

1 UNITED STATES DISTRICT COURT
2 DISTRICT OF NEVADA

3 SPECTRUM PHARMACEUTICALS, INC.)
4 and UNIVERSITY OF STRATHCLYDE,)

5 Plaintiffs,)

6 vs.)

7 SANDOZ INC.,)

8 Defendant.)
9

Case No.: 2:12-cv-00111-GMN-NJK

AMENDED ORDER

10 NOTE: This Amended Order is being filed for the sole purpose of correcting a
11 typographical error in the patent number. All other aspects of the original Order filed on
February 20, 2015 at ECF No. 365, remain in full force and effect.

12 I. BACKGROUND

13 1. Plaintiffs Spectrum Pharmaceuticals, Inc. and University of Strathclyde
14 (collectively, “Spectrum” or “Plaintiffs”) filed this action under the Hatch-Waxman Act
15 alleging patent infringement against Defendant Sandoz Inc. (“Sandoz”). Sandoz contends that
16 the asserted patent claims are invalid.

17 2. The Court conducted a bench trial from January 12–20, 2015, regarding the validity
18 of claims 1 and 2 of U.S. Patent No. 6,500,829 (the “’829 patent”). Having considered the
19 parties’ pleadings and filings, the testimony and credibility of the witnesses, the evidence, the
20 arguments and briefs of counsel, and the applicable law, the Court enters the following findings
21 of fact and conclusions of law pursuant to Federal Rule of Civil Procedure 52(a).

22 3. Congress passed the Hatch-Waxman Act in 1984 to promote the approval and
23 marketing of lower-cost generic drugs. See Drug Price Competition and Patent Term
24 Restoration Act, 98 Stat. 1585 (1984); *PLIVA, Inc. v. Mensing*, 131 S. Ct. 2567, 2574 (2011).
25 “Under this law, ‘generic drugs’ can gain [U.S. Food and Drug Administration (“FDA”)]

1 approval simply by showing equivalence to a reference listed drug that has already been
2 approved by the FDA.” *PLIVA*, 131 S. Ct. at 2547. “This allows manufacturers to develop
3 generic drugs inexpensively, without duplicating the clinical trials already performed on the
4 equivalent brand-name drug.” *Id.*

5 4. Spectrum is the holder of approved New Drug Application (“NDA”) No. 20-140
6 for formulations containing the active ingredient levoleucovorin. (Ex. 1A to Pretrial Order ¶ 5,
7 ECF No. 331-1). Spectrum markets drug products under NDA No. 20-140 under the name
8 Fusilev®. (*Id.*).

9 5. Pursuant to 21 U.S.C. § 355(b)(1), the ’829 patent is listed in the FDA’s
10 publication, Approved Drug Products with Therapeutic Equivalence Evaluations, commonly
11 referred to as the Orange Book, with respect to Fusilev®. (*Id.* ¶ 11). The Orange Book is the
12 authoritative reference source for drug products approved by FDA under the Federal Food,
13 Drug & Cosmetic Act. Companies self-identify those patents they contend cover their products.

14 6. Sandoz submitted Abbreviated New Drug Application (“ANDA”) No. 203563 to
15 the FDA for approval to market generic levoleucovorin products on October 26, 2011. (*Id.* ¶
16 12). On or about December 7, 2011, Plaintiffs received a letter from Sandoz pursuant to 21
17 U.S.C. § 355(j)(2)(A)(vii)(IV) regarding the ’829 patent, which asserts that the claims of the
18 ’829 patent are invalid, unenforceable, and/or will not be infringed by the manufacture, use,
19 importation, sale or offer for sale of the Sandoz ANDA product. (Compl. ¶ 19, ECF No. 1).

20 7. On January 20, 2012, Plaintiffs initiated the present action by filing a complaint
21 against Sandoz in the United States District Court for the District of Nevada alleging, inter alia,
22 that Sandoz’s submission of ANDA No. 203563 to the FDA constitutes infringement of the
23 ’829 patent. (*Id.* ¶ 24). The action was designated Civil No. 2:12-cv-00111-GMN-NJK.

24 8. This Court has subject-matter jurisdiction over this action pursuant to 28 U.S.C. §§
25 1338(a), 2201 and 2202 because this action arises under the patent laws of the United States, 35

1 U.S.C. § 1 et seq., and the Declaratory Judgment Act, 28 U.S.C. §§ 2201 and 2202.

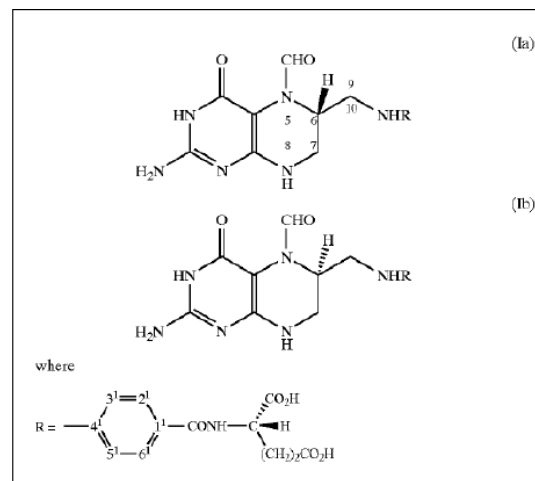
2 **II. FINDINGS OF FACT**

3 **A. LEUCOVORIN BACKGROUND**

4 **i. Leucovorin Exists as (6S) and (6R) Diastereoisomers**

5 9. Leucovorin is a chemically synthesized compound. (PTX 14; PTX 417 at 34:20–
6 35:6 (Machover)). Its chemical name is 5-formyl-(6R,S)-tetrahydrofolic acid. (PTX 14). As
7 the chemical name suggests, leucovorin contains a stereocenter at the 6 carbon. (PTX 1 at 1:30–
8 35). This stereocenter causes leucovorin to exist primarily as a 50-50 mixture of two
9 diastereoisomers, denoted as the “(6S)” and “(6R)” isomers.¹ (*Id.*).

10 10. The chemical structures of the (6S) and (6R) leucovorin isomers are depicted
11 below, where formula (Ia) represents the (6R) isomers and (Ib) represents the (6S) isomer:



20 (PTX 1 at 1:36–56).

21 11. Leucovorin (in the form of its calcium salt) has a long history of being used as a
22 pharmaceutical for human beings (first sold under the trade name Wellcovorin). (PTX 1 at
23 _____

24 ¹ The 50/50 mixture of the (6S) and (6R) leucovorin isomers is sometimes called “racemic leucovorin.” The term
25 “racemic leucovorin” is technically incorrect because “racemic” refers to enantiomers and leucovorin exists as
diastereoisomers, not enantiomers. (Tr. 274:19–275:6 (Martin)). This technical distinction is insignificant to the
Court’s decision. For the purposes of this opinion, the Court uses the term “racemic leucovorin” and
“leucovorin” to refer to a 50/50 mixture of the (6S) and (6R) leucovorin isomers.

1 1:30–35; DX 739; Tr. 164:22–25 (Suckling); 269:3–273:14 (Martin); 475:10–15 (Moran);
2 503:2–6 (Krook)). Dr. Krook and Dr. Martin provided unchallenged testimony that leucovorin
3 was first used to treat patients in the 1950s. (Tr. 289:20–22 (Martin); 503:2–6 (Krook)).

4 12. It has been known since the 1950s that between the leucovorin isomers, only the
5 (6S) isomer has desired biological activity. (PTX 1 at 1:57–61, 4:67–5:9; PTX 14; PTX 15 at
6 1:13–23; PTX 22 at 117; PTX 241 at 687; DX 732 at 70; DX 739 at 821; Tr. 165:9–15
7 (Suckling); 312:25–313:6 (Martin); 475:3–20 (Moran); 515:9–516:10 (Krook)).

8 13. The (6S) leucovorin isomer is also known as levoleucovorin, the natural leucovorin
9 isomer, Citrovorum factor, l-leucovorin, or (-)-folinic acid. (*See, e.g.*, PTX 14; PTX 15; PTX
10 242; DX 711; DX 732).

11 14. The (6R) leucovorin isomer is also known as the unnatural leucovorin isomer, or d-
12 leucovorin. (*See, e.g.*, DX 609; DX 711).

13 **ii. Leucovorin Has Been Used For Methotrexate Rescue Since the 1950s**

14 15. Leucovorin has been used in human patients since the 1950s to prevent toxic side-
15 effects of the cancer chemotherapy treatment methotrexate. (PTX 1 at 1:22–24; Tr. 164:22–25
16 (Suckling); 287:3–14 (Martin); 475:10–15 (Moran); 503:2–6 (Krook)). This use of leucovorin
17 is known as “methotrexate rescue.” (PTX 1 at 1:24–29).

18 16. Methotrexate is a chemotherapy agent that prevents the biosynthesis of DNA. (PTX
19 1 at 1:22–26). Methotrexate is toxic to normal cells as well as cancerous cells. (*Id.*).
20 Methotrexate toxicity can be inhibited by administering leucovorin. (DX 832; DX 822; Tr.
21 506:5–19, 507:3–24; 509:24–510:8, 515:9–516:7 (Krook)). In this sense, leucovorin may be
22 used as a “rescue agent,” administered 12 to 24 hours after the methotrexate, to prevent
23 methotrexate toxicity to normal cells after the methotrexate affects faster-dividing cancer cells.
24 (PTX 1 at 1:24–29). Without leucovorin rescue, the methotrexate would cause more undesired
25 side effects. (*Id.*; Tr. 506:5–19 (Krook)).

1 17. A typical daily dose of leucovorin used for methotrexate rescue is around 50 to 300
2 mg. (DX 739 at 821 (“A conventional leucovorin rescue dosage schedule is 10 mg/m² I.M. or
3 I.V. followed by 10 mg/m² orally every six hours for seventy-two hours”); Tr. 553:24–555:10
4 (Krook)). As noted in the ’829 patent, the dose range for levoleucovorin for methotrexate
5 rescue is “in the range from 25 to 150 mg.” (PTX 1 at 5:15–21).

6 18. Leucovorin has also been used for treating folate deficiency. (PTX 1 at 4:67–5:1;
7 DX 739; Tr. 516:8–10 (Krook)). For treating folate deficiency, lower doses of leucovorin
8 generally are administered. (PTX 1 at 5:21–22). As noted in the ’829 patent, the dosed range
9 for levoleucovorin used for treating folate deficiency is “from 2 to 25 mg.” (*Id.* at 5:22–24).

10 **iii. In the 1980s, Clinicians Began Using Leucovorin in Much Larger**
11 **Doses in “5-FU Combination Therapy”**

12 19. Around 1982, clinicians began using leucovorin in a different way—to enhance the
13 effects of 5-fluorouracil (“5-FU”) in the treatment of colorectal cancer. (PTX 1 at 5:1–8; PTX
14 417 at 20:18–21 (Machover)). This use of leucovorin is known as “5-FU combination therapy”
15 or “5-FU modulation.”

16 20. 5-FU is a cytotoxic chemotherapy agent. (DX 831 at 1). 5-FU is metabolized to
17 fluorodeoxyuridylic acid, which binds to and inhibits the enzyme thymidylate synthase (an
18 enzyme important in DNA repair and replication). (*Id.*). After absorption of leucovorin, the
19 (6S) isomer is readily converted to 5,10-methylenetetrahydrofolate, which acts to stabilize the
20 binding of fluorodeoxyuridylic acid to thymidylate synthase and thereby enhances the
21 inhibition of this enzyme. (*Id.*).

