¶183.

c. March 2001 - VCEG-M21

VCEG-M21 is a technical proposal to Study Group 16 of the Video Coding Expert Group that was working on the development of H.264. Ex-1069 at 1. Even though VCEG-M21 is not an asserted reference, Petitioner relies on VCEG-M21's disclosure of an alleged first offset given by $8(q0 - p0) - 2.5(q1 - p1)/16$ in its obviousness analysis related to the first offset. Petition at 15. Not only is VCEG-M21's offset different than the '659 Patent's first offset, but the second coefficient being 2.5 significantly undermines Petitioner's argument that a POSITA would have necessarily used integer coefficients. Petition at 28; Ex-1003, ¶280; Ex-2001, ¶184.

2. July 2003 - H.264 Standard as described in List (Ex-1024)

List is an article titled *Adaptive Deblocking Filter*, published by the Institute of Electrical and Electronics Engineers ("IEEE") in July 2003. Ex-1024, 614. Importantly, List is explicitly cited on the face of the '659 Patent as describing the

context of H.264 deblocking, which the '659 Patent explicitly improves upon. Ex-1001, 2:14-16.

List discloses a filtering for luma pixels where the following offsets could be applied to P0, P1, Q0, and Q1:

Pixel	List/H.264's Offset Calculations
P0	$\Delta = (4(q_0 - p_0) + (p_1 - q_1) + 4) \gg 3$
Q0	$\Delta = (4(q_0 - p_0) + (p_1 - q_1) + 4) \gg 3$
P1	$\Delta p = (p_2 + ((p_0 + q_0 + 1) \gg 1) - 2p_1) \gg 1$
Q1	$\Delta q = (q_2 + ((p_0 + q_0 + 1) \gg 1) - 2q_1) \gg 1$

Ex-2001, ¶¶148-149; Ex-1024, 615. The offsets disclosed in List or H.264 do not avoid filtering ramps and do not smooth other structures in the same way that is achieved by the '659 Patent. *Id.*

3. *Proposed Changes to H.264*

The following references disclose proposed changes to the H.264 Standard. It is undisputed that none of these references calculates the same offsets as the '659 Patent.

a. **Oct. 2005 - Bjontegaard '048 (Ex-1025)**

U.S. Patent Application Publication US2006/0078048 ("Bjontegaard '048") was filed October 13, 2005. Ex-1025 at Face. Bjontegaard '048 explicitly states that

it seeks to improve the prior art method for removing blocking noise described in H.264. Ex-1025, ¶[0022]. While Petitioner does not assert Bjontegaard '048 as a reference against the '659 Patent, Petitioner relies on Bjontegaard '048 for an example of a first offset that can be written as $(8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2))/16$. See Ex-1003, ¶272.

However, this disclosure undermines Petitioner and Dr. Schonfeld's assertion that the claimed first offset would have been obvious because Bjontegaard '048 discloses a fundamentally different offset design that uses six pixels instead of four pixels, which teach away from the claimed first offset, which only uses two pixels. Ex-2001, ¶186.

b. Aug. 2008 - Fu (Ex-1022)

Fu was filed on August 21, 2008, which is before the work on the HEVC Standard began and prior to the B205. Ex-1022 at Face. The Petition provides no explanation why a POSITA would have selected Fu as the state of the art over B205 given the significant industry involvement in continually and incrementally improving the then-current draft available for further development. Ex-2001, ¶193.

Fu does disclose a process for modifying pixels at a block boundary, but Fu is focused on identifying and filtering fundamentally different structures from the '659 Patent. Ex-2001, ¶194. Specifically, while the '659 Patent's deblocking filter is designed not to filter ramp and then smooth local step structures, Fu is focused

solely on “region flatness” for determining when and how to filter pixels. Ex-1022, 4:3-20; Ex-2001, ¶194. For example, Fu describes measuring region flatness by calculating the number of “similarity pairs around the block boundary.” Ex-1022, 2:1-9. If there are “many similarity pairs,” then Fu describes that the flatness is considered “relatively great.” *Id.*

Fu describes that the region flatness is used to calculate a filtering strength (identified as “BS”), which will then determine what samples are filtered and what offsets are applied to those samples. Ex-1022, 2:1-10:11. The following is a list of potential offsets that Fu discloses could be applied to pixels P0, Q0, P1, and Q1 depending on which of Fu’s filtering “Process[es]” are applied:⁹

Pixel	Fu’s Potential Offset Calculation
P0	Process 1 & Process 2: $(2 \times p1 + p2 + 2 \times (p0 + q0) + q1 + 4) \gg 3$ or $(2 \times p0 + p1 + q0 + 2) \gg 2$ Process 3: $delta = ((q0 - p0) \times 3 + (p1 - q1) + 4) \gg 3$
Q0	Process 1 & Process 2: $(2 \times q1 + q2 + 2 \times (q0 + p0) + p1 + 4) \gg 3$ or $(2 \times q0 + q1 + p0 + 2) \gg 2$ Process 3: $delta = ((q0 - p0) \times 3 + (p1 - q1) + 4) \gg 3$
P1	Process 1 & Process 2: $(p0 + 2 \times p1 + q0 + 2) \gg 2$ or $p1$

⁹ This table does not include any clipping operations.

	Process 3: $(P_0 - p_1) \times 3 + (p_2 - (q_0 - \text{delta})) + 4 \gg 3$
Q1	Process 1 & Process 2: $(q_0 + 2 \times q_1 + p_0 + 2) \gg 2$ or q_1 Process 3: $(q_1 - Q_0) \times 3 + ((p_0 + \text{delta}) - q) + 4 \gg 3$

Ex-1022, 5:1-6; 7:20-25; 8:12-25; Ex-2001, ¶¶194-196.

Notably, without explaining the basis for doing so, Dr. Schonfeld’s analysis “assumes that BS=1,” and analyzes the Challenged Claims in view of Fu’s Process 3. However, Fu discloses another weak filter for luma deblocking when the region flatness indicates that BS=3 in Process 1. Ex-2001, ¶¶194-195. Under those conditions, the filter applied to P0, for example, would be $(2 \times p_0 + p_1 + q_0 + 2) \gg 2$ instead of the delta value that Dr. Schonfeld identifies arbitrarily. *Id.* This change would substantially change the filtering results generated by Fu’s design, and Dr. Schonfeld does not consider or address this. Ex-1022, 5:1-14; Ex-2001, ¶196.

c. July 2010 - B205 (Ex-1018)

The ITU-T’s and ISO/IEC’s Joint Collaborative Team on Video Coding (JCT-VC) published B205, titled “Test Model Under Consideration,” is a draft of its High-Efficiency Video Coding (HEVC) Standard. Ex-1018 at 1. B205 is mentioned in the Background of the ’659 Patent as a draft of the HEVC standard with several problems. Ex-1001, 2:18-3:36. Specifically, the ’659 Patent states that a problem in the deblocking filter disclosed in B205 is that “the weak filter does not have good

low-pass characteristics” and has a frequency response that can cause worse rate-distortion performance in the coder Ex-1001, 3:18-33. The filter disclosed in the ’659 Patent expressly improves upon B205 to address these shortcomings. Ex-2001, ¶197

Notably, the Δ values in B205 shown below is calculated using the absolute difference of six pixels, p_0 , p_1 , p_2 , q_0 , q_1 , and q_2 , and fundamentally different filtering coefficients 13, 4, and 5 than the offsets disclosed in the ’659 Patent. Ex-1018 at 134; Ex-2001 ¶202. The following is a list of potential offsets that B118 discloses could be applied to pixels P_0 , Q_0 , P_1 , and Q_1 :¹⁰

