**IN THE UNITED STATES DISTRICT COURT FOR THE
WESTERN DISTRICT OF MISSOURI
WESTERN DIVISION**

FEDERAL TRADE COMMISSION,	)	
	)	
Plaintiff,	)	
	)	
v.	)	**Case No.: 14-CV-00815-W-BCW**
	)	
BF LABS INC.., et al.,	)	
	)	
Defendants.	)	

DEFENDANTS BF LABS INC., SONNY VLEISIDES, AND DARLA DRAKE'S SUGGESTIONS IN SUPPORT OF MOTION TO STRIKE DECLARATION AND EXCLUDE ALL TESTIMONY FROM ARVIND NARAYANAN, Ph. D.

Defendants BF Labs Inc., Sonny Vleisides, and Darla Drake (collectively "Defendants")
move the Court under Federal Rules of Evidence 403, 701, and 702 to strike the declaration of
Arvind Narayanan, Ph. D., (Doc. 166-16), and move to exclude from evidence all testimony,
expert opinions, and conclusions offered by Dr. Narayanan at the November 24, 2014
preliminary injunction hearing.

Dr. Narayanan's declaration ultimately asserts two conclusions: (1) that bitcoin mining
equipment depreciates, and (2) that testing bitcoin mining equipment on the live bitcoin network,
rather than in a controlled testnet environment, is unnecessary. No one disputes that, generally,
bitcoin mining equipment depreciates over time. But the further "lifetime mining revenue" and
return-on-investment conclusions that Dr. Narayanan draws from his overall depreciation
opinion are based on readily disproved assumptions—that is, to equate equipment depreciation
with an inability to mine profitable amounts of bitcoin fails to account for the market reality that
even a percentage of a bitcoin can have significant value based on exchange rates.

Separately, Dr. Narayanan's "testnet" opinion disregards settled principles of engineering
and ignores that testnet testing does not test critical reliability points within each piece of mining

equipment. Ultimately, Dr. Narayanan appears to be versed in the theory of bitcoin, yet not at all versed in the actual production of bitcoin equipment, or in the factors that affect the potential profitability of bitcoin mining over time.

Dr. Narayanan's opinions and conclusions set forth in his declaration are therefore not based on sufficient facts and data regarding bitcoin mining, mining equipment, and equipment testing and validation, and were not developed using reliable principles and methodology. Dr. Narayanan's opinions and conclusions are therefore unreliable and should be excluded in whatever form they are offered.

Those opinions and conclusions should also be excluded for the independent reason that the FTC failed to provide any of the expert-witness disclosures required by Federal Rule of Civil Procedure 26(a)(2)(B).[1] The FTC is not excused from the requirement of making these disclosures simply because it had "not yet completed administrative and contracting paperwork" and believed it was "not in a position to make him available for a deposition or to require that he produce a report." *See* Doc. 160, Ex. D.

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[1] Under Fed. R. Civ. P. 26(a)(2)(B), the FTC was required to disclose:

(i)   a complete statement of all opinions Dr. Narayanan will express and the basis and reasons for them;

(ii)   the facts or data considered by Dr. Narayanan in forming them;

(iii)   any exhibits that will be used to summarize or support them;

(iv)   Dr. Narayanan's qualifications, including a list of all publications authored in the previous 10 years;

(v)   a list of all other cases in which, during the previous 4 years, Dr. Narayanan testified as an expert at trial or by deposition; and

(vi)   a statement of the compensation to be paid for the study and testimony in the case.

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For these reasons, set forth more fully herein, the Court should strike Dr. Narayanan's declaration as unreliable, irrelevant, and inadmissible, and exclude him from offering testimony in any other form.

I. *Daubert* Standards.

The role of the Court under Federal Rule of Evidence 702 is to review and exclude all unreliable expert testimony. *See* Advisory Committee's Note to 2000 Amendment to Rule 702, citing *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 597, 113 S. Ct. 2786, 125 L.Ed. 2d 469 (1993); *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 143 L. Ed. 2d 238, 119 S.Ct. 1167 (1999).

The FTC has the burden of demonstrating by a preponderance of the evidence that the expert testimony offered by Dr. Narayanan is admissible. *Daubert*, 509 U.S. at 592 n. 10 (citing *Bourgaily v. United States*, 483 U.S. 171, 97 L. Ed. 2d. 144, 107 S.Ct. 2775 (1987)). To meet this burden, the FTC must establish: (a) that Dr. Narayanan's testimony is based on scientific facts or data; (b) that the data was produced using reliable principles and methods; and (c) that Dr. Narayanan has applied reliable principles and methods in a reliable manner to the facts of this case. Fed. R. Evid. 702.