22 21. The development of this 5-FU combination therapy in the 1980s greatly increased
23 the use of leucovorin in terms of the number of patients administered leucovorin, and the
24 amount of leucovorin administered. (Tr. 451:5–452:1 (Moran); 514:2–13, 554:20–555:10
25 (Krook).)

1 22. A typical daily dose of leucovorin for 5-FU combination therapy for treating
2 colorectal cancer is in the range from 400 mg to 4000 mg. (PTX 1 at 5:25–28). As noted in the
3 ’829 patent, the dose range for levoleucovorin for use in combination with 5-FU is “from 200
4 to 2000 mg.” (*Id.*).

5 23. 5-FU combination therapy for treating colorectal cancer requires significantly
6 greater quantities of leucovorin than the prior uses of methotrexate rescue and treating folate
7 deficiency. (Tr. 554:2–555:10 (Krook)).

8 24. Dr. Moran testified that in the early 1980s “people were starting to use leucovorin
9 in humans at much higher levels than they usually use for methotrexate when they were
10 combining it with 5-FU.” (Tr. 451:5–452:1 (Moran)).

11 25. At the high end of the dose ranges provided in the ’829 patent, a typical daily dose
12 of leucovorin for 5-FU combination therapy is about 80 times greater than for treating folate
13 deficiency (4000 mg compared to 50 mg), and about 13.3 times greater than for methotrexate
14 rescue (4000 mg compared to 300 mg). (*See* PTX 1 at 5:15–30).

15 26. The typical dose of leucovorin in a 5-FU combination treatment course for
16 colorectal cancer is substantially greater than the daily dose. A typical treatment course in the
17 1980s was 5 days, with 3-4 weeks between repeated treatments. (*See, e.g.*, PTX 242 at 1805
18 (“Treatment comprised 5-day courses followed by drug-free intervals of 21 days”). The
19 typical dose for just one course could thus be 20,000 mg leucovorin (4000 mg daily for 5 days).
20 (*See* PTX 1 at 5:15–30). And, colorectal cancer patients typically undergo numerous courses.
21 (*See, e.g.*, PTX 242 at 1804, Table 1 (describing number of courses at evaluation from 2 to
22 14)).

23 **B. THE ’829 PATENT**

24 27. The ’829 patent is titled “Substantially Pure Diastereoisomers of Tetrahydrofolate
25 Derivatives.” (PTX 1). It issued on December 31, 2002, and was assigned to the University of

1 Strathclyde. (Ex. 1B to Pretrial Order 1, ECF No. 331-2). Spectrum is the exclusive licensee of
2 the '829 patent. (*Id.*). The '829 patent lists a September 2, 1987, earliest related U.S.
3 application and a September 3, 1986, foreign application priority date. (Ex. 1A ¶ 10; PTX 1 at
4 (63) "Related U.S. Application Data", (30) "Foreign Application Priority Data").

5 28. The '829 patent discloses a process for preparing a "substantially pure"
6 diastereoisomer of a derivative of tetrahydrofolic acid—e.g., purified (6S) leucovorin. (PTX 1
7 at 2:45–67). The disclosed process involves: (1) attaching a chiral auxiliary group to precursors
8 of the chosen diastereoisomers in a mixture so as to form a pair of new diastereoisomers; (2)
9 partially separating the pair of new diastereoisomers and recovering the new diastereoisomer
10 ((6R) or (6S)) so formed; and (3) converting the isolated, substantially pure new
11 diastereoisomer into the corresponding desired diastereoisomer. (*Id.* at 2:45–67). However,
12 none of the claims of the '829 patent cover this process. (Tr. 172:17–24 (Suckling); 242:6–24
13 (Martin); 455:8–11 (Moran)).

14 29. Ms. Liliias Rees was the primary person working on the project leading up to the
15 filing of the '829 patent. (Tr. 176:1–4 (Suckling)). Ms. Rees was a lab technician and she did
16 not have an advanced degree in life sciences prior to September 196, or at any time point. (Tr.
17 176:5–8 (Suckling)).

18 30. There is no evidence that anyone has ever used the University's method disclosed
19 in the '829 patent to manufacture a commercial product. (Tr. 181:9–17 (Suckling)). Dr.
20 Suckling testified that none of the companies that expressed interest in the '829 patent ever
21 produced a commercial (6S) leucovorin using the '829 patent's chiral auxiliary method. (Tr.
22 181:9–17 (Suckling)). Additionally, there is no evidence that Burroughs Wellcome ever used
23 the method to make a commercial product. (181:24–182:2 (Suckling)). Not even Spectrum or
24 its supplier uses the method. (Tr. 181:9–20 (Suckling)). As Spectrum's senior vice president of
25 pharmaceutical operations testified, how Spectrum's Fusilev is made is "proprietary to Merck

1 Eprova” and does not involve use of a chiral auxiliary, as in the ’829 patent. (DX 1029 at
2 15:16–18, 79:19–21, 82:10–14 (Gupta)).

3 31. The inventors of the ’829 patent also obtained U.S. Patent No. 4,959,472 (the “’472
4 patent”), which is directed to their chiral auxiliary process. (DX 501; Tr. 172:22–173:4
5 (Suckling); 261:21–262:10 (Martin)). The ’472 patent has expired. (Tr. 172:25–173:4
6 (Suckling); 262:11–12 (Martin); 600:24–601:10 (Sullivan)).

7 32. Only claims 1 and 2 of the ’829 patent were asserted at trial. (Am. Pre-Trial Order
8 ¶ 14, ECF No. 334; Tr. 242:1–19 (Martin)). Claims 1 and 2 are reproduced below:

9 **i. Claim 1**

10 33. Claim 1 of the ’829 patent is:

11 1. A pharmaceutical composition for therapeutic use which consists
12 essentially of a therapeutically effective amount sufficient for the
13 treatment of human beings for methotrexate rescue or folate
14 deficiency, of a pharmaceutically acceptable compound which is a
15 (6S) diastereoisomer selected from the group consisting of (6S)
16 leucovorin (5-formyl-(6S)-tetrahydrofolic acid) and pharmaceutically
17 acceptable salts and esters of (6S) leucovorin; wherein the compound
consists of a mixture of (6S) and (6R) diastereoisomers and consists of
at least 92% by weight of the (6S) diastereoisomer, the balance of said
compound consisting of the (6R) diastereoisomer; in combination with
a pharmaceutically acceptable carrier

18 (PTX 1 at 9:55–67).

19 **ii. Claim 2**

20 34. Claim 2 of the ’829 patent is:

21 2. The pharmaceutical composition according to claim 1 which
22 consists of greater than 95% by weight of the (6S) diastereoisomer.

23 (PTX 1 at 10:1–3).

24 35. Dr. Suckling testified that the goal of claims 1 and 2 was to reduce the (6R)
25 impurities in a (6S) composition. (Tr. 173:5–16, 174:4–7 (Suckling)).

1 **C. CLAIM CONSTRUCTION**

2 36. On January 8, 2014, the Court issued a final Claim Construction Order. (Order,
3 ECF No. 202). The Court construed disputed claim terms relevant to claims 1 and 2 of the '829
4 patent as follows:

Claim Term	Court's Construction (D.I. 202)
"mixture"	Plain and ordinary meaning
the "percentage" claim terms	Plain and ordinary meaning
"the balance of said composition consisting of the (6R) diastereoisomer"	the remaining amount of the mixture of (6S) and (6R) diastereoisomers is the (6R) diastereoisomers, and any impurities normally associated with the mixture of (6S) and (6R) diastereoisomers
"pharmaceutical composition for therapeutic use"	a pharmaceutical composition suitable for treating medical conditions
"pharmaceutical composition for preparing medicaments for therapeutic use for the treatment of human beings"	a pharmaceutical composition from which can be prepared a medicine suitable for treating medical conditions in human beings
"consists essentially of"	"the specified materials and those that do not materially affect the basic and novel characteristic(s) of the composition"
the "multiple dose" or "4,000 mg (4 grams)" claim terms	Plain and ordinary meaning; the pharmaceutical composition must contain enough of the (6S)/(6R) mixture to provide two or more doses of, at minimum, 2000 mg per dose of the mixture

17
18 (*Id.* at 24–26, 37).

19 **D. CLAIMS 1 AND 2 OF THE '829 PATENT ARE INVALID AS OBVIOUS**

20 37. The Court addresses below the level of ordinary skill in the art, the scope and
21 content of the prior art, the difference between the claims and the prior art, and the lack of
22 objective (also called "secondary") considerations of nonobviousness.

23 **i. The Level of Ordinary Skill in the Art**

24 38. Dr. Martin testified that "one of ordinary skill in the art in 1986 in the chemical
25 aspects of the patent would have a PhD in organic chemistry with two to five years of industrial

1 and/or postdoctoral experience in synthetic, organic, and/or medicinal chemistry.” (Tr. 238:10–
2 15, 238:23–239:1 (Martin)).

3 39. Additionally, “a person of ordinary skill in the art may consult with others in the
4 relevant field. For example, a person with a medical degree having the requisite experience in
5 treating patients with leucovorin could work with a person of expertise in the chemical aspects
6 of the patent.” (Tr. 238:16–22 (Martin)).

7 40. The Court credits and applies Dr. Martin’s definition of the level of ordinary skill
8 in the art.

9 41. Spectrum’s expert, Dr. Moran, applied a definition of a person of ordinary skill in
10 the art that includes a person having pharmacology and formulation science expertise. (Tr.
11 239:11–22 (Martin)). Such a person may not have significant experience with stereoisomers, or
12 in making them or separating them. (*Id.* at 239:23–240:3 (Martin)).

13 42. The Court disagrees with Dr. Moran’s definition with respect to the chemical
14 aspects of the ’829 patent, to the extent that it includes a person without significant experience
15 with stereoisomers, or in making them or separating them.

16 43. However, the Court’s conclusions on the invalidity of claims 1 and 2 of the ’829
17 patent do not change whether Dr. Martin’s or Dr. Moran’s definition is applied.

18 **ii. The Scope and Content of the Prior Art**

19 44. The prior art falls into four general categories, described below:

20 45. **Leucovorin:** Leucovorin, the 50/50 mixture of (6R) and (6S) isomers, had been
21 synthesized, studied and used clinically since at least the 1950s. The record is replete with
22 undisputed evidence that a person of ordinary skill in the art would have known that the
23 desirable properties of leucovorin (e.g. its usefulness for methotrexate rescue, folate deficiency,
24 and 5-FU combination therapy) derive in whole from the (6S) isomer. It was equally well-
25 established that the (6R) isomer lacked significant biological activity, and was an impurity

1 resulting from the way leucovorin was manufactured.

2 **46. Purified (6S) Leucovorin Made by Enzymatic Synthesis:** Before the priority
3 date, more than one group of researchers had publically reported the synthesis of purified (6S)
4 leucovorin by using an enzymatic synthesis technique.² This prior art technique had been used
5 to produce nearly 1 gram of (6S) leucovorin by scientists at the University of Strathclyde.
6 Purified (6R) isomer also had been produced by Spectrum's expert, Dr. Richard Moran, using
7 an enzymatic synthesis technique before the critical time. And, there was no technical obstacle
8 to preparing more of either isomer.

9 **47. Purified (6S) Leucovorin Made by Separation Methods:** Before the priority
10 date, more than one group of researchers had publically reported the preparation of purified
11 (6S) leucovorin by separating the (6S) and (6R) leucovorin isomers using techniques such as
12 fractional crystallization and chromatography.