Pixel	B-205’s Offset Calculations
P0	$\Delta = (13 * (q_0 - p_0) + 4 * (q_1 - p_1) - 5 * (q_2 - p_2) + 16) \gg 5$
Q0	$\Delta = (13 * (q_0 - p_0) + 4 * (q_1 - p_1) - 5 * (q_2 - p_2) + 16) \gg 5$
P1	$((13 * (q_0 - p_0) + 4 * (q_1 - p_1) - 5 * (q_2 - p_2) + 16) \gg 5) / 2$
Q1	$((13 * (q_0 - p_0) + 4 * (q_1 - p_1) - 5 * (q_2 - p_2) + 16) \gg 5) / 2$

Weak filtering

Weak filtering mode filtering is performed based on the above conditions,

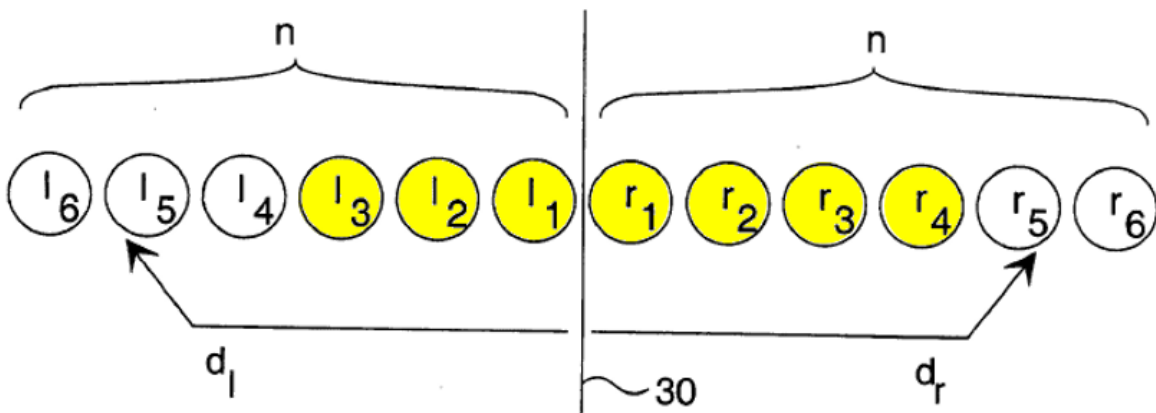
$$\begin{aligned}
 \Delta &= \text{Clip}(-tc, tc, (13 * (q_{0i} - p_{0i}) + 4 * (q_{1i} - p_{1i}) - 5 * (q_{2i} - p_{2i}) + 16) \gg 5)) & i = 0, 7 \\
 p_{0i} &= \text{Clip}_{0-255}(p_{0i} + \Delta) & i = 0, 7 \\
 q_{0i} &= \text{Clip}_{0-255}(q_{0i} - \Delta) & i = 0, 7 \\
 p_{1i} &= \text{Clip}_{0-255}(p_{1i} + \Delta / 2) & i = 0, 7 \\
 q_{1i} &= \text{Clip}_{0-255}(q_{1i} - \Delta / 2) & i = 0, 7
 \end{aligned}$$

¹⁰ This table does not include clipping operations.

Ex-1018 at 131; Ex-2001, ¶202.

F. Prior Art Examples Missing From the Petition

In a related IPR proceeding challenging the claims of U.S. Patent No. 9,641,841 filed by Petitioner, PCT/FI01/00049 (“Aksu”) (Ex-2015) is asserted as a primary reference. Aksu was submitted during the time of the development of H.264 and demonstrates further differences in offsets for deblocking filters proposed by those skilled in the art over the course of the years-long development of deblocking filters. Ex-2001, ¶188. Aksu discloses an averaging filter that is based on a sliding filtering window. *Id.*, ¶¶187, 189-192. The pixels in the filtering window of Aksu include zero to seven possible pixels, centering on the pixel to be filtered. *Id.* For example, if r_1 is the pixel to be filtered and the filtering window includes three pixels on either side of r_1 , then filtering window used to calculate the offset is shown below.



Ex-2001, ¶190. The offset applied to r_1 is given by:

$$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$$

Ex-2001, ¶191; Ex-2015at Fig. 2, 15:2-15. The possible filters that can be applied to r_1 (which corresponds to p_0) are described as follows:

	Offset to Modify r_1
3-pixel window	$\frac{l_1 + r_1 + r_2}{3}$
5-pixel window	$\frac{l_2 + l_1 + r_1 + r_2 + r_3}{5}$
7-pixel window	$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$

Ex-2001, ¶192.

The Aksu filter based on the average pixel values of the pixels in the filtering window is another fundamentally different filter than the filter disclosed in the '659 Patent. Ex-2001, ¶187. Petitioner did not cite Aksu because it undermines many of the assumptions made in Petitioner's obviousness arguments regarding known structures of the offsets. *Id.*

III. SIMULATIONS SHOW THAT PETITIONER GROSSLY OVERSTATES THE SIMILARITIES BETWEEN DEBLOCKING FILTER DESIGNS

Petitioner's asserted grounds, discussed below, are based on cobbling together different aspects (e.g., different offsets) from different deblocking filter designs and arguing that, even though these combined references still do not disclose the claimed

offsets in the '659 Patent, it nonetheless would have been obvious to a POSITA to further modify the coefficients and weights of the offset equations disclosed in these disparate references to arrive at the claimed deblocking design of the '659 Patent. Underlying this argument is an oversimplification of the effect of a deblocking filter. Ex-2001, ¶103. The offsets in the prior art references and the '659 Patent represent the filter that is applied to actually modify the pixel value. *Id.*, ¶267. These filters have carefully designed frequency responses and different behavior to different block structures that are sensitive to changes in the design, including but not limited to which pixels are used or the filter coefficients used in the offset equations. *Id.*, ¶103. Accordingly, any change to the filter will not necessarily yield predictable results. *UCB, Inc. v. Actavis Labs. UT, Inc.*, 65 F.4th 679, 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art). In addition, the particular filtering results of the '659 filter design not filtering ramp structures and smoothing other structure in a specific way is “a difference in kind,” rather than a “difference in degree,” which is persuasive that Petitioner’s proposed modification of the prior art would not yield predictable results. *Id.*

Petitioner argues that “[t]he only difference between the first offset expression in Bjontegaard and the first offset expression of [claims 1 and 10] of the '659 Patent is the coefficient applied to the first set of pixels (q0-p0).” Petition, 62. Petitioner

makes a similar argument for the second and third offsets and for Fu. *Id.*, 25, 37. However, the differences between the invention of the '659 Patent and the references relied upon by Petitioners cannot be so oversimplified, because these differences presented as slight by Petitioner, result in significantly different filtering outcomes. Ex-2001, ¶103.

To illustrate these differences, Dr. Richardson conducted test simulations to compare the '659 Patent and Bjontegaard and Bjontegaard's Code. Dr. Richardson's simulations created 8x8 neighboring blocks of pixel values wherein the pixel values of the block were randomly generated in a way that is intended to represent a typical image sample block in real-world video coding applications. Ex-2001, ¶111. In total, the simulations generated 1000 blocks of pixels and tested 8000 lines of pixels. Dr. Richardson made the following observations:

- The offset applied to the P0 and Q0 pixels was different between the '659 Patent and Bjontegaard in 40% of the lines tested.
- The offset applied to the P1 pixel was different between the '659 Patent and Bjontegaard in 76.8% of the lines tested.
- The offset applied to the Q1 pixel was different between the '659 Patent and Bjontegaard in 76.8% of the lines tested.

Ex-2001, ¶147. Dr. Richardson also explained that these testing results are conservative as the range of pixels generated in his blocks was purposefully limited

to avoid critique of overly inflated numbers. *Id.*, ¶147. But Dr. Richardson explained that increasing the range of values, which would be likely in certain contexts (e.g. high dynamic range video that is played on newer displays), would cause the variance between the two systems to increase. *Id.*, ¶147.

Thus, Dr. Richardson’s test simulations illustrate that deblocking filtering designs cannot be oversimplified to mere coefficients, and any change to the design, including to the coefficients, result in significant differences in the filtering. *Id.*, ¶103.