To analyze the reliability of an expert's opinions, the Court considers:

1. Whether the expert's technique or theory can be or has been tested; in other words, whether the theory of the expert can be challenged in some objective sense, or whether it is simply a subjective, conclusory approach, and on an *ipse dixit* that cannot reasonably be assessed to determine its reliability;

2. Whether the expert's technique or theory has been subject to peer review and publication;

3. The known or potential rate of error of the technique, theory, or methodology when it is applied to the evidence in question;

4. Whether and to what extent standards and controls exist and are maintained; and

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5.   Whether the technique, theory, or methodology espoused by the expert in question has been generally accepted in the scientific, professional, or relevant community.

See Daubert v. Merrell Dow Pharm., Inc., 43 F.3d 1311, 1317 (9th Cir. 1995), *cert. denied*, 516 U.S. 869, 116 S. Ct. 189, 133 L.Ed.2d 126 (1995).

Because Rule 703 requires that expert testimony be predicated on well-founded data and analyses, the FTC has the burden of establishing that the "underlying assumptions" on which Dr. Narayanan's opinions are based are reliable. *See TK-Seven Corp. v. Estate of Barbouti*, 993 F.2d 722 (10th Cir. 1993). The trial court's gatekeeping function requires more than simply "taking the expert's word for it." *Daubert*, 43 F.2d at 1319.

Finally, under *Daubert*, general expertise itself is insufficient. An expert must also possess "sufficient specialized knowledge to assist the [fact finder] in deciding the particular issues in the case." *Kumho*, 526 at 156 (quoting 4 McLaughlin, Weinstein's Federal Evidence §702.05[l], p. 702-33 (2d ed. 1998)). An expert's failure to link his theory to the facts of the case may therefore result in exclusion of the expert's testimony, even though the research used by the expert may rest on sound methodology and the expert may be well qualified in his field. *United States v. Mamah,* 332 F.3d 475 (7th Cir. 2003).

II.   The Court Should Exclude Dr. Narayanan's Opinions.[2]

A.   The Court Should Exclude Dr. Narayanan's "Depreciation" Opinions.

A significant portion of Dr. Narayanan's declaration can be summed up as standing for the overarching conclusion that bitcoin mining equipment depreciates. *See* Doc. 166-16, ¶¶ 7-31. As a general proposition, no one disputes this point. But Dr. Narayanan then attempts to go

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[2] The FTC filed Dr. Narayanan's Declaration on November 19, 2014. *See* Doc. 166-16. The issues addressed in this Motion are in no way exhaustive of the reliability flaws that are apparent from Dr. Narayanan's Declaration.

further and declare the ways in which equipment depreciation manifests in terms of bitcoin-mining profitability. The extrapolations and assumptions on which Dr. Narayanan bases these further opinions, however, are not supported by sufficient facts and evidence and, in fact, are readily disproved.[3] Dr. Narayanan's opinions therefore do not pass muster under *Daubert* and must be excluded.

As a starting point, Dr. Narayanan's depreciation opinions principally fail to account for bitcoin exchange rate and hash rate volatility, among other variables. This failure alone is sufficient to render Dr. Narayanan's opinions unreliable and require that they be excluded. Consider, for example, the following opinion offered by Dr. Narayanan:

> Assuming that difficulty doubles steadily every two months, a given piece of mining equipment, even if it represents the newest and most efficient technology when the miner purchases it, will rapidly erode in value. If it was switched on in January, by March it would only generate 50% of the mining revenue per day as it did at first. By May, it would only generate 25%, and by July, only 12.5%, at which point, it would likely be considered obsolete. Given that the equipment incurs costs, such as the cost electricity to operate, after a point, ***the miner will be unable to generate any profits using it***, as costs will exceed revenues . . . . The miner's fundamental challenge is to acquire equipment early enough in the technology lifecycle to maximize its operational lifetime. If he succeeds, he will be able to use it for long enough—typically, a few months—to recoup the cost of the hardware investment ***and make an overall profit***.