13 **48. University of Strathclyde Samples Sent to Burroughs Wellcome:** Before the
14 priority date, the University of Strathclyde sent 500 mg samples of the two diastereoisomers of
15 leucovorin to a pharmaceutical company, Burroughs Wellcome.

16 **a. Prior Art: Leucovorin**

17 49. Leucovorin, the 50/50 mixture of (6R) and (6S) isomers, has been synthesized,
18 studied and used clinically since at least the 1950s. (PTX 1 at 1:30–35; PTX 14; PTX 15).

19 50. Dr. Suckling admitted that long before 1986, leucovorin was commonly used for
20 methotrexate rescue, known to have two chiral centers, and known to contain equal parts of the
21 (6S) and (6R) isomers. (Tr. 164:22–165:8 (Suckling); *see also* PTX 14; PTX 15; DX 732; DX
22 739).

23 51. Further, Dr. Suckling admitted that persons of skill in the art knew before 1986 that

24 ² Although the issue was disputed during claim construction, Sandoz did not dispute at trial whether the prior art
25 enzymatic technique also produced a small amount of the (6R) isomer, because whether or not it did does not
change the obviousness analysis. The Court agrees that the claimed composition would have been just as
obvious regardless of whether the prior art enzymatic technique produced a small amount of the (6R) isomer.

1 only the (6S) isomer was effective for methotrexate rescue, and that before 1986 leucovorin had
2 been separated into the (6S) and (6R) isomers. (Tr. 165:9–15 (Suckling); *see also* PTX 14; PTX
3 15).

4 52. As admitted in the '829 patent specification, before the priority date, a group led by
5 Dr. Donna Cosulich had separated the (6R) and (6S) leucovorin isomers by fractional
6 crystallization, and another group led by scientist Feeney had separated the isomers by
7 chromatography. (PTX 1 at 2:13–16; Tr. 166:9–20 (Suckling); PTX 14; PTX 15). Dr. Suckling
8 confirmed that the fact that the (6R) and (6S) isomers had been separated before September
9 1986 “was true in terms of what was reported in the literature.” (Tr. 167:1–7 (Suckling)).

10 53. A person of ordinary skill in the art would have known that the desirable properties
11 of leucovorin (e.g. its usefulness for methotrexate rescue, folate deficiency, and 5-FU
12 combination therapy) derive in whole from the (6S) isomer. (PTX 1 at 1:57–61, 4:67–5:1; PTX
13 14; PTX 15 at 1:15–21 (“The biologically active IL-isomer is designated l-leucovorin”); PTX
14 22 at 117 (“it has been established that the active diastereoisomer . . . has the S-configuration at
15 position 6”); DX 732 at 70 (“the enzymatically active diastereoisomer of this compound was
16 shown to have the S chirality at the 6-carbon”); DX 739 at 821 (“The biologically active
17 component of the mixture is the (-)-L-isomer”); Tr. 165:9–15 (Suckling); 312:25–313:6
18 (Martin); 475:3–20 (Moran); Tr. 515:9–516:10 (Krook)).

19 54. One example of prior art knowledge about the (6R) and (6S) leucovorin isomers is
20 the Wellcovorin entry in the Physician’s Desk Reference. (DX 739). Entries for Wellcovorin
21 Injection and Wellcovorin Tablets were published in the 1985 edition of the Physician’s Desk
22 Reference (“Wellcovorin PDR”). (DX 739; Tr. 288:15–290:10 (Martin); 514:16–516:10
23 (Krook)).

24 55. The Wellcovorin PDR discloses a pharmaceutical composition of leucovorin sold
25 under the trade name “Wellcovorin” for treating humans for methotrexate rescue or folate

1 deficiency. (DX 739 at 821–22; Tr. 288:15–289:2 (Martin); 514:16–516:10 (Krook)).

2 56. The Wellcovorin PDR also discloses that leucovorin is a mixture of the
3 diastereoisomers of leucovorin. (DX 739; Tr. 289:12–19 (Martin)). The Wellcovorin PDR
4 states that (6S) leucovorin is the biologically active component. (DX 739 at 821; Tr. 289:12–19
5 (Martin)).

6 57. The Wellcovorin PDR also discloses injectable solutions of leucovorin calcium and
7 tablets of leucovorin calcium. (DX 739 at 821). The injectable formulation contains water and
8 paraffins as preservatives. (DX 739; Tr. 289:23–290:7 (Martin)). These ingredients are
9 examples of pharmaceutically acceptable carriers for leucovorin isomers. (Tr. 290:8–10
10 (Martin)).

11 58. The Court credits Dr. Martin’s testimony that a person of ordinary skill in the art in
12 1986 would have understood from the Wellcovorin PDR that in leucovorin, the (6S) isomer
13 was the active component with clinical utility, and one would understand that the isomers could
14 be formulated easily as described in the Wellcovorin PDR. (Tr. 290:23–291:10 (Martin);
15 475:3–20 (Moran)).

16 59. Dr. Moran testified that the ’829 patent inventors incorporated the knowledge of
17 formulating a pharmaceutical product from what was already known about leucovorin drugs at
18 the time. (Tr. 475:3–15 (Moran)). A person of ordinary skill in the art in 1986 would have
19 known that they could change out the leucovorin for levoleucovorin in the Wellcovorin
20 composition that was already on the market. (Tr. 475:16–20 (Moran)).

21 60. Indeed, the specification of the ’829 patent admits that suitable pharmaceutical
22 acceptable carriers for substantially pure (6S) leucovorin “include those known in the art for
23 preparing pharmaceutical compositions containing leucovorin.” (PTX 1 at 4:58–59).

24 ///

25 ///

1 **b. Prior Art: Purified (6S) Leucovorin Prepared by Enzymatic**
2 **Synthesis**

3 61. Before the priority date, more than one group of researchers had publically reported
4 the synthesis of purified (6S) leucovorin by using an enzymatic synthesis technique.

5 62. This prior art technique had been used to produce nearly 1 gram of purified (6S)
6 leucovorin. Purified (6R) isomer also had been produced by using an enzymatic synthesis
7 technique before the critical time. And, there was no technical obstacle to preparing even more
8 of either isomer.

9 **1. Rees 1986 (PTX 22)**

10 63. Liliias Rees et al., Asymmetric Reduction of Dihydrofolate Using Dihydrofolate
11 Reductase and Chiral Boron-Containing Compounds, 42 Tetrahedron 117-136 (1986) (“Rees
12 1986”) was published in January 1986. (PTX 22). Rees 1986 is authored by the inventors of
13 the ’829 patent and a then graduate student at the University of Strathclyde, Edward Valente.
14 (PTX 22; Tr. 168:20–169:1 (Suckling); 295:10–296:10 (Martin)).

15 64. Rees 1986 discloses the synthesis of the calcium salt of (6S) leucovorin by an
16 enzymatic synthesis method. (PTX 22 at 118, 120, 129–30; Tr. 159:2–15 (Suckling); 261:2–4
17 (Martin)). Rees 1986 reports that the authors made 0.91 grams (or 910 mg) of the material.
18 (PTX 22 at 130; 159:19–20 (Suckling); Tr. 296:11–297:17 (Martin)). Both experts Dr. Moran
19 and Dr. Martin, and inventor Dr. Suckling, agreed that nearly 1 gram of (6S) leucovorin was
20 produced as reported in Rees 1986. (Tr. 89:3–10, 169:2–9 (Suckling), 296:11–297:17 (Martin);
21 460:2–6 (Moran)).

22 65. Rees 1986 reports that the enzymatic method described therein “makes the
23 possibility of synthesizing chiral 5-formyltetrahydrofolate (leucovorin) for use in cancer rescue
24 therapy attainable.” (PTX 22 at 117). Thus, Rees 1986 discloses that (6S) leucovorin created
25 by the enzymatic method described therein would be useful in cancer rescue therapy (e.g.

1 methotrexate rescue therapy). (Tr. 298:19–24 (Martin)).

2 66. Indeed, in the specification of the '829 patent, the applicants admitted that “[t]he
3 (6S) diastereoisomer has been obtained by the enzyme catalyzed reduction of dihydrofolate
4 followed-by formylation,” citing Rees 1986 for support. (PTX 1 at 2:16–19; Tr. 166:21–167:7
5 (Suckling); 299:4–25 (Martin)). The '829 patent specification states that “yields are low” with
6 the enzymatic method of Rees 1986, which is a measure of efficiency of the reaction and does
7 not refer to how much (6S) material could be made in total. (Tr. 299:11–25 (Martin)). A
8 person of ordinary skill in the art could have run a number of Rees 1986 reactions in parallel to
9 get a desired amount of material. (Tr. 300:3–11 (Martin)).

10 67. During the prosecution of the '829 patent, the applicant submitted a declaration
11 from their consultant Dr. Stanley Michael Roberts, “a professor of organic chemistry who had
12 expertise in the field of enzymes and organic synthesis.” (DX 503; DX 752; Tr. 169:20–170:11
13 (Suckling); Tr. 301:2–21 (Martin)). Dr. Roberts’s declaration states that the Rees 1986 reaction
14 that made about 0.9 grams could be scaled up and, doing a rough calculation, determined that
15 one could get about 500 grams of the material in a year. (DX 752 ¶ 11; Tr. 171:1–10
16 (Suckling); 302:3–19 (Martin)). Dr. Roberts did not include the fact that one could also have
17 run the reaction in parallel, which could greatly increase the amount of product prepared in a
18 very short time. (Tr. 302:3–19 (Martin)).

19 68. Dr. Suckling did not disagree with Dr. Roberts that the enzymatic process
20 potentially could make 500 grams of purified (6S) leucovorin in a year. (Tr. 171:1–10
21 (Suckling)). He testified that as a practical matter they could have made 10 grams and,
22 theoretically, could have made 500 grams in a year. (Tr. 171:1–10, 171:22–172:12 (Suckling)).

23 69. Mr. Valente, the graduate student who performed much of the work described in
24 Rees 1986 and an author of the publication, also testified that the Rees 1986 process could have
25 been repeated to produce more than 1 gram of (6S) leucovorin. (DX 1030 at 33:4–7, 99:2–10

1 (Valente)). Dr. Suckling testified that Mr. Valente did all of the lab work on the enzymatic
2 process along with Ms. Rees. (Tr. 168:20–169:1 (Suckling)).

3 70. Thus, Rees 1986 discloses an operable prior art method for generating purified (6S)
4 leucovorin. (Tr. 261:2–4 (Martin)). Furthermore, the Rees 1986 method easily made more than
5 the “therapeutically effective amount sufficient for the treatment of human beings for
6 methotrexate rescue or folate deficiency” claimed in the ’829 patent. As described in the
7 background section above, the typical daily doses of (6S) leucovorin range from 2 to 25 mg for
8 folate deficiency, and from 25 to 150 mg for methotrexate rescue. (*See* PTX 1 5:15–25). The
9 910 mg reported in Rees 1986 would have been more than the claimed amount “sufficient” for
10 methotrexate rescue or folate deficiency treatment.

11 **2. Moran (1982) (DX 732)**

12 71. Richard Moran & Paul Colman, A Simple Procedure for the Synthesis of High
13 Specific Activity Tritiated (6S)-5-Formyltetrahydrofolate, 122 Analytical Biochemistry 70-78
14 1982) (“Moran”), was published in 1982. (DX 732; Tr. 305:10–25 (Martin); Tr. 445:3–11
15 (Moran)). Dr. Moran was Spectrum’s technical expert at trial.