IV. LEVEL OF SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) for the ’659 Patent would have had a bachelor’s degree in electrical engineering, computer engineering, or a related field, with approximately two years of experience in video decoding or encoding technologies as of the priority date of the ’659 Patent. Ex-2001, ¶ 36. Largely, Petitioner agrees with this definition of a POSITA, except that it further asserts that advanced graduate studies with coursework and/or research focusing on video and/or image coding and processing could be a substitute for the two years of working experience in the field. *See* Petition, 13; Ex-1003 ¶165. The differences in proposed levels of skill in the art does not affect the analysis set forth herein.

V. CLAIM CONSTRUCTION

Petitioner and Patent Owner agree that claim construction is not necessary to resolve the merits of this Petition. None of the Asserted Grounds anticipate or render obvious the Challenged Claims under any construction. However, to the extent Petitioner later alleges that a claim construction analysis is necessary, Patent Owner reserves the right to respond.

VI. PETITIONER HAS FAILED TO ESTABLISH A REASONABLE LIKELIHOOD THAT ANY CHALLENGED CLAIM IS UNPATENTABLE UNDER 37 C.F.R. § 42.108(c).

As described in detail below, each Ground is based on combining a reference (Fu or Bjontegaard) with the alleged “POSITA’s Knowledge.” The Petition grossly overstates a POSITA’s Knowledge by manufacturing alleged design constraints that are not document in any prior art reference. The alleged design constraints are fundamentally flawed, and the Petition does not provide any motivation for combining over seven references to derive the offsets of the Challenged Claims. Thus, Petitioner has failed to meet its initial burden with respect to any of the Challenged Claims of the ’659 Patent.

A. Petitioner’s Ground 1 Fails Because the Challenged Claims Are Not Obvious in View of Fu and “a POSITA’s Knowledge as Evidenced by List, Bjontegaard, B205, and B118”

As set forth below, Fu fails to disclose the required elements of the claims of the ’659 Patent, including the claimed first, second, and third offsets that comprise

Ericsson's novel deblocking filter design. Because Fu does not disclose this design, Petitioner alleges that the prior art is replete with deblocking filter designs that would render the claimed offsets obvious. Petitioner, however, must concede that Fu and the cited references do not, alone or in combination, teach the specific filter design of the '659 Patent that does not filter ramps, but smooths other structures in a specific way. Ex-2001, ¶¶218, 220, 230. Contrary to the Petition, the many references cited that disclose deblocking filters illustrate the nonobviousness of the '659 Patent. If it was so logical to modify Fu to reach the claims of the '659 Patent, someone would have done so. *Id.*, ¶¶220-221. They didn't because the offsets of the '659 Patent were carefully designed to have specific qualities, including not filtering ramp while smoothing other structures, such as a step, in a particular way. *Id.*, ¶218. Accordingly, Petitioner has not shown a reasonable likelihood of success that it can show that the claims are obvious in light of Fu.

1. Claim 1 & Claim 10 are not invalid

Claims 1 and 10 require: (i) calculating a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, (ii) modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 and (iii) modifying said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 . Ex-1001, cl. 1, 10.

The following is a comparison of the first offset equation in the '659 Patent and Fu.

Reference	First Offset Expression
'659 Patent	$(9(q_0 - p_0) - 3(q_1 - p_1) + 8) \gg 4$
Fu	$(6(q_0 - p_0) - 2(q_1 - p_1) + 8) \gg 4$

Ex-2001, ¶217; Ex-1003, ¶261. Petitioner admits that that neither Fu nor any other reference cited in the Petition (including List, Bjontegaard, B205, or B118) disclose calculating a first offset equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$ and then using that offset to modify pixel values p_0 and q_0 . Petitioner thus alleges that Fu in view of “a POSITA’s Knowledge as Evidenced by List, Bjontegaard, B205, and B118” renders obvious changing the offset of Fu to use the first offset of claim 1 of the 659 Patent. Petition at 22. As described below, Petitioner’s argument is riddled with impermissible hindsight-driven analysis. *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1320 (Fed. Cir. 2004) (quoting *Ecolochem, Inc. v. Co. Cal. Edison Co.*, 227 F.3d 1361, 1371-72 (Fed. Cir. 2000)) (additional citations omitted) (holding that it is impermissible to use “the inventor’s disclosure as a blueprint for piecing together the prior art to defeat patentability—the essence of hindsight.”).

a. The first offset is not obvious in light of Fu

Petitioner has not shown a motivation to alter Fu to reach the first offset of the '659 Patent. As described above, the deblocking filter of the '659 Patent does not “modify the pixel values over a block boundary if these pixel values form a ramp but smooth the pixel values if they instead are in the form of a step.” Ex-1001, 8:57-60. The '659 Patent explains that its deblocking filter will have good lowpass characteristics and can remove high frequencies that can appear near the block boundary.” Ex-1001, 8:57-63. Fu does not disclose that its filter avoids filtering a ramp and smooths pixel values if they instead are in the form of a step. Ex-2001, ¶218. Nor does it disclose that the filter needs or has good lowpass characteristics or removes high frequencies near the block boundary. *Id.* Instead, as described above, Fu focuses on the flatness of a signal to determine how to filter that signal. *Id.*

Petitioner urges the Board to find a motivation to modify the first offset in Fu, but Petitioner improperly ignores that modifying one offset in a system will impact how all other aspects of the filter function. For example, Fu describes applying different offsets to pixels p1 and q1, and Petitioner provides no explanation as to how modifying the first offset filter (which modifies p0 and q0) would impact these other pixels. Ex-2001, ¶219. The failure to explain how the modified filter would impact the remainder of the filter is fatal to the Petition, because Petitioner has thus not shown that the modification of Fu to use a different first offset would yield

predictable results. *Id.*; *UCB, Inc.*, 65 F.4th at 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art).

b. Petitioner cannot show a motivation to modify Fu in light of “a POSITA’s Knowledge as Evidenced by List, Bjontegaard, B205, and B118”

As preliminary matter, Petitioner’s attempt to cast a combination of references as “a POSITA’s Knowledge” is improper. Here, the element that is admittedly missing from Fu is not taught by any single reference in the art, nor is it taught collectively by the references. Ex-2001, ¶¶220-221. Petitioner’s argument is that a POSITA would combine a wealth of knowledge and somehow land on the exact offset in the ’659 Patent. Such an argument is improperly cast as merely the knowledge of a POSITA. *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363 (Fed. Cir. 2016) (warning against invoking a POSITA’s general knowledge from the prior art as “common sense . . . to supply a limitation that was admittedly missing from the prior art” and that was not “supported by evidence and reasoned explanation.”). Regardless, Petitioner must affirmatively demonstrate a reason why a POSITA would have combined the identified references and modified the Fu to meet the claims. *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) ([O]bviousness concerns whether a skilled artisan not only *could have made but would have been motivated to make* the combinations or modifications of prior art

to arrive at the claimed invention.”). The Petition is lacking any such motivation and thus, for this reason alone, the Petition fails.

Petitioner did not offer such motivation because Fu teaches away from a combination with the references identified in the Petition. Ex-2001, ¶205. For example, Fu proposed an alleged improvement to the deblocking filter of the H.264 Standard. *Id.* Specifically, Fu teaches that the H.264 deblocking filter does not adequately address “trapezoidal noise” or “lattice noise.” Ex-1022 at 1:15-32. List describes the H.264 deblocking filter that Fu criticizes, and Bjontegaard and B118 were technical submission to the H.264 Standardization process that were expressly rejected in favor of the deblocking filter described in List. Ex-2001, ¶205. Accordingly, Fu’s criticism of H.264 would teach away from a POSITA’s modification of Fu in light of List and Bjontegaard and B118 as Fu is described as an improvement to those designs. *Id.*

Petitioner also ignores the in-depth, involved, iterative process involved in developing the H.264 Standard (and any other standard). To develop H.264, hundreds of engineers worked together to evaluate ideas and proposals to create the best video coding standard possible. *Id.* As part of this process, certain proposals are adopted into the standard, and ultimately are integrated into the technical standards adopted by the standardization body. Ex-2001, ¶205. Other proposals, such as Bjontegaard and B118 were proposed, and may even be temporarily or partially

adopted, before ultimately being rejected. These decisions, which were not influenced by litigation, illustrate how sensitive deblocking filters are and how the industry recognized that certain designs were inferior. *Id.* Petitioner’s attempt to rewrite history without any evidence to support a motivation to do so are contrary to well-established Federal Circuit precedent. *Unigene Labs., Inc. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011) (holding that a showing of obviousness must demonstrate that a person of ordinary skill in the art at the time of the invention would have combined prior art elements to yield the claimed inventions); *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007) (explaining the importance of identifying “a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.”); *Artic Cat Inc. v. Polaris Indus.*, 795 F.App’x 827, 833 (Fed. Cir. 2019) (citing *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 (Fed. Cir. 2000)) (“The relevant inquiry is whether or not a person having ordinary skill in the art would be motivated to combine references despite drawbacks that combination might present.”)

