

June 30, 2017

Eduardo A. Aleman
Assistant Secretary
U.S. Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549

Re: File No. SR-CHX-2017-04; Self-Regulatory Organizations; Chicago Stock Exchange, Inc.; Notice of Filing of Proposed Rule Change to Adopt the CHX Liquidity Enhancing Access Delay (Release No. 34-80041; File No. SR-CHX-2017-04)

Dear Mr. Aleman:

The Chicago Stock Exchange, Inc. (the “Exchange” or “CHX”) thanks the U.S. Securities and Exchange Commission (“Commission”) for the opportunity to comment on the Exchange’s proposed rule change¹ (“Proposal”) to adopt the CHX Liquidity Enhancing Access Delay (“LEAD”). As described in detail below, LEAD is an asymmetric access delay designed to enhance displayed liquidity and price discovery by minimizing the effectiveness of latency arbitrage² strategies that have diminished displayed liquidity at CHX and market wide.³

The Exchange submits this letter in response to the questions (“Questions”) posed by the Commission in its order instituting proceedings on the Proposal⁴ and the three comment letters⁵ (“Comments”) that were filed with the Commission since proceedings were instituted. As part of its response, the Exchange incorporates, by reference, the Proposal and the Exchange’s initial comment letter regarding the Proposal.⁶

¹ See Securities Act Release No. 80041 (February 14, 2017), 82 FR 11252 (February 21, 2017) (SR-CHX-2017-04) (“Notice”).

² “Latency arbitrage” means the practice of exploiting disparities in the price of a security or related securities that are being traded in different markets by taking advantage of the time it takes to access and respond to symmetric information. See Notice, *id.*, at 11253. At CHX, latency arbitrage is effected by low-latency market participants that leverage microsecond speed advantages to take resting liquidity at stale prices from the CHX limit order book. See *id.*

³ See Notice, *supra* note 1, at 11253.

⁴ See Securities Exchange Act Release No. 80740 (May 22, 2017), 82 FR 24412 (May 26, 2017) (“Order”).

⁵ See Letter to Brent J. Fields, Secretary, Commission, from R.T. Leuchtkafer (June 15, 2017) (“Second Leuchtkafer Letter”); see also Letter to Eduardo A. Aleman, Assistant Secretary, Commission, from Stephen John Berger, Managing Director, Government & Regulatory Policy, Citadel Securities (June 16, 2017) (“Second Citadel Letter”); see also Letter to Brent J. Fields, Secretary, Commission, from Joanne Mallers, Secretary, FIA Principal Traders Group (June 16, 2017) (“Second FIA Letter”). All comment letters on the Proposal may be found at <https://www.sec.gov/comments/sr-chx-2017-04/chx201704.htm>.

⁶ See Letter to Eduardo Aleman, Assistant Secretary, Commission, from James G. Ongena, Executive Vice President and General Counsel, CHX (March 24, 2017) (“First CHX LEAD Response”).

1. Background

1.1. Latency Arbitrage Diminishes Displayed Liquidity and Impairs Price Discovery

One of the principal goals of Regulation NMS is to enhance displayed liquidity and price discovery,⁷ which is achieved by way of protected quotations currently displayed only on the national securities exchanges. While market quality has increased by many measures in recent years,⁸ the average size of a trade has decreased and trading volume has increasingly migrated away from the lit markets, which can be attributed, in large part, to the proliferation of less-than-transparent alternative trading systems, broker internalizers and wholesale market makers (“wholesalers”) fueled by payment for order flow schemes that have a vested interest in degrading the quality of, or abolishing, protected quotations, and low-latency market participants that have extracted rents so high from a shortcoming in market design⁹ to cause well-established liquidity providers to withdraw from the market altogether.¹⁰ This reality has hindered competition among orders and trading centers, which has impaired price discovery to the detriment of the investing public.

The shortcoming in market design is as follows. Latency arbitrageurs exploit the fact that updating the continuous limit order book (utilized by every national securities exchange) necessarily requires the processing of order-related messages serially by time of receipt. Thus, when reacting to the same symmetric information, a liquidity provider with a quote displayed on an exchange must be faster than a latency arbitrageur to avoid its stale quote from being executed. This structural bias enables the latency arbitrageur to extract profits from symmetric information and has furthered a technology “arms race” that is counter to investor protection and the public interest.¹¹ The results is that latency arbitrage has skewed the risk/reward dynamic for displayed liquidity provision¹² such

⁷ See Exchange Act Release No. 51808 (June 9, 2005), 70 FR 37496, 37514 (June 29, 2005) (“Regulation NMS Adopting Release”).