16 72. Moran also discloses the preparation of (6S) leucovorin by the enzymatic reduction
17 of dihydrofolic acid followed by formylation, which is the basically same method described in
18 Rees 1986. (DX 732; Tr. 306:1–14 (Martin); Tr. 445:12–446:3 (Moran)).

19 73. Moran describes the (6S) leucovorin isomer as an active pharmaceutical ingredient,
20 and described using calcium leucovorin to treat human beings for methotrexate rescue. (DX
21 732 at 70–71). Moran proposes using (6S) leucovorin to study the mechanism of reversal of
22 methotrexate toxicity. (*Id.*). Moran reports a bioassay showing that its (6S) leucovorin
23 composition was about twice as active as the (6R,S) mixture composition. (*Id.* at 75).

24 74. Rees 1986 and Moran taught that pure (6S) leucovorin could be readily made
25 before the priority date for the ’829 patent. (PTX 22; DX 732; Tr. 307:4–12 (Martin); Tr.

1 445:12–446:3 (Moran)).

2 75. The (6S) leucovorin compositions prepared by enzymatic synthesis techniques
3 described in Rees 1986 and Moran contained impurities other than the (6R) isomer impurity.
4 Rees 1986 and Moran employed basically the same method, and Moran discloses the synthesis
5 of (6S) leucovorin resulted in a purity “in excess of 95%”—in other words, less than 5%
6 impurities. (DX 732 at 74, Figure 1B; Tr. 448:9–19 (Moran)).

7 **c. Prior Art: Purified (6S) Leucovorin Made by Separation**
8 **Methods**

9 76. As admitted in the '829 patent, separation of the two leucovorin isomers had been
10 carried out by fractional crystallization and by chromatography prior to the priority date. (PTX
11 1 at 2:13–21).

12 **1. Cosulich 1952 (PTX 14)**

13 77. “Cosulich 1952” is an article published in the peer-reviewed Journal of the
14 American Chemical Society in 1952, titled “Diastereoisomers of Leucovorin.” (PTX 14; Tr.
15 276:14–21 (Martin)).

16 78. The Court accepts Dr. Martin’s uncontested testimony that the Journal of the
17 American Chemical Society is “one of the most prestigious journals in chemistry in the world”
18 today and certainly was in 1952. (Tr. 276:14–277:16 (Martin)).

19 79. Cosulich 1952 discloses that leucovorin is a mixture of diastereoisomers, the dL
20 and IL isomers, which are the (6R) and (6S) isomers of leucovorin, respectively. (PTX 14; Tr.
21 277:17–25 (Martin)). It teaches that the (6S) isomer is the biologically active component of the
22 mixture, and that (6S) leucovorin is about twice as active as the mixture itself. (PTX 14; Tr.
23 278:9–18).

24 80. Cosulich 1952 reports the separation of (6S) and (6R) leucovorin isomers utilizing
25 the difference in solubility of the calcium salts. (PTX 14). As Dr. Martin explained,

1 diastereoisomers have different physical properties, and one manifestation of a physical
2 property is solubility. (Tr. 280:17–281:2 (Martin)).

3 81. Cosulich 1952 reports the isolation of (6S) leucovorin having an optical rotation of
4 -15.1° . (PTX 14; Tr. 281:21–282:8 (Martin); Tr. 473:12–20 (Moran)). Due to the nature of the
5 separation method described in Cosulich, (6S) leucovorin isolated by the method would have
6 invariably existed as a mixture also containing (6R) leucovorin as an impurity. (Tr. 295:3–9
7 (Martin)). A person of ordinary skill would have understood this fact. (*Id.*).

8 82. The reported optical rotation of the (6S) isomer in Cosulich 1952 is consistent with
9 what scientists later confirmed—namely, that the optical rotation of (6S) leucovorin is about $-$
10 15° . (Tr. 283:6–16 (Martin); Tr. 473:12–20 (Moran)). Dr. Martin testified that the optical
11 rotation reported in Cosulich 1952 for the (6S) isomer is “right on the money” for (6S)
12 leucovorin. (Tr. 283:6–16 (Martin)). Dr. Moran testified that the data “is compatible with it
13 being the (6S) diastereomer” and “within the range of what’s commonly accepted now as the
14 correct thing.” (Tr. 473:12–20 (Moran)).

15 83. Furthermore, Cosulich 1952 reported that the isolated (6S) isomer had nearly twice
16 the activity as the mixture of isomers using a *Leuconostoc citrovorum* assay and by examining
17 PGA activity—exactly what would be expected for the (6S) isomer. (PTX 14; Tr. 278:19–279:6
18 (Martin)).

19 84. The Court credits Dr. Martin’s opinion that “[i]n 1986, a person of ordinary skill
20 would read this article and understand that leucovorin was a mixture of two stereoisomers; that
21 one of the isomers had all of the activity, and that that isomer was the (6S) isomer.” (Tr. 279:7–
22 280:9 (Martin)). This knowledge would have motivated a person of ordinary skill in the art to
23 make the purified (6S) leucovorin isomer. (Tr. 280:11–14 (Martin)).

24 85. The data from the optical rotation and biological activity analyses reported in
25 Cosulich 1952 demonstrate that Dr. Cosulich generated purified (6S) leucovorin. All trial

1 witnesses agreed or did not dispute this fact.

2 86. For example, Dr. Suckling testified that he did not doubt that Dr. Cosulich obtained
3 purified (6S) leucovorin, noting that the article was peer reviewed and that “[a] scientist would
4 normally attribute veracity to somebody else’s results.” (Tr. 167:8–23 (Suckling)).

5 87. Moreover, Dr. Martin said that the publication data “indicates to me. . . that she has
6 the pure (6S) isomer.” (Tr. 283:6–16 (Martin)).

7 88. Additionally, Dr. Moran testified “if I were a betting man . . . I would say she got
8 it.” (Tr. 474:13–15 (Moran)).

9 89. Indeed, in the specification of the ’829 patent, the inventors admitted that
10 “[s]eparation of the two diastereoisomers of leucovorin has been carried out by fractional
11 crystallisation,” citing Cosulich 1952 to support this statement. (PTX 1 at 2:13–15).

12 90. Thus, Cosulich would have provided motivation to a person of skill in the art to
13 make a substantially pure (6S) leucovorin pharmaceutical product as recited in the claim 1 and
14 2 of the ’829 patent. (Tr. 279:7–10, 280:5–14 (Martin); 450:25–451:7 (Moran)).

15 2. Cosulich ’018 Patent (PTX 15)

16 91. U.S. Patent No. 2,688,018 (the “’018 patent”) issued on August 31, 1954. (PTX 15;
17 Tr. 286:2–287:2 (Martin)). The ’018 patent is titled “Method of Preparing Alkaline Earth
18 Metal Salts of l-Leucovorin.” (PTX 15). The inventor of the ’018 patent is Dr. Cosulich. (*Id.*).

19 92. The ’018 patent discloses and claims a method for isolating calcium l-leucovorin,
20 which is (6S) leucovorin. (*Id.*; Tr. 286:2–287:2 (Martin)). It discloses the isolation of (6S)
21 leucovorin having an optical rotation of -15.2° . (PTX 15 at 1:52–2:8; 2:21–42; Tr. 288:5–14
22 (Martin)). As Dr. Martin explained about the optical rotation data, the fact that Dr. Cosulich
23 obtained a constant rotation “supports the fact that she had pure (6S).” (Tr. 288:11–14
24 (Martin)).

25 93. The ’018 patent also discloses that calcium leucovorin was known for treating

1 humans for methotrexate rescue. (PTX 15 at 1:10–36). It teaches that the isolated (6S) isomer
2 is about twice as active for *Leuconostoc citrovorum* 8081 as the mixture of (6S) and (6R)
3 isomers. (*Id.* at 2:5–8).

4 94. The data from the optical rotation and biological activity analyses reported in the
5 '018 patent demonstrate that Dr. Cosulich's method generated highly pure (6S) leucovorin.

6 95. The Court credits Dr. Martin's testimony that a person of ordinary skill in the art in
7 1986 would have understood from the '018 patent that there is a clinically useful drug called
8 leucovorin, which is a mixture of stereoisomers, and that the (6S) isomer has the desired
9 biological activity. (Tr. 287:15–24 (Martin)). This understanding would have motivated a
10 person of skill in the art in 1986 to make purified (6S) leucovorin. (Tr. 287:25–288:4 (Martin)).

11 96. Plaintiffs offered the trial testimony of Dr. Bannister who found that Cosulich was
12 not repeatable by him. (Tr. 400:3–14 (Bannister)). But, Dr. Bannister did not offer any opinion
13 one way or the other on whether Dr. Cosulich made highly pure (6S) leucovorin in the 1950s.
14 (Tr. 425:16–20 (Bannister)).

15 97. Dr. Bannister admitted that he was not aware of any scientific literature stating that
16 Dr. Cosulich and her team did not make purified (6S) leucovorin as described in Cosulich. (Tr.
17 424:11–15 (Bannister)).

18 98. Plaintiffs also offered statements made by various patent applicants that the method
19 of Cosulich was not repeatable. (PTX 18; PTX 159; PTX 236; Tr. 407:22–25, 409:11–17,
20 411:10–14 (Bannister)).

21 99. However, no witness testified that Dr. Cosulich did not obtain highly pure (6S)
22 leucovorin, and in fact Drs. Martin, Suckling and Moran all testified that they believed Dr.
23 Cosulich did so. (Tr. 167:8–18 (Suckling); 283:6–16 (Martin); 474:13–15 (Moran)). And, as
24 Dr. Moran testified, the Journal of the American Chemical Society has “never retracted this
25 paper [Cosulich]” even though “they had a long time to do it.” (Tr. 470:20–471:9 (Moran)).

1 100. Cosulich 1952 and the '018 patent qualify as prior art for purposes of the
2 obviousness analysis.

3 **d. Prior Art: University of Strathclyde Samples Sent to Burroughs**
4 **Wellcome**

5 101. Although the parties introduced evidence relating to samples sent to Burroughs
6 Wellcome, the Court does not make any factual findings on this evidence because such findings
7 are not necessary to the Court's conclusions of law.

8 **iii. There Was a Strong Motivation Prior to September 1986 to Produce**
9 **“Substantially Pure” (6S) Leucovorin**

10 **a. Skilled Persons Knew (6S) Leucovorin Had Desired**
11 **Biological Properties**

12 102. A person of ordinary skill in the art of the '829 patent would have known that
13 leucovorin's usefulness for methotrexate rescue, folate deficiency, and 5-FU combination
14 therapy derived wholly from the (6S) isomer, whereas the (6R) isomer was an undesired
15 impurity. (PTX 1 at 1:57–61, 4:67–5:1; PTX 14; PTX 15 at 1:13–22; PTX 22 at 117; PTX 241
16 at 687; DX 732 at 70; DX 739 at 821; Tr. 165:9–15 (Suckling); 312:25–313:6 (Martin); 475:3–
17 20 (Moran); 515:9–516:10 (Krook)). Therefore, as Dr. Martin testified, the skilled person
18 would have “very definitely” been motivated to make purified (6S) leucovorin. (Tr. 312:25–
19 313:9, 331:15–332:24 (Martin)). Drs. Moran and Suckling agreed. (Tr. 116:2–7 (Suckling);
20 450:25–451:7 (Moran)). Dr. Suckling explained that “clearly, if one were able to obtain the
21 (6S) isomer in high degree of purity, potentially at least, that might lead to an enhanced
22 product.” (Tr. 85:21–86:5 (Suckling)).