Petitioner’s attempt to modify Fu in light of the teachings in B205 also fails. Like Fu, B205 was developed to replace the H.264 deblocking filter, but the approaches are fundamentally different. Ex-2001, ¶206. For example, the following

shows that the two offsets are calculated using different coefficients and different sets of pixels:

Petitioner’s Condensed First Offset Equation	
B205	$\frac{7.5(q_0 - p_0) - 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$
Fu	$\frac{6(q_0 - p_0) - 2(q_1 - p_1)}{16}$

Ex-2001, ¶¶206, 220.

There is no explanation as to why a POSITA would have been motivated to combine these equations to reach the first offset of the 659 Patent. Ex-2001, ¶¶219-229. If anything, Fu teaches away from considering B205 because Fu teaches to use flatness to determine how to filter a pixel where B205 ignores the flatness of the structures. Ex-2001, ¶209.

c. Petitioner’s routine experimentation arguments are unsupported and contrary to the evidence

Petitioner’s argument that the first offset of the ’659 Patent would be obvious because it could be identified with only “routine” experimentation is contrary to the law and the evidence. *See id.* at 26-30. *Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009) (holding that an invention is not obvious to try if it would require “vary[ing] all parameters or try each of numerous possible choices until one possibly arrived at a successful result.”). The number of options to

try must be “small and easily traversed,” which is not the case here. *Id.* (quoting *Ortho-McNeil Pharm., Inc. v. Mylan Labs., Inc.*, 520 F.3d 1358, 1364 (Fed. Cir. 2008)).

Petitioner’s arguments, however, ignore that the evidence shows that decades of experimenting with deblocking filtering never resulted in the claimed first offset in the ’659 Patent. Ex-2001, ¶¶220-221. Experts in the field have tried for decades to develop a solution to the same deblocking problem. *Id.* For example, Dr. Schonfeld included the following set of offset equations, which he referred to as “Condensed Offset Equations,” which were proposed and/or adopted into video coding standards over a nearly a decade. *Id.*

Table 1: Condensed Offset Equation	
'659 Patent	$\frac{9(q_0 - p_0) - 3(q_1 - p_1)}{16}$
Fu	$\frac{6(q_0 - p_0) - 2(q_1 - p_1)}{16}$
H.264, List	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
B118	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
Bjontegaard	$\frac{8(q_0 - p_0) - 3(q_1 - p_1)}{16}$
VCEG-M21	$\frac{8(q_0 - p_0) - 2.5(q_1 - p_1)}{16}$
Bjontegaard '048	$\frac{8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2)}{16}$
B205	$\frac{7.5(q_0 - p_0) + 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$

Ex-1003, ¶272; Ex-2001, ¶220.

As can be seen from this table, the proposals used (i) different “coefficients” and (ii) different sets of pixels (e.g. B205 uses the pixels q_2 and p_2). These changes lead to fundamentally different filters. Ex-2001, ¶¶224, 220, 208. For example, as Dr. Richardson’s testing showed, changing an “8” to a “9” could cause a 40% change in the resulting offset used. Ex-2001, ¶224. Accordingly, Petitioner has not provided any justification for its belief that a move from “6” to “9” combined with a move from “2” to “3” (as would be necessary to change F_u to match the ’659 Patent) would have been a simple step that would yield predictable results. Ex-2001, ¶206.

It is also notable that Petitioner also failed to allege that this is the complete set of possible first offsets. It purposefully did not do so because it is aware that its obviousness analysis excludes different offset structures. For example, Petitioner did not allege that the one of F_u ’s alternative first offsets $((2 \times p_0 + p_1 + q_0 + 2) \gg 2)$, which would apply when region flatness indicates that $BS=3$, instead of arbitrarily assuming $BS=1$ as Dr. Schonfeld did, is a fundamentally different structure. Specifically, this offset only uses 3 pixels instead of the four cited by Petitioner.

As another example, Petitioner failed to identify Aksu, which was cited in a related IPR. The first offset in Aksu is fundamentally different than the proposals in Dr. Schonfeld’s table and in the ’659 Patent. This is because Aksu describes an

averaging filter that centers on the pixel to be filtered based on a sliding, adjustable filtering window. Ex-2001, ¶221. Examples of that offset include:

	Offset to Modify r1
3-pixel window	$\frac{l_1 + r_1 + r_2}{3}$
5-pixel window	$\frac{l_2 + l_1 + r_1 + r_2 + r_3}{5}$
7-pixel window	$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$

Ex-2001, ¶192. Not only is Aksu’s filter centered on the pixel to be filtered instead of the block boundary so that the pixels used to calculate the offset are not fixed, but the pixels used can also range from 3 pixels to 7 pixels. *Id.* This fundamentally different filter is notably absent from Petitioner’s description of the prior art first offsets, because it significantly undermines Petitioner’s argument that the possible first offset equations were limited by particular design constraints such that the claimed offset would have been obvious. Ex-2001, ¶¶221-230.

d. Petitioner’s attempt to conjure “design constraints” to guide a POSITA are unsupported and riddled with impermissible hindsight.

Because Petitioner cannot identify the first offset of the ’659 Patent in any reference nor can they identify a single clear motivation to use that offset, Petitioner attempts to manufacture a set of rules, which it refers to as “design constraints,” that would lead a POSITA to the first offset of the ’659 Patent.

Petitioner fails to cite any support that these are hard and fast rules of design, nor do any of the “design constraints” limit the potential solutions in any meaningful way. Ex-2001, ¶¶221-230. Instead, as the history of deblocking filter development shows, deblocking filters requires significant testing and experimentation, and Dr. Richardson’s testing shows that any change can have a significant impact on the operation of the filter. Ex-2001, Section X. The following addresses the specific design constraints raised in the Petition.

First, Petitioner argues that it would have been obvious to use the first offset of the ’659 Patent in light of Fu because the coefficients both use a “3:1 ratio.” Petitioner, however, has not shown that it was well known in the art that a 3:1 ratio in the calculation of the first offset was desirable or that it would not filter a ramp structure. Ex-2001, ¶¶222-224, 227. For example, none of the references identified by Petitioner other than Fu disclose this ratio, and some references use additional pixels (e.g. B205 and Bjontegaard ’048) where the ratio is inapplicable. *Id.* Further, Petitioner’s argument ignores that the actual ratio in Fu is 6:2, and the ’659 Patent uses a ratio of 9:3. While the difference between these ratios would not affect the filtering of a ramp, the difference is substantial when applied to a step function or other localized structures that do not form a ramp. *Id.*, ¶230. For example, the following chart prepared by Petitioner shows that, for every non-ramp example, the first offset of Fu and the first offset of the ’659 Patent are different, and Petitioner

has made no attempt to show that those differences are insubstantial or that a POSITA would be motivated to change Fu to use the offsets of the '659 Patent over the original offsets. *Id.*, ¶230.

p2	p1	p0	q0	q1	Type	$\frac{9(q0 - p0) - 3(q0 - p0)}{16}$	$\frac{6(q0 - p0) - 2(q1 - p1)}{16}$
200	150	150	150	150	Step (p1)	0	0
200	200	150	150	150	Step (p0)	9	6
200	200	200	150	150	Step (q0)	-19	-13
150	160	170	180	190	Ramp (10)	0	0
125	150	175	200	225	Ramp (25)	0	0
200	250	200	250	200	Alternating	38	25
255	50	50	255	255	Line	77	51
255	255	50	50	255	Line	0	0
175	200	150	150	175	Random	5	3
50	125	100	150	125	Random	28	19
75	100	150	75	125	Random	-47	-31

Ex-1003, ¶282; Ex-2001, ¶230.