⁸ SEC public statement (May 11, 2015). Retrieved from <http://www.sec.gov/news/statement/us-equity-market-structure.html>

⁹ See generally Eric Budish, Peter Cramton and John Shim. The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response. *Quarterly Journal of Economics*, Vol. 130(4), November 2015 (“Budish Paper”).

¹⁰ See e.g., Interactive Brokers LLC. 2017. *Interactive Brokers Group Announces Decision to Cease Options Market Making Activities*. Retrieved from <https://www.interactivebrokers.com/en/index.php?f=24473>

¹¹ See Letter to Brent J. Fields, Secretary, Commission, from Steve Crutchfield, Head of Market Structure, Chicago Trading Company (April 4, 2017) (“CTC Letter”) at 2. Eric Budish (University of Chicago Booth School of Business), Peter Cramton (University of Maryland), and John Shim (University of Chicago Booth School of Business) have modeled this situation, which they identify as “a never-ending arms race for speed,” and characterize the result as “a classic prisoner’s dilemma: snipers invest in speed to try to win the race to snipe stale quotes; liquidity providers invest in speed to try to get out of the way of the snipers; and all trading firms would be better off if they could collectively commit not to invest in speed, but it is in each firm’s private interest to invest.” They conclude, “Our results say that sniping is negative for liquidity and that the speed race is socially wasteful.” See Budish Paper, *supra* note 9.

¹² Under the First CHX LEAD Response, the Exchange stated the following regarding the current risk/reward dynamic for liquidity provision:

The Exchange acknowledges that LEAD will impact the current risk/reward dynamic for liquidity provision. This is precisely the point of LEAD. Latency arbitrage has increased the risk of displayed liquidity provision to the point that it has driven valuable displayed liquidity and liquidity providers away from lit markets. In other words, the current risk of displaying liquidity on a lit market is disproportionate to the current rewards. As such, LEAD is not

that major liquidity providers have either reduced the amount of liquidity displayed on exchanges or have withdrawn from the market altogether.¹³

Recent declines in displayed liquidity at CHX typify this trend. As described under the Notice,¹⁴ starting in January 2016, the Exchange experienced a material decline in CHX volume and displayed liquidity in the SPDR S&P 500 trust exchange-traded fund (“SPY”),¹⁵ which the Exchange has attributed to latency arbitrage activity in SPY (“SPY latency arbitrage activity”) first observed at CHX in January 2016. Specifically, during the period of January through July 2016, the Exchange observed unusual messaging patterns in SPY whereby an execution of a large inbound Immediate Or Cancel (“IOC”) order against a contra-side order resting on the CHX book was frequently followed by a late cancel message for the executed resting order soon after the execution (“Too Late to Cancel” or “TLTC”). Based on these observations, Participant corroboration of the observations and market data analysis, as described below, the Exchange found that SPY latency arbitrage activity caused CHX liquidity providers to dramatically reduce displayed liquidity in SPY (and eventually withdraw from the market altogether), which materially decreased liquidity in SPY market wide, in light of CHX’s significant contributions to overall volume and liquidity in SPY prior to the declines.

Under the Notice,¹⁶ the Exchange included comprehensive market data analysis (“CHX ETF Analysis”) clearly showing the negative impact that the SPY latency arbitrage activity had on displayed liquidity in SPY. In sum, as a result of the SPY latency arbitrage activity, CHX market share in SPY, as a percentage of total SPY volume, decreased from 5.73% in January 2016 to 0.57% in July 2016, while control securities¹⁷ did not experience similar declines. Also, the time-weighted average CHX size at the NBBO in SPY relative to the total NMS size at the NBBO in SPY decreased from 44.36% in January 2016 to 3.39% in July 2016, while, again, control securities did

designed to eliminate the risk of providing displayed liquidity, but rather, to bring the risk of providing displayed liquidity back to levels commensurate with its rewards. In particular, the 350 microsecond delay will not completely eliminate instances of latency arbitrage at CHX and, as such, a LEAD MM will still be subject to material risk when providing liquidity at CHX. See CHX First Letter, supra note 6, at 7.