23 **b. Scientists Hypothesized that the (6R) Isomer Could Have a**
24 **Deleterious Effect in 5-FU Combination Therapy**

25 103. Dr. Moran testified that in the early 1980s “people were starting to use leucovorin

1 in humans at much higher levels than they usually use for methotrexate when they were
2 combining it with 5-FU.” (Tr. 451:5–452:1 (Moran)).

3 104. A person skilled in the art would have known that only the (6S) isomer is the
4 effective agent for 5-FU combination therapy. (PTX 417 at 21:8–22:13, 23:3–16 (Machover);
5 DX 831 at 1 (“The d-isomer of racemic [leucovorin] has no biologic activity”); PTX 241 at 695
6 (“At this time, it is not known whether the D-isomer can interact with TS and FdUMP to form a
7 ternary complex”); DX 739 at 821 (“The biologically active component of the mixture is the (-
8)-L-isomer”); Tr. 312:25–313:6 (Martin); 450:25–451:7 (Moran)).

9 105. However, preclinical studies from the 1970s and 1980s raised a research
10 hypothesis that the presence of large amounts of the (6R) isomer in the body could have some
11 deleterious effect on the modulation of 5-FU by the (6S) isomer. (*See, e.g.*, DX 609 at 908
12 (explaining that “the possibility of a deleterious effect of the unnatural [(6R)] isomer on the
13 modulation of FU cannot be ruled out”); PTX 417 at 45:4–24 (Machover)).

14 106. Dr. David Machover, a clinician experienced with 5-FU combination therapy
15 testified that “we made the hypothesis that the D-form was, the D-form was deleterious . . . for
16 the modulation of the fluorinated pyrimidine” (PTX 417 at 45:4–24 (Machover)). He
17 explained that a large excess of the (6R) isomer in the plasma could compete with (6S) for
18 entry into the cell, and if it enters the cell, could compete with the enzyme for polyglutamation
19 of the folate species that are required for 5-FU modulation. (*Id.* at 38:11–39:19 (Machover)).
20 By the mid-1980s it was a “hypothesis” that the (6R) isomer could be lowering the intracellular
21 concentration of the folate species (derived from the (6S) isomer), preventing optimal inhibition
22 of the thymidylate synthase enzyme, which is wanted for 5-FU modulation. (*Id.* at 40:19–41:13
23 (Machover)).

24 107. Dr. Suckling testified that, when the University started researching leucovorin in
25 the early 1980s, “nobody knew whether the (6R) was a good thing or a bad thing” and the “jury

1 was out” since it had not been “investigated to say what the situation was.” (Tr. 84:3–4, 84:15–
2 16, 86:6–9, 173:19–174:3 (Suckling)).

3 108. This research hypothesis provided a rationale for investigating a purified (6S)
4 leucovorin pharmaceutical product, meaning one with significantly less of the (6R) isomer
5 impurity compared to leucovorin. (DX 831 at 1).

6 109. The concern about the (6R) in connection with 5-FU modulation did not exist
7 with regard to methotrexate rescue, because of the different mechanisms involved, and because
8 leucovorin could be given orally for methotrexate rescue and it was known that when
9 leucovorin is given orally, only the (6S) isomer is absorbed in significant amounts. (DX 739
10 (disclosing Wellcovorin tablets for oral administration); PTX 417 at 106:21–107:11
11 (Machover) (“Orally, the D-form is not absorbed. It is not absorbed by the intestine, or just in
12 very low amounts.”); Tr. 521:4–7 (Krook) (“giving [leucovorin] orally stereoselects out the
13 (6S). In other words, more (6S) is absorbed through the gut than the (6R).”)).

14 **c. Near-Simultaneous Developments of “Substantially Pure”**
15 **(6S) Leucovorin Evidences the Strong Motivation**

16 110. Besides the University of Strathclyde, numerous other research groups had
17 responded to the motivation and were pursuing purified (6S) leucovorin prior to the priority
18 date for the '829 patent. (Tr. 450:25–451:7 (Moran)). In short time, many succeeded. (DX 788;
19 DX 791; DX 793; Tr. 337:18–338:4, 339:3–15, 340:2–341:4 (Martin)).

20 111. For example, researchers including Dr. Eguchi and others at the Kyowa Hakko
21 Kogyo Company in Japan obtained a patent titled “Process For Producing L(-)-Tetrahydrofolic
22 Acid” with a priority date of August 30, 1988. (DX 788; Tr. 337:18–338:4 (Martin)).

23 112. Researchers including Dr. Mueller and others at Eprova A.G. in Switzerland
24 (Merck Eprova) obtained a patent titled “Process for Separating Folinic Acid” with a priority
25 date of May 15, 1987. (DX 791; Tr. 338:13–19 (Martin)). Dr. Suckling testified that Merck

1 Eprova's process was different than the process described in the '829 patent. (PTX 404; Tr.
2 190:21–191:3 (Suckling)).

3 113. Researchers including Dr. Schlingmann and another at American Cyanamid
4 Company in New Jersey obtained a patent titled “Process for the Preparation of Optically Pure
5 Diastereoisomers of Tetrahydrofolate Compounds Using 10-Formyltetrahydrofolate Synthetase
6 from Clostridium” with a priority date of Dec. 11, 1989. (DX 793; Tr. 339:3–15 (Martin)).

7 114. These patents to Drs. Eguchi, Mueller and Schlingmann teach different methods
8 for making purified (6S) leucovorin, or precursors of (6S) leucovorin. (Tr. 340:2–341:4
9 (Martin)).

10 115. The work leading to these patents would have been done well before their priority
11 dates. (Tr. 340:2–341:4 (Martin)). The patents evidence that numerous companies responded to
12 the motivation for new methods for making highly pure (6S) leucovorin, and quickly
13 succeeded. (*Id.*).

14 **iv. A Skilled Person Could Have Easily Made the Claimed “Substantially**
15 **Pure” (6S) Leucovorin**

16 116. The asserted claims do not require that the claimed composition be made through
17 any particular process, let alone by a singular process described in the prior art. (Tr. at 242:23–
18 24 (Martin)). As Dr. Martin explained, “any process that you could come up with to make [the
19 claimed composition] would be fine.” (*Id.*).

20 117. By the priority date, the purified (6S) leucovorin isomer could have been made,
21 and had been made in ample quantity, by at least the enzymatic techniques in Rees 1986 and
22 Moran. Dr. Moran testified that there was no technical or scientific obstacle to making more of
23 the enzyme in Rees 1986 so as to be able to produce more purified (6S) leucovorin. (Tr. 465:6–
24 11 (Moran)).

25 118. Dr. Moran had even published how to successfully make the purified (6R)

1 leucovorin isomer. (Tr. 467:7–20 (Moran)). When asked whether he could have made more,
2 Dr. Moran testified “Certainly. I mean, it just is a question of how much time do you have to
3 do what.” (Tr. 469:9–17 (Moran)).

4 119. It would have been very easy for a person of ordinary skill to make the claimed
5 compositions by combining the prior art compositions. (Tr. 361:6–15 (Martin)). For example,
6 the purified (6S) and (6R) leucovorin isomers could have been combined (Tr. 469:9–17). Dr.
7 Moran testified “[n]obody would debate” that it could have been done. (*Id.*).

8 120. The only quantity-related limitation in claims 1 and 2 is “a therapeutically
9 effective amount sufficient for the treatment of human beings for methotrexate rescue or folate
10 deficiency.” (PTX 1 at claim 1; Tr. 177:2–6 (Suckling); 329:15–25 (Martin)). As stated in the
11 ’829 patent specification, and confirmed by Dr. Suckling, the therapeutically effective amount
12 is on the scale of about 2 to 25 mg for folate deficiency, and 25 to 150 mg for methotrexate
13 rescue. (PTX 1 at 5:15–25; Tr. 178:17–24 (Suckling)).

14 121. The Rees 1986 enzyme method produced 910 mg of purified (6S) leucovorin, and
15 there was no technical problem making more. (Tr. 171:22–172:12 (Suckling); 300:8–11
16 (Martin); 469:9–12 (Moran)).

17 122. The 910 mg of purified (6S) leucovorin produced in Rees 1986 was significantly
18 more than the amount required by claims 1 and 2 of the ’829 patent. (Tr. 461:13–19, 465:13–18
19 (Moran)). Furthermore, Dr. Moran himself had produced and published how to produce more
20 than the claimed therapeutically effective amount of purified (6S) leucovorin in his Moran
21 publication. (DX 732; Tr. 465:19–23 (Moran)).

22 **v. A Skilled Person Would Have Expected the Claimed Compositions to**
23 **Have the Same Properties as Pure (6S) Leucovorin**

24 123. Dr. Suckling testified that the chiral auxiliary process of the ’829 patent could
25 produce 99 or even 99.99 pure (6S) leucovorin. (Tr. 109:5–14, 162:17–163:4; 174:25–175:10

1 (Suckling)). Assuming that Rees 1986 and Moran produced 100% pure (6S) leucovorin, the
2 difference between that and a 99.99 pure (6S) leucovorin composition prepared according to
3 the '829 patent would be meaningless because such composition would have the identical
4 properties. (*See* DX 1031 at 289:4–294:15 (Reider)).

5 124. A person of ordinary skill in the art would not have expected there to be any
6 differences in the biological properties between purified (6S) leucovorin with or without a
7 small amount of (6R) impurity. (DX 1031 at 289:4–294:15 (Reider); Tr. 179:5–14 (Suckling);
8 328:22–329:1 (Martin)). This is because small amounts of the inactive isomer would not be
9 noticeable in terms of therapeutic effects. (DX 1031 at 289:4–294:15 (Reider); Tr. 329:2–8
10 (Martin)). Plaintiffs' expert Dr. Reider testified that for leucovorin, "once you get above, you
11 know, 92%, 90% . . ." (6S) leucovorin isomeric purity, "I don't think any biological system can
12 tell the difference." (DX 1031 at 289:4–294:15 (Reider)).

13 125. Furthermore, clinical trials have established that purified (6S) leucovorin and
14 leucovorin are clinically interchangeable. (DX 607, DX 609, DX 711, DX 823, DX 831; Tr.
15 524:4–12, 540:20–25 (Krook)).

16 126. Dr. Moran agreed that minor difference between the prior art and the claims
17 offers no meaningful difference from the prior art. (Tr. 460:7–13 (Moran)). Dr. Moran testified
18 that the "only advantage" of the composition in claims 1 and 2 over the Rees 1986 prior art is
19 that it was possible to make more of the composition in the claims. (*Id.*).

20 127. Dr. Suckling agreed, too. He also testified that the "only advantage" of the
21 composition made by the '829 patent process over the composition in Rees 1986 is that more
22 could be made with the process in the '829 patent. (Tr. 202:18–203:5 (Suckling)).

23 ///

24 ///

25 ///

1 **vi. Secondary Considerations Do Not Support Nonobviousness**

2 **a. The Claimed Composition Did Not Satisfy Any Long-Felt**
3 **But Unsolved Need**

4 128. Dr. Krook, Sandoz’s expert in oncology, hematology, and clinical research
5 provided un rebutted testimony that, by 1986, leucovorin had been used in smaller doses for
6 methotrexate rescue or folate deficiency for decades, with no clinical concern about the (6R)
7 isomer. (Tr. 503:2–6; 556:1–4 (Krook); DX 832; DX 822; DX 739). Dr. Krook testified that
8 there has never been a clinical problem with leucovorin, and that there has never been a clinical
9 need for purified (6S) leucovorin. (Tr. 504:16–22 (Krook)).