Doc. 166-16, ¶¶ 9-10 (emphases added). Setting aside for a moment several other flawed assumptions contained in this opinion, Dr. Narayanan cannot state that a miner will be unable to generate any profits using a particular piece of equipment unless he assumes either (1) that the miner will yield zero bitcoins (which his hypothetical does not appear to assume) or (2) that the

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[3] Due to the current asset freeze, Defendants are effectively precluded from hiring an expert to counter Dr. Narayanan's declaration, even though the declaration is readily discredited for failure to account for the impacts of market and network hash rate volatility, among other things. The counter-facts and assumptions set forth herein, then, are offered by Defendants to assist the Court, and can be supported by declarations if the Court so directs.

bitcoin exchange rate is too low at any particular time (he does not designate a rate or a time at which profitability is being measured) to render the number of bitcoins ultimately mined "profitable."

On a related note, Dr. Narayanan's opinions *assume* (incorrectly, it turns out) that people who mine bitcoins decide, on the day that they stop using a particular piece of bitcoin mining equipment, whether they received a "profitable" return on investment or not. But Dr. Narayanan's assumption does not account for the fact that people frequently mine bitcoins at exchange rates and with electricity costs that yield net losses at certain points in time, yet who intend to hold on to any bitcoins mined in hopes that the exchange rate will once again skyrocket, as it has historically done, rendering even miniscule numbers of bitcoin profitable. This is the true nature of bitcoin mining—it is an inherently speculative venture, which necessarily attracts people who don't mind speculating and hedging their risks.

Dr. Narayanan's intentional or unintentional decision to ignore these market realities is precisely what renders his opinions unreliable and subject to exclusion by the Court, just as the United States Court of Appeals for the Eighth Circuit held that a "hypothetical market" expert should have been excluded in *Concord Board Corp. v. Brunswick Corp*., 207 F.3d 1039 (8th Cir. 2000). In *Concord*, the plaintiffs claimed that a manufacturer's discount programs constituted *de facto* exclusive dealing. *Id.* at 1055-57. The district court admitted the testimony of a Stanford economics professor whose testimony was offered by the plaintiffs to establish a "hypothetical market" that accounted for anticompetitive activities, but the Eighth Circuit reversed because the hypothetical market that the expert constructed ignored inconvenient evidence, disregarded economic realities, and failed to account for market events unrelated to anticompetitive conduct. *Id*.

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In much the same way as the *Concord* expert, Dr. Narayanan also disregards inconvenient evidence and economic realities. Additional examples include the following:

Increasing difficulty of mining. Dr. Narayanan concludes that "[f]or most of Bitcoin's existence, the difficulty level of these puzzles (measured by computation effort required) has grown at an astonishing rate" and explains that, "[f]or example, over the course of year 2013 it grew about 500-fold, representing a doubling in difficulty every 41 days." Doc. 166-16, p. 2.

In fact, mining difficulty has not always increased and has actually decreased on several occasions. Given the rapid growth experienced in the recent past, it is likely another decrease will occur sometime in the not too distant future. At present, the network growth has slowed by a substantial amount.

For a large part of 2013, the network was growing by 20-30% every ten days. For the past 42 days, the difficulty has increased by a mere 15.6%. This is evidence that the network growth rate is slowing dramatically and also signals a likely decrease in the network size (and resulting decrease in network difficulty) in the near future. In any event, no one can predict with complete accuracy what the network will do. Just as no one foresaw the explosive expansion of the network in 2012, few, if any, people saw the rapid stagnation of the hash rate that the network is currently experiencing. Dr. Narayanan is no exception. Dr. Narayanan offers no factual or theoretical basis for his assumption that 2013 and 2014 data are accurate predictors for the future of the bitcoin network.[4]

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[4] Dr. Narayanan also used 2013 network difficulty data to conclude that the hash rate doubles every 41 days. Although that figure is a good summary for 2013, it is not necessarily a good guide for the future. For example, in the last 60 days, the hash rate has only increased marginally. *See* Doc. 155, Ex. F.

The miner's costs and revenues. Dr. Narayanan concludes that "[a]ssuming that difficulty doubles steadily every two months, a given piece of mining equipment, even if it represents the newest and most efficient technology when the miner purchases it, will rapidly erode in value. If it was switched on in January, by March it would only generate 50% of the mining revenue per day as it did at first. By May, it would only generate 25%, and by July, only 12.5%, at which point, it would likely be considered obsolete." Doc. 166-16, p. 3.