Instead, as shown by Dr. Richardson's testing, these variations can lead to materially different filters. Ex-2001, Section X. Thus, nothing in Fu (or any of the other identified references) would suggest that a POSITA would want to experiment and change the coefficients associated with the deblocking filter and keep the relative ratio at 3:1 when performing this experimentation. Ex-2001, ¶222; *Bayer Schering Pharma AG, Inc.*, 575 F.3d at 1347 (“[A]n invention would not have been

obvious to try when the inventor would have to try all possibilities in a field unreduced by direction of the prior art.”).

Second, Petitioner alleges that a POSITA would have experimented with six additional “design constraints” to optimize Fu’s offset equation, including (i) the magnitude of the coefficients applied that controls the “width” of the filter, (ii) the sum of the coefficients in the numerator and division by the denominator, (iii) the “window” used to calculate the offset, (iv) the “DC” gain of the offset equaling one; (v) the value of the offset’s right-shift being between three and six; and (vi) the use of integer coefficients instead of decimal coefficients. Petitioner’s argument collapses in view of its own cited prior art references. Specifically, despite the actual significant experimentation in the art with different deblocking filters spanning over the period of at least decade, not a single reference or codec used or experimented with the particular offset claimed in the ’659 Patent, with its specific combination of coefficients, window, DC gain, and right shift. Ex-2001, ¶228. Nor did anyone recognize the benefits to avoiding filtering ramp and smoothing steps as claimed in the ’659 Patent. *Id.*, ¶¶228, 230.

Moreover, the Petition fails to consider the number of possible design choices created by these alleged constraints. When combining the possibilities generated by all of the options presented in the Petition, there are well over 100 possibilities, and the Petition provides no motivation to why a POSITA would have selected one

design over the other. *Id.*, ¶229. Thus, even applying Petitioner’s design constraints, the task of finding an optimal deblocking filter would not be the subject of routine experimentation or obvious to try. *Rolls-Royce, PLC v. United Techs. Corp.*, 603 F.3d 1325, 1339 (Fed. Cir. 2010) (finding the claimed invention nonobvious because of the “broad selection of choices for further investigation available to a person of ordinary skill included any degree of sweep”); *Takeda Chem. Indus. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1359 (Fed. Cir. 2007) (holding the invention not obvious to try because the prior art disclosed a broad selection of compounds that an ordinarily skilled artisan could have selected for further investigation).

Thus, Petitioner’s argument that these alleged design constraints would have been used by a POSITA to modify the first offset in F_u to arrive at the claimed amounts to nothing more than hindsight bias. *See, e.g.*, Ex-2001, ¶227. Such hindsight bias is fatal to the Petition because Petitioner does not and cannot explain how these understandings would facilitate the discovery of the ’659 Patent’s invention, absent a template from the ’659 Patent itself. *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1320 (Fed. Cir. 2004) (quoting *Ecolochem, Inc. v. Co. Cal. Edison Co.*, 227 F.3d 1361, 1371-72 (Fed. Cir. 2000)) (additional citations omitted) (holding that it is impermissible to use “the inventor’s disclosure as a blueprint for piecing together the prior art to defeat patentability—the essence of hindsight.”). Even if these constraints could form the basis of a brute-force level of

“routine experimentation” to ultimately arrive at the ’659 Patent’s coefficients and offsets, “routine experimentation does not necessarily preclude patentability.” *Honeywell Int’l Inc. v. Mexichem Amanco Holding S.A. De C.V.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017).

In addition, Petitioner’s design constraints do not survive scrutiny. For example, Petitioner argues that a POSITA would have known that the workable range would typically be defined such that “summing the coefficients in the numerator and dividing by the denominator produces a fraction between 1/4 and 1/2.” Petition at 27. Because the claimed offset of the ’659 Patent uses the coefficients 9/16 and 3/16, the sum would be 12/16 or 3/4, which is outside of the range suggested by the Petition. Ex-2001, ¶228. Thus, if the design constraint was legitimate, it would actually show that the ’659 Patent’s offset was outside of the norm. *Id.*

Third, contrary to the arbitrary design constraints manufactured for the Petition, Dr. Richardson’s test results show that any one of the changes suggested by the Petition can result in large objective and subjective changes in the filtering results. Ex-2001, Section X.

Thus, Petitioner’s allegations of “routine experimentation” are unsubstantiated conclusions improperly driven by hindsight. Ex-2001, ¶¶221-230. As shown in Dr. Richardson’s simulations, modifying the prior art equations has

significant effects on the filter response to different types of activity line such as ramps and line structures. Ex-2001, Section X. Optimizing the filter response in the context of the overall in-loop filter design requires extensive objective and subjective testing that goes far beyond routine experimentation. Ex-2001, *e.g.*, ¶¶229, 267. Thus, a POSITA would not have a reasonable expectation of success in substituting different elements from different deblocking designs. Ex-2001, ¶229; *In re Stepan Co.*, 868 F.3d 1342, 1347 (Fed. Cir. 2017) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1365 (Fed. Cir. 2007)) (additional citations omitted) (“[T]o have a reasonable expectation of success, one must be motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result.”).

In addition, Claims 2 and 3 depend from Claim 1, and Claims 11 and 12 depends from Claim 10. Ex-1001, cl. 1-3, 10-12. Thus, for the same reasons Petitioner’s Ground 1 fails with respect to Claims 1 and 10, Petitioner’s challenge to Claims 2, 3, 11, and 12 fails.

2. Claim 4 is not invalid

Claim 4 requires (i) calculating a second offset to be based on $(p_2 + p_0 - 2 \times p_1 - 2 \times \Delta)/4$, (ii) calculating a third offset to be based on $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$, (iii) modifying said pixel value p_1 of said pixel next closest to said block boundary in said line of pixels by adding said second offset to said pixel value p_1 ;

and (iv) modifying said pixel value q1 of said pixel next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value q1. Ex-1001, cl. 4

Petitioner cannot show that a POSITA would have been motivated to modify Fu in view of a “POSITA’s knowledge” to use the second and third offset of the claims.

e. The second offset is not obvious in light of Fu

Fu in view of a POSITA’s knowledge does not teach or suggest calculating the second offset based on $\frac{p0j+p2j-2p1j+2\Delta}{4}$.

Petitioner argues that the offsets are different in two ways: the exact high-pass filter used; and (2) the coefficients applied to that component. Ex-1003, ¶344. Petitioner’s table comparing Fu to the ’659 Patent is below.

Reference	Second Offset Equation
’659 Patent	$\Delta = \frac{1(p2 - 2p1 + p0)}{4} + \frac{2\Delta}{4}$
Fu	$\Delta = \frac{1(p2 - 3p1 + 3p0 - q0)}{8} + \frac{2\Delta}{4}$

Id. These differences cannot and should not be minimized because they reflect a very specific design with specific resulting frequency response. Ex-2001, ¶235. In particular, the ’659 Second offset uses a Laplacian that only uses p pixels for the

“high-pass component.” Ex-2001, ¶235. This was a specific design choice of the overall ’659 deblocking design such that the (i) consider the local structure near the block boundary and (ii) do not filter ramp. *Id.* Moreover, the frequency response is specific to other types of structures, and the coefficients ensure that other structures, such as lines and steps are smoothed in a particular way. *Id.* In contrast, Fu teaches to use q0 pixel and thus takes into account the structure of the neighboring block for the high pass component. These two approaches are fundamentally different. *Id.*

The differences between these two offsets is further illustrated when the previously-calculated first offset (“ Δ ”) is considered. Ex-2001, ¶236. Specifically, while both offsets include a Δ , the Δ is a reference to the first offset. *Id.* Thus, the following table reflect the actual deblocking filters normalized based on the value of Δ .