10 129. Clinical trials from as early as 1967 and 1970 reported the effectiveness of
11 leucovorin for methotrexate rescues and made no mention of any problem with the (6R) isomer.
12 (Tr. 507:25–508:3, 510:19–22 (Krook); DX 832; DX 822). Likewise, the Wellcovorin PDR in
13 1985, which has information about the indications for methotrexate rescue and folate
14 deficiency, does not mention any concern about (6R) isomer. (Tr. 516:1–13 (Krook); DX 739).

15 130. Thus, there was no long-felt unmet need for a purified (6S) leucovorin product for
16 the methotrexate rescue and folate deficiency uses, which are the only uses recited in claims 1
17 and 2 of the ’819 patent.

18 131. Dr. Machover’s 1982 publication describing one of the first clinical investigations
19 of leucovorin in 5-FU combination therapy (“Machover 1982”) expresses no concern about the
20 (6R) isomer expressed. (PTX 242; Tr. 513:15–514:1 (Krook)). To the contrary, Machover
21 1982 encouraged clinicians to continue to use leucovorin in this way. (Tr. 514:2–13 (Krook)).

22 132. In addition, Claims 1 and 2 define the need being addressed by the ’829 patent—
23 “[a] pharmaceutical composition for therapeutic use,” which the Court construed to mean “a
24 pharmaceutical composition suitable for treating medical conditions.” (Order, ECF No. 202).
25 In other words, a composition for treatment of patients. The need identified in the patent is not

1 for research.

2 133. The research hypothesis identified by Spectrum to investigate purified (6S)
3 leucovorin in relation to 5-FU combination therapy never developed into a pharmaceutical
4 need, which is the relevant need in the '829 patent.

5 134. Dr. Krook's unchallenged testimony was that, before and after 1986, cancer
6 doctors have considered leucovorin and levoleucovorin to be interchangeable. (Tr. 524:4–12,
7 540:20–25 (Krook)).

8 135. Dr. Suckling testified that he is not aware of any information in the art that the
9 (6S) isomer of his invention is more therapeutically effective than the prior art commercially
10 available leucovorin. (Tr. 179:5–14 (Suckling)).

11 **1. Goldberg (DX 711)**

12 136. Dr. Krook's clinical research study was among the first major studies comparing
13 the clinical safety and efficacy of leucovorin and levoleucovorin ("Goldberg"). (DX 711; Tr.
14 517:10–518:11 (Krook)). Goldberg reported a large clinical study, ultimately enrolling 926
15 patients with advanced colorectal cancer. (DX 711 at 3320; Tr. 519:18–522:23 (Krook)).
16 Patients received one of three treatment regimens, generally: (A) 5-FU plus intravenous
17 levoleucovorin; (B) 5-FU plus oral leucovorin; or (C) 5-FU plus intravenous leucovorin. (DX
18 711; Tr. 519:18–522:23 (Krook)).

19 137. Goldberg reported no difference in response, survival, or toxicity between the
20 three different treatment regimens. (DX 711 at 3320, 3323–3326; Tr. 522:24–523:18 (Krook)).
21 The conclusions of the clinical trial was that "there is no compelling reason to use either the
22 purified l-isomer form of leucovorin or the oral administration of the (d,l) form of the drug" as
23 there was equivalent toxicity and outcome with leucovorin and levoleucovorin. (DX 711 at
24 3328; Tr. 523:12–18 (Krook)).

25 ///

1 [PK]/pharmacodynamic studies and 1 population PK study); and 40 case studies,” including the
2 Goldberg and Scheithauer articles discussed above. (DX 831 at 201; Tr. 533:23–534:15
3 (Krook)). Koor concludes, “There seems to be no difference in efficacy or side effects
4 between the 2 formulations of LV [i.e., levoleucovorin and leucovorin], whether they are used
5 in combination with other chemotherapeutic agents” or alone. (DX 831 at 200, 205; Tr.
6 534:19–535:21 (Krook)). Koor also concludes that given a shortage in racemic leucovorin,
7 levoleucovorin would be a clinically interchangeable alternative, but more expensive. (DX 831
8 at 205; Tr. 534:19–535:21 (Krook)).

9 **4. Chuang (DX 823)**

10 143. Dr. Krook also testified that he agreed with the conclusions of a 2012 report by
11 Victor Tuan Giam Chuang & Manabu Suno, titled “Levoleucovorin as Replacement for
12 Leucovorin in Cancer Treatment” (“Chuang”). (DX 823 at 1349; Tr. 530:22–531:14, 533:4–5
13 (Krook)).

14 144. After a search of articles published between January 1980 and April 2012, the
15 authors analyzed articles “evaluating the efficacy, interchangeability, and safety of
16 levoleucovorin.” (DX 823 at 1349; Tr. 531:7–532:11 (Krook)). With respect to efficacy, the
17 authors conclude that “the use of levoleucovorin as a biochemical modulator of fluorouracil or
18 in high-dose methotrexate therapy rescue demonstrate that levoleucovorin is as efficacious as
19 leucovorin and that no clear increase in the percentage of grade 3 or 4 toxicity profiles when
20 patients were given levoleucovorin.” (DX 823 at 1353; Tr. 532:12–18 (Krook)). The authors
21 also found “no significant differences between levoleucovorin and leucovorin with respect to
22 adverse events.” (DX 823 at 1353; Tr. 532:12–18 (Krook)).

23 145. Chuang also concluded that the “current shortage of the supply of leucovorin
24 centered in North America renders levoleucovorin a reasonable alternative in terms of efficacy
25 and toxicity profile, but from the perspective of cost, leucovorin remains the drug of choice.”

1 (DX 823 at 1349; Tr. 532:12–25 (Krook)).

2 **5. Han (DX 607)**

3 146. Dr. Krook also testified that he agreed with the conclusions of a report by David
4 Han and others, titled “Phase I, Open-Label, Single Dose, Two-Way Crossover Bioequivalence
5 Study of Levoleucovorin and d,l-Leucovorin in Healthy Volunteers” (“Han”). (DX 607; Tr.
6 536:4–23, 539:14–20 (Krook)).

7 147. Notably, one of the authors is a Vice President of Spectrum. (DX 607 at
8 SPPI_SANDOZ0017979; Tr. 540:1–6 (Krook)). The study was also funded by Spectrum. (DX
9 607 at SPPI_SANDOZ0017980; Tr. 539:21–25 (Krook)). The study was never published. (Tr.
10 540:7–8 (Krook)).

11 148. The primary purpose of the study was to evaluate the bioequivalence of
12 levoleucovorin and leucovorin in healthy volunteers. (DX 607 at SPPI_SANDOZ0017981; Tr.
13 536:24–537:11 (Krook)). Forty-three patients were randomly assigned to one of two treatment
14 sequences: a 2-hour IV infusion of levoleucovorin 200 mg/m² or leucovorin 400 mg/m² on Day
15 1 (Period 1) followed by crossover to infusion of the alternative treatment on Day 8 (Period 2),
16 separated by a one-week washout period. (DX 607 at SPPI_SANDOZ0017981; Tr. 537:17–
17 538:14 (Krook)).

18 149. The authors concluded that levoleucovorin and leucovorin were bioequivalent,
19 and that levoleucovorin and leucovorin “may be used interchangeably in clinical practice,”
20 mentioning the many clinical applications of leucovorin. (DX 607 at SPPI_SANDOZ0017992,
21 SPPI_SANDOZ0017981; Tr. 538:15–539:13 (Krook)).

22 150. Accordingly, there is no evidence of a pharmaceutical need for purified (6S)
23 leucovorin. Purified (6S) leucovorin and leucovorin are clinically interchangeable and,
24 therefore, the claimed subject matter could not have satisfied any unmet clinical need since it is
25 interchangeable with the prior art.

b. Spectrum's Leucovorin Product Is Not a Commercial Success

1
2 151. At trial, Spectrum argued that the licensing of the '829 patent evidences the value
3 of the invention.

4 152. The Court finds no nexus between Spectrum's evidence on licensing and the
5 claims.

6 153. Spectrum presented evidence on an exclusive option agreement in 1987 for rights
7 to the '829 patent between the University and Burroughs Wellcome. (Tr. 130:3-5 (Suckling);
8 PTX 7). Burroughs Wellcome, however, never exercised its option. (Tr. 131:9-10, 182:15-17
9 (Suckling); Tr. 568:15-22 (Sullivan)). Dr. Suckling admitted that Burroughs Wellcome was
10 having a racemization problem with the '829 patent process as late as 1989, which is over two
11 years after Dr. Wood disclosed the process to them. (DX 526; DX 533; Tr. 182:15-23, 184:12-
12 25, 187:13-24; 189:4-15 (Suckling)). In August 1988, Burroughs Wellcome resorted to
13 separating the leucovorin isomers by chromatography because the '829 process was not
14 working. (DX 526; Tr. 185:16-22, 188:17-20 (Suckling)).

15 154. The fact that an option was not exercised and no license agreement was entered
16 into is not evidence of commercial success. (Tr. 569:13-24 (Sullivan)).

17 155. Spectrum introduced evidence of other organizations reaching out to the
18 University regarding the '829 patent, but the University did not enter into any licensing
19 agreements with these organizations. (Tr. 132:15-134:23 (Suckling); PTX 8; PTX 9). After the
20 lapse of the option agreement with Burroughs Wellcome, the University had the ability to
21 license the '829 patent to other parties but no companies besides American Cyanamid and
22 Spectrum ever took a license to the '829 patent. (Tr. 201:20-202:8 (Suckling); Tr. 571:17-
23 572:1 (Sullivan)).

24 156. Expressing interest without actually entering into a license agreement is not
25 probative of commercial success. (Tr. 569:13-15 (Sullivan)).

1 157. The only companies to take a license to the '829 patent are American Cyanamid
2 (Lederle) and Spectrum. (Tr. 201:16–202:8 (Suckling)).

3 158. Spectrum presented evidence of the University's license with American
4 Cyanamid and royalties under this license. (Tr. 141:8–10 (Suckling); PTX 12). The license was
5 not exclusive. (Tr. 200:15–18 (Suckling); PTX 12).

6 159. The license with American Cyanamid included not only the application that
7 became the '829 patent but also patent applications in several other countries including Canada,
8 Japan, and countries in Europe. (Tr. 199:17–21 (Suckling); PTX 12).

9 160. Dr. Suckling admitted he could not “subdivide” the amount received specifically
10 for the license for the '829 patent from the total income received for the whole leucovorin
11 project from American Cyanamid. (Tr. 197:20–198:13 (Suckling)).

12 161. Spectrum also presented evidence on the University's current license of the '829
13 patent to Spectrum. (Tr. 141:13–14 (Suckling)). Dr. Suckling conceded that “not a lot of
14 money” was made by the University from this license. (Tr. 197:23–198:1 (Suckling)).

15 162. For the license that Spectrum ultimately acquired, the University received a
16 onetime, up-front payment of \$50,000 and a running royalty of one percent of sales for the use
17 of methotrexate therapy. (Tr. 581:10–582:16 (Sullivan); DX 611).

18 163. Dr. Suckling did not know how much money the University has been paid by
19 Spectrum for the license to the '829 patent for the sale of Fusilev products in the United States.
20 (Tr. 202:17–22 (Suckling)).

21 164. In contrast, Spectrum paid royalties ranging from 4.5 percent to 7 percent for
22 rights to Merck's process patents for levoleucovorin and related know-how and technology.
23 (Tr. 583:4–584:2 (Sullivan); DX 854).

24 165. In the fourth quarter of 2011, Spectrum paid approximately \$28,000 in royalties
25 to the University compared to approximately \$2.4 million in royalties to Merck, about an 85-

1 fold difference. (Tr. 584:13–23 (Sullivan)).