Dr. Narayanan's assumption that mining difficulty doubles "steadily" every two months is not borne out by present data. Over the course of the past 42 days, the network has grown 15.6%, nowhere near a doubling. It has increased from 250 PH to 288 PH, not to 500 PH. In any event, an exponential growth rate like the one that Dr. Narayanan assumes is impossible to maintain for any substantial period of time—bitcoin is no exception. Any assumptions or calculations based off of an exponential growth rate for any extended period of time are, therefore, by definition, unreliable.

Impact of BitForce shipping delays. Dr. Narayanan analyzes the impact of delays on the "BitForce Jalapeno" machines and concludes that mining revenues depreciated. Doc. 166-16, pp. 4-6.

This conclusion fails to factor in two important facts. First, all the machines that came after the BitForce Jalapeno would increase the network difficulty going forward, reducing the lifetime mining revenues (LMR). Second, if BF Labs shipped machines in bulk and had them available in the quantities that Dr. Narayanan suggests, BF Labs would have garnered tens of thousands of more orders in a very short space of time, and all of them would have further increased the network difficulty, further reducing the LMR by a significant amount.

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Indeed, once people understood that bitcoin mining could be a significant source of income, many people ordered more products. BF Labs sold fewer than 3000 FPGA products and expected to sell about the same number of BitForce products. BF Labs saw, however, that once more people became aware of bitcoin, demand shot up almost 20 fold, purely based off of future mining expectations. And if a product were shipping off the shelf, as Dr. Narayanan suggests, the number of orders could be expected to double or triple even further, with a net effect of increasing the network difficulty two to three times higher than it would have been even if all orders had shipped on time, and reducing the LMR of any unit significantly.

Analysis of Monarch Machines. Dr. Narayanan concludes that "[u]nder the implausibly optimistic assumption that the mining difficulty remains constant at the current level, such a machine would break even in slightly over three years (if it had been purchased for $2,499)." Doc. 166-16, p. 7. He further concludes that "[t]hus, a customer of a Monarch machine will not come close to recouping his hardware investment in the most plausible scenarios of the network's evolution." *Id.*

This analysis appears to presuppose that the bitcoin exchange rate will remain at its current level, which it has *never* done. But if, for example, the price of bitcoin goes up, the same machine could pay for itself in a short period of time. Just recently, a former global macro fund manager, predicted that the price of one bitcoin could reach $1,000,000. *See* Business Insider article, attached as Exhibit A. Bitcoin has seen wild volatility, going from $10 per coin to over $1200 per coin in less than a year and then back down to less than $300 per coin and back up again. Around this time last year, one bitcoin was worth about $300. In less than 60 days it was worth over $1200 per coin. These fluctuations could easily recur and could even surpass the previous spike to $1200, making the Monarch and even the previous generation of products not

just profitable, but wildly profitable. Dr. Narayanan utterly fails to account for this fluctuation, however, in each of his opinions.[5]

Like the *Concord* expert, whose theories were perhaps useful in a classroom environment without application to market realities, Dr. Narayanan has not set forth opinions that account— reliably or otherwise—for variables like the bitcoin exchange rate and network hash rate that are critical to any analysis of bitcoin mining equipment depreciation and profitability. Dr. Narayanan's theories should therefore be excluded as unreliable under *Daubert*.

B. The Court Should Exclude Dr. Narayanan's "Testnet" Opinions.

Dr. Narayanan's declaration also asserts that testing bitcoin mining equipment on the live bitcoin network, rather than in a controlled testnet environment, is unnecessary. Dr. Narayanan claims that "[t]he mining puzzle derives its difficulty from the fact that it requires performing the same calculation (called a "hash function") over and over again with different inputs. This hash function is in fact a mathematical formula that is independent of, and long predates, the Bitcoin protocol. I therefore know of no technological reason why ASIC mining hardware must be tested on the live Bitcoin network." (Doc. 166-16, p. 8)

According to his CV and Declaration, Dr. Narayanan has no experience in manufacturing electronics, so the fact he claims that he knows no technological reason why ASIC mining hardware must be tested on the live bitcoin network is probably true. There are important technological reasons, however, why ASIC mining hardware on a real bitcoin network (as compared to simply being issued jobs to hash, which is a theoretical approach). The card that

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[5] Separately, Dr. Narayanan's calculations fail to contemplate that Monarchs can be run in high efficiency mode, which drops power consumption by approximately 30%. This capability has a meaningful effect on the long term viability of the Monarch, currently the most efficient miner on the network.