	Second Offset
659 Patent	$\frac{8(p_2 - 2p_1 + p_0) + 9(q_0 - p_0) - 3(q_1 - p_1)}{32}$
Fu	$\frac{4(p_2 - 3p_1 + 3p_0 - q_0) + 6(q_0 - p_0) - 2(q_1 - p_1)}{32}$

Ex-2001, ¶236. Petitioner completely ignores these differences and merely argues that it would have been obvious to a POSITA to reach the claimed second offset expressions using routine experimentation. Ex-2001, ¶237. Petitioner then cites to a number of prior art references, but Petitioner again fails to account for the fact that

the Δ in each equation is a reference to the first offset. Ex-2001, ¶¶237-238. Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. In contrast, Dr. Richardson's testing showed that any change to the filter design, including to the second offset, could have a significant impact on the operation of the filter. Ex-2001, Section X. For example, Dr. Richardson showed that, when applied to the same pixel values, the simulation of the '659 Patent and Bjontegaard, which have different first offsets and different second offsets, filtered the pixel p1 (to which the second offset would apply) differently 76.8% of the time. Ex-2001, ¶¶143-145. Thus, Petitioner has failed to show that the claimed second offset is non-obvious

f. The third offset is not obvious in light of Fu

Fu in view of a POSITA's knowledge does not teach or suggest calculating the third offset based on $\frac{q0j+q2j-2q1j+2\Delta}{4}$.

For similar reasons discussed above with respect to the second offset, which are incorporated by reference herein, Petitioner cannot show that the claimed third offset would have been obvious to a POSITA. Petitioner argues that the offsets are different in two ways: the exact high-pass filter used; and (2) the coefficients applied to that component. These differences, however, cannot and should not be minimized

because they reflect a very specific design with specific resulting frequency response. Ex-2001, ¶245. In particular, the '659 third offset uses a Laplacian that only uses q pixels for the “high-pass component.” This was a specific design choice of the overall '659 deblocking design such that the (i) consider the local structure near the block boundary and (ii) do not filter ramp. Ex-2001, ¶245. Moreover, the frequency response is specific to other types of structures, and the coefficients ensure that other structures, such as lines and steps are smoothed in a particular way. *Id.* In contrast, Fu teaches to use p_0 pixel and thus takes into account the structure of the neighboring block for the high pass component. *Id.* These two approaches are fundamentally different. *Id.* Like the second offset, the differences between these two offsets are further illustrated when the Δ is considered. *Id.*, ¶246.

Petitioner completely ignores these differences and merely argues that it would have been obvious to a POSITA to reach the claimed third offset expressions using routine experimentation. Petitioner then cites to a number of prior art references, but Petitioner again fails to account for the fact that the Δ in each equation is a reference to the first offset. *Id.*, ¶247. Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design, nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. *Id.* In contrast, Dr. Richardson’s testing, however, shows that any change to the filter design, including to the third offset, could have a

significant impact on the operation of the filter. *Id.*, Section X. For example, Dr. Richardson showed that when applied to the same pixel values, the simulation of the '659 Patent and Bjontegaard, which have different first offsets and different third offsets, filtered the pixel q1 (to which the third offset would apply) differently 76.8% of the time. Ex-2001, ¶¶143-145.

In addition, Claims 5-7 depends from Claim 4. Ex-1001, cl. 4-7. Thus, for the same reasons Petitioner's Ground 1 fails with respect to Claim 4, Petitioner's challenge to Claims 5-7 fails.

B. Petitioner's Ground 2 Fails Because the Challenged Claims Are Not Obvious In View Of Bjontegaard in view of Bjontegaard's Code and "a POSITA's Knowledge As Evidenced By List, Fu, B205, And B118"

Bjontegaard does not render obvious the required elements of the claims of the '659 Patent, including the claimed first, second, and third offsets of Ericsson's novel deblocking filter design. As described above, the invention of the '659 Patent was carefully designed to have specific qualities, including not filtering ramp structures while smoothing other structures, such as a step structure, in a particular way. Ex-2001, *e.g.*, ¶¶98, 230. No prior art reference achieved these same qualities. *Id.*, ¶230. For example, as demonstrated by Dr. Schonfeld's analysis, unlike the '659 Patent, Bjontegaard's first offset does filter ramp, and does not smooth step, line or random structures in the same way that the '659 Patent offsets do. Ex-2001, ¶267.

As shown by Dr. Richardson's testing, these differences are substantial. See Ex-2001, Section X.

Like Ground 1, Petitioner attempts to cure this defect in Bjontegaard in light of "a POSITA's Knowledge As Evidenced By List, Fu, B205, And B118." Contrary to the Petition, the many references cited that disclose deblocking filters illustrate the nonobviousness of the '659 Patent. Ex-2001, ¶¶257, 261-262. If it was so logical to modify Bjontegaard to reach the claims of the '659 Patent, someone would have done so. They didn't because the offsets of the '659 Patent were carefully designed to have specific qualities, including not filtering ramp while smoothing other structures, such as a step, in a particular way. *Id.*, ¶262. And Bjontegaard teaches a fundamentally different filter. *Id.*, ¶267. Accordingly, Petitioner has not shown a reasonable likelihood of success that it can show that the claims are obvious in light of Bjontegaard and Bjontegaard Code in combination with the alleged "POSITA's Knowledge."

1. Claim 1 & Claim 10 are not invalid

a. The first offset is not obvious in light of Bjontegaard

Petitioner has not shown a motivation to alter Bjontegaard to reach the first offset of the '659 Patent. As described above, the deblocking filter of the '659 Patent does not "modify the pixel values over a block boundary if these pixel values form a ramp but smooths the pixel values if they instead are in the form of a step." Ex-

1001, 8:57-60; Ex-2001, ¶267. The '659 Patent explains that its deblocking filter will have good lowpass characteristics and can remove high frequencies that can appear near the block boundary.” Ex-1001, 8:57-63.

In contrast, Bjontegaard’s filter was specifically designed to filter ramp structures and smooth other structures in a different way. Ex-2001, ¶¶267-269. Petitioner urges the Board to find a motivation to modify the first offset of Bjontegaard, but Petitioner improperly ignores that modifying one offset in a system will impact how all other aspects of the filter function. Ex-2001, ¶¶266, 271, 219. For example, Bjontegaard describes applying different offsets (Diff values) to pixels c and f (corresponding to p1 and q1), but fails to provide any explanation as to how modifying the first offset (which modified pixels d and e—corresponding to pixels p0 and q0) would impact these other pixels. *See id.* This failure to provide any analysis is fatal to the petition. Specifically, Petitioner fails to show that the modification of Bjontegaard to use a different first offset would yield predictable results and a functioning filter design. *UCB, Inc.*, 65 F.4th at 693 (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art).