2 166. This 85-fold difference demonstrates the relative value of the technologies as well
3 as how the market viewed the relative values of the technologies. (Tr. 584:22–585:2
4 (Sullivan)).

5 167. The licensing fees and revenues for the technology in the '829 patent are
6 substantially lower than the revenues of licenses for other technology that is utilized in
7 levoleucovorin products. (Tr. 562:19–24 (Sullivan)).

8 168. Plaintiffs put forth no evidence of commercial success.

9 **c. The Claimed Composition Produced No Unexpected Results**

10 169. Plaintiffs put forth no evidence of alleged unexpected results or properties of the
11 compositions in claims 1 and 2 of the '829 patent.

12 **III. CONCLUSIONS OF LAW**

13 **A. RELEVANT LEGAL PRINCIPLES**

14 **i. Burden of Proof and Presumption of Validity**

15 170. Obviousness must be shown by clear and convincing evidence. *Microsoft Corp. v.*
16 *i4i Ltd. P'ship*, 131 S. Ct. 2238, 2242 (2011).

17 171. Following *i4i*, the Federal Circuit repeatedly has held that there is no enhanced
18 burden or heightened standard of proof for an obviousness inquiry involving prior art
19 previously considered by the PTO. *See, e.g., Osram Sylvania, Inc. v. Am. Induction Techs., Inc.*,
20 701 F.3d 698, 705 (Fed. Cir. 2012) (“the burden to prove invalidity does not change; at all
21 times, it remains a showing ‘by clear and convincing evidence.’”) (citation omitted); *Sciele*
22 *Pharma, Inc. v. Lupin Ltd.*, 684 F.3d 1253, 1260 (Fed. Cir. 2012) (rejecting argument of
23 heightened burden in Hatch-Waxman litigation).

24 172. The statutory presumption of validity merely assumes the PTO properly did its
25 job by considering all prior art or other evidence material to patentability. *Lannom Mfg. Co. v.*

1 *U.S. Int'l Trade Comm'n*, 799 F.2d 1572, 1575 (Fed. Cir. 1986).

2 173. No decision of the Supreme Court or the Federal Circuit has ever suggested that
3 there is an added burden to overcome PTO findings in district court infringement proceedings,
4 and the presence or absence of PTO findings on particular issues does not affect the basic
5 presumption of validity. *Novo Nordisk A/S v. Caraco Pharm. Labs., Ltd*, 719 F.3d 1346, 1357
6 (Fed. Cir. 2013).

7 174. Thus, “[t]he courts are the final arbiter of patent validity and, although courts may
8 take cognizance of, and benefit from, the proceedings before the patent examiner, the question
9 is ultimately for the courts to decide, without deference to the rulings of the patent examiner.”
10 *Quad Envtl. Techs. Corp. v. Union Sanitary Dist.*, 946 F.2d 870, 876 (Fed. Cir. 1991).

11 **ii. 35 U.S.C. § 103(a)—Obviousness**

12 175. Under 35 U.S.C. § 103(a), “[a] patent may not be obtained though the invention is
13 not identically disclosed or described as set forth in section 102 of this title, if the differences
14 between the subject matter sought to be patented and the prior art are such that the subject
15 matter as a whole would have been obvious at the time the invention was made to a person
16 having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a)
17 (2011).

18 176. Obviousness is a question of law, based upon underlying facts, that takes into
19 account: (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; (3)
20 the differences between the claims and the prior art; and (4) objective, also called “secondary,”
21 considerations of nonobviousness. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007)
22 (quoting *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)).

23 177. “Obviousness does not require absolute predictability of success [A]ll that
24 is required is a reasonable expectation of success.” *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d
25 1157, 1165 (Fed. Cir. 2006) (quoting *In re O’Farrell*, 853 F.2d 894, 903-04 (Fed. Cir. 1988)).

1 The “case law is clear that obviousness cannot be avoided simply by a showing of some degree
2 of unpredictability in the art so long as there was a reasonable probability of success.” *Pfizer,*
3 *Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007).

4 178. Moreover, a “combination of familiar elements according to known methods is
5 likely to be obvious when it does no more than yield predictable results.” *KSR*, 550 U.S. at 416.

6 179. More specifically, “if a technique has been used to improve one device, and a
7 person of ordinary skill in the art would recognize that it would improve similar devices in the
8 same way, using the technique is obvious unless its actual application is beyond his or her
9 skill.” *Id.* at 417.

10 180. The Supreme Court has held that market demands and pressures are critical to
11 obviousness and “it will be necessary for a court to look to . . . the effects of demands known to
12 the design community or present in the marketplace” because “it often may be the case that
13 market demand, rather than scientific literature, will drive design trends.” *Id.* at 418-19.

14 181. “When there is a design need or market pressure to solve a problem and there are
15 a finite number of identified, predictable solutions, a person of ordinary skill has good reason to
16 pursue the known options within his or her technical grasp. If this leads to the anticipated
17 success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.*
18 at 421.

19 182. Furthermore, admissions about the prior art in the ’829 patent specification are
20 binding. *Pharmastem Therapeutics, Inc. v. Viacell, Inc.*, 491 F.3d 1342, 1362 (Fed. Cir. 2007);
21 *see also Sjolund v. Musland*, 847 F.2d 1573, 1577-79 (Fed. Cir. 1988) (patent specification
22 admitted that certain matter was prior art, and thus “the jury was not free to disregard [that
23 matter]” and “must have accepted [it] as prior art, as a matter of law”).

24 ///

25 ///

1 **B. CLAIMS 1 AND 2 OF THE '829 PATENT WOULD HAVE BEEN**
2 **OBVIOUS OVER THE PRIOR ART**

3 183. The Federal Circuit has held patent claims directed to a compound from a prior
4 art mixture in a purified form to be prima facie obvious over the mixture if a person of ordinary
5 skill in the art would know or have reason to believe the compound has some desirable
6 property:

7 However, if it is known that some desirable property of a mixture
8 derives in whole or in part from a particular one of its components,
9 or if the prior art would provide a person of ordinary skill in the art
10 with reason to believe that this is so, the purified compound is prima
facie obvious over the mixture even without an explicit teaching that
the ingredient should be concentrated or purified.

11 *Aventis Pharma Deutschland GmbH v. Lupin, Ltd.*, 499 F.3d 1293, 1301 (Fed. Cir. 2007).

12 184. In *Aventis*, the asserted patent claimed 5(S) ramipril “being substantially free of
13 other isomers.” *Id.* at 1300. The prior art disclosed a mixture containing the 5(S) ramipril
14 isomer with another isomer. *Id.* The prior art however only suggested that the 5(S) isomer
15 contained the biological activity. The prior art disclosed a similar molecule, which had fewer
16 stereocenters than ramipril, and disclosed that the isomer of this molecule with each
17 stereocenter in the (S) configuration had enhanced biological activity. *Id.* at 1302.

18 185. The Federal Circuit explained that, “[i]n the chemical arts, we have long held that
19 ‘structural similarity between claimed and prior art subject matter, proved by combining
20 references or otherwise, where the prior art gives reason or motivation to make the claimed
21 compositions, creates a prima facie case of obviousness.’” *Id.* at 1301 (citations omitted); *see*
22 *also In re Adamson*, 275 F.2d 952, 954 (C.C.P.A. 1960) (a patent on a purified isomer was
23 obvious when the mixture of isomers was known in the art, even though the art did not specify
24 a method for purifying the isomer). Expectation that the new compound will have “similar
25 properties” to the old provides such motivation. *Aventis*, 499 F.3d at 1301 (citing *In re Dillon*,

1 919 F.2d 688, 692 (Fed. Cir. 1990) (en banc)).

2 186. Applying this standard, the Federal Circuit found that because the claimed 5(S)
3 isomer was reasonably thought to be therapeutically active and that creating the purified isomer
4 was not outside the capability of an ordinarily skilled artisan, the claimed compound was prima
5 facie obvious. *Id.* at 1302. And because the potency of the purified 5(S) was consistent with
6 the suggestions in the art, the plaintiff patentee had “failed to show unexpected results” to rebut
7 the prima facie obviousness case. *Id.* The Federal Circuit thus found the asserted claims were
8 obvious. *Id.*; *see also In Re Merz*, 97 F.2d 599, 601 (C.C.P.A. 1938) (an applicant is not entitled
9 to a patent on a purified product unless it has different properties than the known product).

10 187. Here, a person of ordinary skill knew in September 1986 that leucovorin existed
11 as a mixture of desired (6S) and undesired (6R) isomers, and that its therapeutic usefulness
12 derives wholly from the (6S) isomer. (PTX 1 at 1:57–61, 4:67–5:9; PTX 14; PTX 15 at 1:15–
13 21; PTX 22 at 117; PTX 241 at 687; DX 732 at 70; DX 739 at 821–22; Tr. 164:22–165:15
14 (Suckling); Tr. 312:25–313:6 (Martin); Tr. 475:3–20 (Moran); Tr. 515:9–516:10 (Krook)).
15 These facts alone make the composition of claims 1 and 2 of the ’829 patent “prima facie
16 obvious over the mixture even without an explicit teaching that the ingredient should be
17 concentrated or purified.” *Aventis*, 499 F.3d at 1301.

18 188. Additionally, there was an explicit prior art teaching to purify (6S) leucovorin. In
19 about 1982, clinicians started using leucovorin in 5-FU combination therapy, which involves
20 much larger doses of leucovorin than for the prior uses of methotrexate rescue and treating
21 folate deficiency. (PTX 242; Tr. 451:16–19 (Moran); 514:2–13, 554:20–555:10 (Krook)).
22 Preclinical studies raised a research “hypothesis” that high levels of the (6R) isomer in the body
23 could have a deleterious effect on 5-FU modulation by the (6S) isomer. (*See* PTX 241 at 695
24 (“The slow disappearance of the D-isomer from plasma should be considered in future studies
25 because there is competition between the diastereoisomers for carrier-mediated membrane

1 transport.”). This new use and hypothesis provided an explicit teaching to purify the (6S)
2 isomer.³

3 189. Moreover, the desired (6S) isomer previously had been isolated and was in the
4 prior art. The '829 patent specification admits that the state of the art was such that pure (6S)
5 leucovorin had been produced by fractional crystallization, chromatography and enzymatic
6 synthesis. (PTX 1 at 2:13–23). Spectrum admits that Rees 1986 and Moran made 100% pure
7 (6S) leucovorin. Thus, a person of skill in September 1986 knew that the pure (6S) isomer and
8 (6R) isomer were available. It would have thus been very easy for a person of ordinary skill to
9 make the claimed compositions by combining the prior art compositions. (Tr. 361:6–15
10 (Martin)). Such a process would have been so easy that Dr. Moran testified “nobody would
11 debate” that it could have been done. (Tr. 469:9–17 (Moran)). In addition, the '829 patent also
12 taught that the racemic leucovorin could be separated using standard techniques such as
13 crystallization and chromatography. (PTX 1 at 2:13–16).

14 190. *Aventis* controls this case and provides a basis for rendering claims 1 and 2 of the
15 '829 patent prima facie obvious.