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performs the process is made of a MicroProcessor, a FPGA, Voltage Regulator Module, and the Hash Processors. In order to have a healthy unit, all of the aforementioned sections of the unit must perform as expected. By simply sending a job to the unit and read back the result, only a small fraction of the hardware design will be tested. In order to test all aspects of the design, the following criteria must be met:

1. Enough jobs should be issued to the unit to fill the internal queue of the microprocessor, the FPGA and the ASICs.

2. The unit must remain in processing mode for an extended period of time to validate thermal stress aspects of the unit (which in turn stress-tests the MOSFETs, heat sink connection, solder joints and ASIC heat sustainability).

3. Every once in a while (at random intervals), the internal queues must be emptied and a new stream of jobs must be issued. This will test the VRM transitional response (going from 30 Amps to 350 Amps of supply, and the vice versa). Most bad solder joints or MOSFETs will show themselves in these test cycles. The interval is also important, as fast transitions (less than 100ms) will show the impact of capacitor-discharge and recharge effects (which can damage the high side FETs) and slow-transitions will stress-test the High-Side MOSFETs of the VRM for "Avalanche Breakdown."

4. The network must acknowledge the speed of the unit independently. For unknown reasons, the speed reported by BFGMiner on differs from what the bitcoin network reports. The bitcoin network reports higher performance than what BFGMiner reports. Thus it is strongly suggested to verify the "network reported"

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speed over a period of at least several hours to factor out luck related artifacts and random chance.

Dr. Narayanan also claims "[f]urthermore, even if testing on the live network were necessary, there is a way to ensure that it does not affect the network: simply modify the software to only verify that the hardware solved the mining puzzles correctly but not broadcast the solved puzzles to the rest of the network. Existing mining software such as BFGMiner (bfgminer.com) seems to already support a similar feature ("benchmark mode")." (Doc. 166-16, p. 8-9)

In reality, the "Benchmark Mode" of BFGMiner cannot be used to validate units, as it only tests job issuance, not queue flushing and immediate or slow job resubmission, which are critical to fully exercising all device conditions. Failure to do so prevents discovery of faulty hardware which makes it necessary to the test units on the live network where users will use their product. Without verifying end-to-end operation, BF Labs risks shipping non-functional devices.

Dr. Narayanan further fails to address that Bitcoind (the software that implements Bitcoin) is an open source software, released under MIT license. There is no corporation or official organization in charge of maintaining or supporting either the live bitcoin network or testnet. Below is a portion of MIT License, under which Bitcoind is released:

> THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

As it is clearly stated in the license, Bitcoind is under no obligation to perform as expected, and is provided "AS IS." Butterfly Labs products, however, are under obligation to

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perform as expected. The intended execution environment for these units is the live bitcoin network, not testnet. Because the live bitcoin network is the backbone of the bitcoin network, and testnet is only provided for test purposes, it cannot be used to validate correct functionality of BF Labs units. The testnet may be very close to real live bitcoin network but it is not guaranteed in any way. In engineering terms, using any environment other than the intended environment, is not viable for functionality tests. Using any alternative to the true environment for final validation puts the company at the mercy of the alternative environment.

Because there are technological reasons why ASIC mining hardware must be tested on the live bitcoin network and because Dr. Narayanan lacks the experience to offer an opinion regarding testing bitcoin mining equipment, his opinions and conclusions on equipment testing were not developed using reliable principles and methodology and should be excluded in whatever form they are offered.

III.   Conclusion.

Dr. Narayanan's opinions should be excluded under Federal Rules of Evidence 702 and 703 because they ignore technological, engineering, and market realities and are therefore not based on sufficient facts and data to be considered reliable. His opinions should also be excluded under Federal Rule of Evidence 403, because any probative value of Dr. Narayanan's opinions is substantially outweighed by its undue prejudice to Defendants in light of Defendants' inability to hire an expert at this stage and the belated timing of the FTC's "expert" declaration and reliance on Dr. Narayanan for purported "expert" testimony.

The FTC has the burden of establishing by a preponderance of the evidence that Dr. Narayanan's testimony satisfies *Daubert*. It has not met and cannot meet that burden. Defendants therefore request that this Court strike Dr. Narayanan's Declaration and exclude him from

offering testimony in any form, and for such other and further relief as the Court deems just and equitable.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on November 21, 2014, a true and correct copy of the foregoing pleading was served by the Court's ECF system on the following:

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