Further, Dr. Richardson’s testing showed, changing an “8” to a “9”, as Petitioner alleges would have been obvious by modifying Bjontegaard, could cause a 40% change in the resulting offset used. Ex-2001, ¶146. When applied to the same

lines of pixels in thousands of instances, the simulation of the '659 Patent and Bjontegaard filtered the pixel p0 differently 40% of the time. *Id.* Accordingly, Petitioner has not provided any justification for its assertion that an increase in Bjontegaard's coefficient from "8" to "9" would have been a simple step for a POSITA that would yield predictable results. Ex-2001, ¶266, 271; *UCB, Inc.*, 65 F.4th at 693.

b. Petitioner cannot show a motivation to modify Bjontegaard in light of Bjontegaard's Code and "a POSITA's Knowledge as Evidenced by List, Fu, B205, and B118"

As preliminary matter, Petitioner's attempt to cast a combination of references as "a POSITA's Knowledge" is improper. Here, the elements that are admittedly missing from Bjontegaard are not taught by any single reference in the art, nor is it taught collectively by the references. Ex-2001, ¶259. Petitioner's argument is that a POSITA would combine a wealth of knowledge and somehow land on the exact offset in the '659 Patent. Such an argument is improperly cast as merely the knowledge of a POSITA. *Arendi*, 832 F.3d at 1363 (warning against invoking a POSITA's general knowledge from the prior art as "common sense . . . to supply a limitation that was admittedly missing from the prior art" and that was not "supported by evidence and reasoned explanation."). Regardless, Petitioner must affirmatively demonstrate a reason why a POSITA would have combined the

identified references and modified the intentionally designed offset coefficients in Bjontegaard to meet the claims. *SharkNinja Operating LLC v. iRobot Corp.*, 2024 U.S. App. LEXIS 6213, at *8 (March 15, 2024) (upholding the Board’s finding that an element of prior art being a “design choice” does not establish a sufficient motivation to modify the intentional design of the prior art). The Petition is lacking any such motivation and thus, for this reason alone, the Petition fails. Ex-2001, ¶253.

Petitioner cannot show such a motivation because Bjontegaard teaches away from combination with other references identified in the Petition. For example, Bjontegaard proposed an alleged improvement to the deblocking filter of the developing H.26L Test Model, which eventually became the H.264 Standard. Ex-2001, ¶254. However, the design in Bjontegaard was ultimately rejected in favor of the deblocking filter described in List. *Id.* B118 was also a draft version of a deblocking design that was ultimately rejected in favor of the H.264 deblocking filter described in List. *Id.* Fu, on the other hand expressly criticizes the H.264 filter and thus implicitly criticizes the filters that were rejected in favor of that filter. Ex-1022, 1:15-32. Accordingly, the rejection of the deblocking design in Bjontegaard in favor of other designs that were ultimately adopted and then later criticized and eventually obsoleted by next generation codecs teach away from a POSITA’s modification of Bjontegaard in light of Fu, List, and B118. Ex-2001, ¶254.

Petitioner also ignores the in-depth, involved, iterative process involved in developing the H.264 Standard (and any other standard). To develop H.264, hundreds of engineers worked together to evaluate ideas and proposals to create the best video coding standard possible. Ex-2001, ¶254. As part of this process, certain proposals are adopted into the standard, and ultimately are integrated into the technical standards adopted by the standardization body. *Id.* Other proposals, such as Bjontegaard and B118 were proposed, and may even be temporarily or partially adopted, before ultimately being rejected. *Id.* These decisions, which were not influenced by litigation, illustrate how sensitive deblocking filters are and how the industry recognized that certain designs were inferior. Ex-2001, ¶205. Petitioner's attempt to rewrite history without any evidence to support a motivation to do so are contrary to well established Federal Circuit precedent. *Unigene Labs.*, 655 F.3d at 1360; *KSR Int'l*, 550 U.S. at 418; *Artic Cat*, 795 F.App'x at 833.

Petitioner's attempt to modify Bjontegaard in light of the teachings in B205 also fails. While Bjontegaard was considered and ultimately rejected as the H.264 deblocking filter design, B205 was developed to replace the H.264 deblocking filter that was published after the rejection of Bjontegaard. Ex-2001, ¶258. Moreover, the approaches are fundamentally different. *Id.* For example, the following shows that the two offsets are calculated using different coefficients and different sets of pixels:

First Offset Equation	
B205	$\frac{7.5(q_0 - p_0) - 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$
Bjontegaard	$\frac{8(q_0 - p_0) - 3(q_1 - p_1)}{16}$

Ex-2001, ¶220.

As shown here, the offsets use different pixel values, number of pixels, and different coefficients, and there is no explanation as to why a POSITA would have been motivated to combine these equations to reach the first offset of the '659 Patent. *Id.*, ¶258.

c. Petitioner's routine experimentation arguments are unsupported and contrary to the evidence

Petitioner's argument that the first offset of the '659 Patent would be obvious because it could be identified with only "routine" experimentation is contrary to the law and the evidence. *See* Petition at *e.g.*, 25; *Leo Pharm. Prods. v. Rea*, 726 F.3d 1346, 1356 (Fed. Cir. 2013) (holding that the "breadth of choices and numerous combinations" available for formulating a composition did not render obvious the selection of the correct formulation from those available alternatives).

Petitioner ignores the mass of evidence showing that decades of experimenting with deblocking filtering never resulted in the claimed first offset expressions in the '659 Patent. Ex-2001, ¶271.

Experts in the field have tried for decades to develop a solution to the same deblocking problem. Ex-2001, ¶¶220-221. For example, Dr. Schonfeld included the following set of offset equations, which he referred to as “Condensed Offset Equations,” which were proposed and/or adopted into video coding standards over a nearly a decade.

Table 1: Condensed Offset Equation	
'659 Patent	$\frac{9(q_0 - p_0) - 3(q_1 - p_1)}{16}$
Fu	$\frac{6(q_0 - p_0) - 2(q_1 - p_1)}{16}$
H.264, List	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
B118	$\frac{8(q_0 - p_0) - 2(q_1 - p_1)}{16}$
Bjontegaard	$\frac{8(q_0 - p_0) - 3(q_1 - p_1)}{16}$
VCEG-M21	$\frac{8(q_0 - p_0) - 2.5(q_1 - p_1)}{16}$
Bjontegaard '048	$\frac{8(q_0 - p_0) + 4(q_1 - p_1) - 4(q_2 - p_2)}{16}$
B205	$\frac{7.5(q_0 - p_0) + 2(q_1 - p_1) - 2.5(q_2 - p_2)}{16}$

Ex-1003, ¶272.

As can be seen from this table, the proposals used (i) different “coefficients” and (ii) different sets of pixels (e.g. B205 uses the pixels q2 and p2). These changes lead to fundamentally different filters. Ex-2001, ¶88. For example, as Dr. Richardson’s testing showed, changing an “8” to a “9”, as Petitioner alleges would have been obvious by modifying Bjontegaard, could cause a 40% change in the

resulting offset used. Ex-2001, ¶¶267, Section X. That is, the pixels are filtered differently 40% of the time. *Id.* Accordingly, Petitioner has not provided any justification for its assertion that an increase in Bjontegaard’s coefficient from “8” to “9” would have been a simple step for a POSITA that would yield predictable results. Ex-2001, ¶¶267-269, Section X; *UCB, Inc. v. Actavis Labs. UT, Inc.*, 65 F.4th 679, 693 (Fed. Cir. 2023) (explaining that evidence of unexpected results is particularly probative when there is a difference between the results obtained and those of the closest prior art). In addition the particular filtering results of the ’659 filter design not filtering ramp structures and smoothing other structure in a specific way is “a difference in kind,” rather than a “difference in degree,” which is persuasive that Petitioner’s proposed modification of the prior art would not yield predictable results. *Id.*

It is also notable that Petitioner also failed to allege that this is the complete set of possible first offsets. It purposefully did not do so because it is aware that its obviousness analysis excludes different offset structures. For example, Petitioner did not allege that the one of Bjontegaard’s alternative first offsets $\text{Diff} = (p_2 + p_1 - 8(p_0 - q_0) - q_1) - q_2 / 16$, which would apply when Act_{edge} equals 3, instead of arbitrarily assuming Act_{edge} equals 1 or 2 as Dr. Schonfeld did, is a fundamentally different structure. Ex-2001, ¶¶155-156, 267. Specifically, this offset uses six pixels instead of the four cited by Petitioner.