16 **C. SECONDARY CONSIDERATIONS DO NOT REBUT SANDOZ'S**
17 **PRIMA FACIE CASE OF OBVIOUSNESS AND RENDER THE**
18 **ASSERTED CLAIMS NONOBVIOUS**

19 191. “Once such a prima facie case is established, it falls to the applicant or patentee to
20 rebut it, for example with a showing that the claimed compound has unexpected properties.”
21 *Aventis*, 499 F.3d at 1301. *See also Forest Labs., Inc. v. Ivax Pharms., Inc.*, 501 F.3d 1263,
22 1269 (Fed. Cir. 2007) (finding that evidence demonstrating the difficulty to separate
23 enantiomers and unexpected results rebutted prima facie case of obviousness).

24
25 ³ The '829 patent specification also identifies “a potential clinical requirement for the natural (6S)
diastereoisomer of leucovorin” based on prior art preclinical studies suggesting that the (6R) isomer may inhibit
the therapeutic function of (6S) and possibly have negative effects in the body. (PTX 1 at 2:10-12).

1 192. Relevant secondary considerations that may rebut a prima facie case of
2 obviousness may include commercial success, long-felt but unsolved needs, failure of others,
3 and unexpected results. *KSR*, 550 U.S. at 406; *In re Soni*, 54 F.3d 746, 750 (Fed. Cir. 1995); *see*
4 *also Merck & Co., Inc. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1376-77 (Fed. Cir. 2005).

5 193. Evidence of copying in the ANDA context where a showing of bioequivalence is
6 required for FDA approval is not persuasive evidence of nonobviousness. *Purdue Pharma*
7 *Prods. L.P. v. Par Pharm., Inc.*, 377 F. App'x 978, 983 (Fed. Cir. 2010); *see also Santarus, Inc.*
8 *v. Par Pharm. Inc.*, 720 F. Supp. 2d 427, 458 (D. Del. 2010) (evidence of copying is not
9 compelling evidence of nonobviousness in a Hatch-Waxman case), *aff'd in part, denied in part*,
10 694 F.3d 1344 (Fed. Cir. 2012).

11 194. The only secondary considerations Spectrum asserted at trial were long-felt need
12 and commercial licensing or interest in licensing.

13 **i. Spectrum Failed to Prove the Required “Nexus” for Any Secondary**
14 **Consideration**

15 195. In order to give any evidence of secondary considerations “substantial weight in
16 the calculus of obviousness/nonobviousness,” there must be a “nexus” between the merits of
17 the claimed invention and the proffered secondary consideration evidence. *Ashland Oil v. Delta*
18 *Resins & Refractories, Inc.*, 776 F.2d 281, 306 n.42 (Fed. Cir. 1985); *see also Ormco Corp. v.*
19 *Align Tech., Inc.*, 463 F.3d 1299, 1311–12 (Fed. Cir. 2006).

20 196. In other words, evidence of a secondary consideration is “relevant in the
21 obviousness context only if there is proof that . . . [it was] a direct result of the unique
22 characteristics of the claimed invention.” *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996); *see*
23 *also Ormco Corp.*, 463 F.3d at 1312 (“if the feature that creates the commercial success was
24 known in the prior art, the success is not pertinent”).

25 197. The patentee must produce evidence of a nexus. *W. Union Co. v. MoneyGram*

1 *Payment Sys.*, 626 F.3d 1361, 1372 (Fed. Cir. 2010).

2 198. “The commercial success of a product is relevant to the non-obviousness of a
3 claim only insofar as the success of the product is due to the claimed invention.” *Geo M.*
4 *Martin Co. v. Alliance Mach. Sys. Int’l LLC*, 618 F.3d 1294, 1304 (Fed. Cir. 2010); *see also*
5 *Galderma*, 737 F.3d at 740 (“Evidence of commercial success . . . is only significant if there is
6 a nexus between the claimed invention and the commercial success.”) (internal quotation marks
7 and citation omitted). For example, commercial success has not been shown when features
8 present in the prior art are the basis for the success or demand of the commercial embodiment.
9 *Ormco Corp.*, 463 F.3d at 1312; *J.T. Eaton & Co. v. Atl. Paste & Glue Co.*, 106 F.3d 1563,
10 1571 (Fed. Cir. 1997) (“[T]he asserted commercial success of the product must be due to the
11 merits of the claimed invention beyond what was readily available in the prior art.”) (citation
12 omitted); *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983) (holding claims
13 obvious despite purported showing of commercial success because patentee failed to show that
14 commercial success “was due to anything disclosed in the patent in suit which was not readily
15 available in the prior art”).

16 199. The Federal Circuit specifically requires affirmative evidence of nexus where the
17 evidence of commercial success presented is a license, because it is often cheaper to take
18 licenses than to defend infringement suits. *Iron Grip*, 392 F.3d at 1324; *see also In re GPAC*
19 *Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995) (“Licenses taken under the patent in suit may
20 constitute evidence of nonobviousness; however, only little weight can be attributed to such
21 evidence if the patentee does not demonstrate a nexus between the merits of the invention and
22 the licenses of record.”) (internal quotation marks and citation omitted).

23 200. The only distinguishing feature about claims 1 and 2 of the ’829 patent compared
24 to the enzymatically prepared (6S) leucovorin in the prior art is the small presence of the
25 unwanted (6R) isomer in the claimed composition.

1 201. Spectrum has not established any nexus between the distinguishing amount of
2 unwanted (6R) isomer and any alleged secondary consideration.

3 202. There is important, additional lack of nexus evidence that refutes Spectrum's
4 assertion of the claims satisfying a long-felt, unmet need for a sufficient quantities of the (6S)
5 and (6R) isomer to conduct research on the potential effect of the (6R) isomer in 5-FU
6 modulation. Claims 1 and 2 of the '829 patent cover only two indications: methotrexate rescue
7 and folate deficiency. The 5-FU combination therapy use did not arise until the 1980s, which
8 was decades after the methotrexate rescue and folate deficiency uses arose. Thus, Spectrum
9 cannot establish a nexus between its alleged long-felt need and the asserted claims.

10 **ii. Spectrum's Secondary Consideration Evidence Is Weak**

11 203. Furthermore, "weak secondary considerations generally do not overcome a strong
12 prima facie case of obviousness." *W. Union Co.*, 626 F.3d at 1373.

13 204. Secondary considerations will not be a significant factor where the record
14 establishes a strong prima facie case of obviousness. *See, e.g., Pfizer*, 480 F.3d at 1372;
15 *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007); *DyStar*
16 *Textilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1371 (Fed. Cir. 2006); *Richardson-*
17 *Vicks Inc. v. Upjohn Co.*, 122 F.3d 1476, 1483 (Fed. Cir. 1997); *see also In re GPAC, Inc.*, 57
18 F.3d at 1580-81.

19 205. Based on the strength of the prima facie obviousness case here, even if Spectrum
20 had been able to establish the required nexus for any secondary consideration to be probative
21 (and to be clear, Spectrum has not established the nexus), the evidence of secondary
22 considerations set forth by Spectrum would still be too weak to overcome the prima facie
23 obviousness case.

24 206. The only secondary considerations Spectrum asserted at trial were long-felt need
25 and commercial licensing or interest in licensing—in other words, there was no evidence of

1 other typical objective considerations such as unexpected results, prior failure, or skepticism of
2 those in the art.

3 207. As explained above, even if there was a nexus and a long-felt need for a purified
4 (6S) pharmaceutical product, the claimed invention could not have satisfied any need because
5 levoleucovorin is clinically interchangeable with the prior art leucovorin.

6 208. Spectrum presented evidence of an exclusive option agreement in 1987 for rights
7 to the '829 patent between the University and Burroughs Wellcome. (Tr. 130:3–5 (Suckling);
8 PTX 7). Burroughs Wellcome, however, never exercised its option. (Tr. 131:9–10, 182:15–17
9 (Suckling); Tr. 568:15–22 (Sullivan)). The fact that an option was not exercised and no license
10 agreement was entered into is not evidence of commercial success. (Tr. 569:13–24 (Sullivan)).

11 209. Other organizations reached out to the University regarding the '829 patent, but
12 the University did not enter into any licensing agreements with these organizations. (Tr.
13 132:15–134:23 (Suckling); PTX 8; PTX 9). After the lapse of the option agreement with
14 Burroughs Wellcome, the University had the ability to license the '829 patent to other parties
15 but no companies besides American Cyanamid and Spectrum ever took a license to the '829
16 patent. (Tr. 201:20–202:8 (Suckling); Tr. 571:17–572:1 (Sullivan)). Expressing interest
17 without actually entering into a license agreement again is not probative of commercial success.
18 (Tr. 569:13–15 (Sullivan)).

19 210. The license with American Cyanamid included not only the application that
20 became the '829 patent but also patent applications in several other countries including Canada,
21 Japan, and countries in Europe. (Tr. 199:17–21 (Suckling); PTX 12). Dr. Suckling admitted he
22 could not “subdivide” the amount received specifically for the license for the '829 patent from
23 the total income received for the whole leucovorin project from American Cyanamid. (Tr.
24 197:17–198:13 (Suckling)). There thus is no evidence of what royalties were paid by American
25 Cyanamid.

1 211. Dr. Suckling also conceded that “not a lot of money” was made by the University
2 from Spectrum’s license to the ’829 patent. (Tr. 197:23–198:1 (Suckling)). The University
3 received a one-time, up-front payment of \$50,000 and a one percent running royalty limited to
4 the methotrexate rescue indication. (Tr. 581:10–582:16 (Sullivan); DX 611). Dr. Suckling also
5 did not know how much money the University has been paid by Spectrum for the license to the
6 ’829 patent for the sale of Fusilev products in the United States. (Tr. 202:17–22 (Suckling)).

7 212. In sum, none of Spectrum’s evidence on licensing supports a secondary
8 consideration of nonobviousness. Rather, the evidence on licensing and revenues as a whole
9 shows that the licensing program for the ’829 patent was not a success.

10 **D. CONCLUSIONS ON OBVIOUSNESS**

11 213. Based on all the Court’s factual findings, set forth above, Sandoz has proven by
12 clear and convincing evidence that claims 1 and 2 of the ’829 patent would have been obvious
13 to a person of skill in the art in September 1986.

14 **E. EXCEPTIONAL CASE—35 U.S.C. § 285**

15 214. Sandoz seeks an exceptional case determination and all its attorneys’ fees
16 pursuant to 35 U.S.C. § 285. *See Octane Fitness, LLC v. ICON Health & Fitness, Inc.*, 134 S.
17 Ct. 1749, 1756 (2014) (“exceptional” case is one that stands out from others with respect to
18 strength of position or unreasonable manner of litigation).

19 215. These issues will be determined after the Court renders a judgment.

20 **IV. CONCLUSION**

21 **IT IS HEREBY ORDERED** that Plaintiffs’ request for an order pursuant to 35 U.S.C.
22 § 271(e)(4)(A) that the effective date of any approval of Sandoz’s ANDA shall not be earlier
23 than the expiration date of the ’829 patent, is hereby **DENIED**.

24 **IT IS FURTHER ORDERED** that claims 1 and 2 of the ’829 patent are invalid
25 as obvious for the reasons set forth herein.

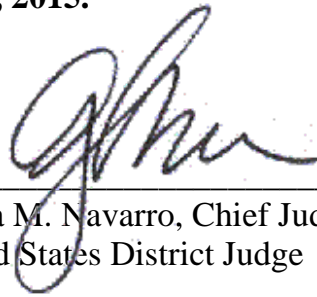
1 **IT IS FURTHER ORDERED** that judgment is entered fully in favor of Defendant
2 Sandoz.

3 The Clerk of the Court shall enter judgment accordingly.

4 **DATED** this 25th day of February, 2015.

5 **NUNC PRO TUNC DATE: February 20, 2015.**

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Gloria M. Navarro, Chief Judge
United States District Judge