As another example, Petitioner failed to identify Aksu, which was cited in a related IPR filed by Petitioner against Patent Owner. *See* IPR2024-01008. The first offset in Aksu is fundamentally different than the proposals in Dr. Schonfeld’s table and in the ’659 Patent. Ex-2001, ¶221, 187. This is because Aksu describes an averaging filter that centers on the pixel to be filtered based on a sliding, adjustable filtering window. Ex-2015 at 15; Ex-2001, ¶190-192. Examples of that offset include:

	Offset to Modify r1
3-pixel window	$\frac{l_1 + r_1 + r_2}{3}$
5-pixel window	$\frac{l_2 + l_1 + r_1 + r_2 + r_3}{5}$
7-pixel window	$\frac{l_3 + l_2 + l_1 + r_1 + r_2 + r_3 + r_4}{7}$

Id. Not only is Aksu’s filter centered on the pixel to be filtered instead of the block boundary so that the pixels used to calculate the offset are not fixed, but the pixels used can also range from 3 pixels to 7 pixels. Ex-2001, ¶¶190-192. This fundamentally different filter is notably absent from Petitioner’s description of the prior art first offsets, because it significantly undermines Petitioner’s argument that the possible first offset equations were limited by particular design constraints such that the claimed offset would have been obvious. Ex-2001, ¶¶187-190.

d. Petitioner’s attempt to conjure “design constraints” to guide a POSITA are unsupported and riddled with impermissible hindsight.

Because Petitioner cannot identify the first offset of the ’659 Patent in any reference nor can they identify a single clear motivation to use that offset, Petitioner attempts to manufacture a set of rules, which it refers to as “design constraints,” that would lead a POSITA to the first offset of the ’659 Patent. Petitioner cited these same design constraints with respect to Ground 1. Thus, for the reasons stated above in Section VI.A.1.a-b above, Petitioner’s manufactured set of set of rules, which it refers to as “design constraints,” do not survive scrutiny and fail to establish that changing Bjontegaard’s first offset to arrive at the claimed offset would have been obvious. *See supra* § VI.A.1.a-b; Ex-2001, ¶228.

In addition, Claims 2 and 3 depend from Claim 1, and Claims 11 and 12 depends from Claim 10. Ex-1001, cl. 1-3, 10-12. Thus, for the same reasons Petitioner’s Ground 1 fails with respect to Claims 1 and 10, Petitioner’s challenge to Claims 2, 3, 11, and 12 fails.

2. Claim 4 is not invalid

For the reasons set forth above with respect to claims 1 and 10, Petitioner cannot show that a POSITA would have been motivated to modify Bjontegaard in view of a “POSITA’s knowledge” to use the second and third offset of the claims.

a. The second offset is not obvious in light of Bjontegaard

Bjontegaard combined with Bjontegaard’s Code and a POSITA’s knowledge does not teach or suggest calculating the second offset based on $\frac{p_{0j}+p_{2j}-2p_{1j}+2\Delta}{4}$.

Petitioner argues that the only difference between the claimed equation and Bjontegaard’s Equation is the “coefficient assigned to each component.” Petition at 68-69.

Claimed Equation	Bjontegaard’s Equation
$\Delta = \frac{1(p_2 - 2p_1 + p_0)}{4} + \frac{1\Delta}{2}$	$\Delta = \frac{5(p_2 - 2p_1 + p_0)}{16} + \frac{5\Delta}{16}$

However, a POSITA would not have minimized these coefficient differences as Petitioner does, because the coefficients of the second offset reflect a very specific design that affects the frequency response of the filter. The coefficients ensure that structures, such as line structures and step structures, are smoothed in a particular way or not modified. Ex-2001, ¶276. For example, the offset of the ’659 Patent would not filter a ramp, whereas the offset of Bjontegaard would. *Id.*

This difference is highlighted by the fact that the offsets require use of the previously-calculated first offset (“Δ”). Specifically, while both offsets include a Δ (assuming, arguendo, that Petitioner’s interpretation of Bjontegaard is correct), the Δ is a reference to the first offset. Thus, the following table reflect the actual deblocking filters normalized based on the value of Δ. Ex-2001, ¶ 278.

	Second Offset
659 Patent	$\frac{64(p_2 - 2p_1 + p_0) + 72(q_0 - p_0) - 24(q_1 - p_1)}{256}$
Bjontegaard	$\frac{80(p_2 - 2p_1 + p_0) + 40(q_0 - p_0) - 15(q_1 - p_1)}{256}$

Petitioner completely ignores these differences and merely argues that it would have been obvious to a POSITA to reach the claimed second offset expressions using routine experimentation. Ex-2001, ¶279. Petitioner then cites to a number of prior art references, but Petitioner again fails to account for the fact that the Δ in each equation is a reference to the first offset. *Id.* Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. *Id.* In contrast, Dr. Richardson’s testing showed that any change to the filter design, including to the second offset, could have a significant impact on the operation of the filter. *Id.* For example, Dr. Richardson showed that, when applied to the same pixel values, the simulation of the ’659 Patent and Bjontegaard filtered the pixel p_1 (to which the second offset would apply) differently 76.8% of the time. Ex-2001, ¶143-145.

Thus, Petitioner has failed to show that the claimed second offset is non-obvious.

b. The third offset is not obvious in light of Bjontegaard

Bjontegaard combined with Bjontegaard's Code and a POSITA's knowledge does not teach or suggest the third offset based on $\frac{q_0j+q_2j-2q_1j-2\Delta}{4}$ disclosed in 4[b].

For similar reasons discussed above with respect to the second offset, which are incorporated by reference herein, Petitioner cannot show that the claimed third offset would have been obvious to a POSITA. See Ex-2001, §XII.D.2.b. Petitioner argues that the offsets are only different in their coefficients. However, a POSITA would not have minimized these coefficient differences as Petitioner does, because the coefficients of the third offset reflect a very specific design that affects the frequency response of the filter. Ex-2001, ¶286. The coefficients ensure that structures, such as line structures and step structures, are smoothed in a particular way or not modified. *Id.* For example, the offset of the '659 Patent would not filter a ramp, whereas the offset of Bjontegaard would. *Id.*, ¶288.

This difference is highlighted by the fact that the offsets require use of the previously-calculated first offset ("Δ"). Specifically, while both offsets include a Δ (assuming, arguendo, that Petitioner interpretation of Bjontegaard is correct), the Δ is a reference to the first offset. Ex-2001, ¶¶287-288, 278. Thus, the same normalization set forth above for the second offset to reflect the actual deblocking filters based on the value of Δ can be calculated for the third offset. *Id.* Petitioner completely ignores the resulting differences and merely argues that it would have

been obvious to a POSITA to reach the claimed third offset expressions using routine experimentation. *Id.* Petitioner has made no attempt to account for how the combination of offsets would impact the overall filter design, nor has the petition shown that any specific motivation exists in the art to combine the teachings of several references. Ex-2001, ¶¶287-288, 278, 289-290.

In contrast, Dr. Richardson's testing showed that any change to the filter design, including to the third offset, could have a significant impact on the operation of the filter. For example, Dr. Richardson showed that when applied to the same pixel values, the simulation of the '659 Patent and Bjontegaard, which have different first offsets and different third offsets, filtered the pixel q1 (to which the third offset would apply) differently 76.8% of the time. Ex-2001, ¶143-145.

In addition, Claims 5-7 depends from Claim 4. Ex-1001, cl. 4-7. Thus, for the same reasons Petitioner's Ground 1 fails with respect to Claim 4, Petitioner's challenge to Claims 5-7 fails.

VII. CONCLUSION

For the foregoing reasons, institution should be denied.

Date: September 20, 2024

Respectfully Submitted

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CERTIFICATION UNDER 37 CFR § 42.24(D)

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Patent Owner's Response to Petition totals 12,566, which is less than the 14,000 allowed under 37 CFR § 42.24(b)(1).

Date: September 20, 2024

By: / David Frist /
David Frist (Reg. No. 60,511)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e)(4), the undersigned certifies that on September 20, 2024, a complete and entire copy of this Patent Owner's Preliminary Response and its supporting exhibits were provided via email, to the Petitioner by serving the email correspondence addresses of record as follows:

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