¹³ From a cost perspective, all other things being equal, the cost to a liquidity provider of getting “picked off” is greater than the expected return of providing liquidity (i.e., the negative outcome to a liquidity provider in a latency arbitrage event always results in a loss), whereas the cost to a latency arbitrageur of a failed latency arbitrage is less than the expected return of “picking off” a stale quote (i.e., the negative outcome to a latency arbitrageur in a latency arbitrage event merely results in no profit). While market makers are currently afforded regulatory subsidies and financial incentives to provide displayed liquidity, those benefits have failed to enhance, much less maintain, the quantity and quality of displayed liquidity. See Notice, supra note 1, at Appendices A and B; see also supra note 8; see also supra note 10.

¹⁴ See Notice, supra note 1, at 11253.

¹⁵ SPY is generally the most actively matched security at CHX and, by far, the most active of the S&P500 correlated ETFs. For example, on June 27, 2017, SPY comprised nearly 1/3 of all single-sided matching activity at CHX. While the Exchange observed latency arbitrage activity and diminished liquidity in other S&P500 related ETFs in 2016, the Exchange chose to focus its market data analysis on SPY in light of CHX’s significant market share in SPY prior to the latency arbitrage activity, as described below.

¹⁶ See Notice, supra note 1, Appendices A and B.

¹⁷ The Exchange did not observe any latency arbitrage activity in the control securities nor did the Exchange receive any feedback from liquidity providers that they were being “picked off” in any securities aside from SPY and certain other S&P500 correlated ETFs.

not experience similar declines. SPY activity levels at CHX have remained depressed to this very day.¹⁸

Given its obligations under Section 6(b)(5) of the Securities Exchange Act of 1934 (“Act”)¹⁹ to maintain rules that, among other things, do not permit unfair discrimination among its members, the Exchange is compelled to rectify inefficiencies on its market that serve to diminish displayed liquidity and unfairly discriminate against liquidity providers.

1.2. CHX Liquidity Taking Access Delay

In response, the Exchange initially proposed the CHX Liquidity Taking Access Delay (“LTAD”).²⁰ LTAD would have required all new liquidity taking orders, as well as certain related cancel messages, to be intentionally delayed for 350 microseconds before the delayed messages would have been processed by the matching system. All other messages, including new liquidity providing orders and cancel messages for resting orders, would have been immediately processed without delay. The Commission received 24 comment letters²¹ on the LTAD Notice, both critical and supportive, including two response letters from the Exchange.²² While the Exchange disagreed with many of the critical comments regarding the LTAD Notice,²³ especially those comments speculating the LTAD would have resulted in unreliable displayed liquidity, the Exchange recognized that the LTAD Notice could be improved to address those concerns, regardless of their validity, by minimizing the possibility of excessive quote fading and order cancellations. Accordingly, the Exchange modified its proposal and replaced LTAD²⁴ with LEAD.

1.3. LEAD

LEAD will require all new incoming orders, cancel and cancel/replace messages to be subject to a 350-microsecond intentional access delay; provided, however, that (1) new incoming orders submitted by LEAD Market Makers (“LEAD MM”), a new class of CHX Market Maker with heightened quoting and trading obligations (“Minimum Performance Standards”), that would immediately be ranked on the CHX book without executing against any resting orders on the CHX book and (2) certain cancel messages related to resting orders that were submitted by LEAD MMs, will not be delayed. The proposed Minimum Performance Standards for LEAD MMs in assigned securities are as follows:

¹⁸ For example, CHX had 1.1 million executed provide shares in SPY on June 27, 2017, as compared to an average daily volume of approximately 7.3 million executed provide shares in SPY in January 2016.

¹⁹ 15 U.S.C 78f(b)(5).

²⁰ See Securities Act Release No. 78860 (September 16, 2016), 81 FR 65442 (September 22, 2016) (SR-CHX-2016-16) (“LTAD Notice”).

²¹ All comment letters on the LTAD Notice may be found at <https://www.sec.gov/comments/sr-chx-2016-16/chx201616.shtml>.

²² See Letter to Brent J. Fields, Secretary, Commission, from James Ongena, Executive Vice President, General Counsel, CHX (October 28, 2016) (“First CHX LTAD Response”); see also Letter to Brent J. Fields, Secretary, Commission, from James Ongena, Executive Vice President, General Counsel, CHX (February 7, 2017) (“Second CHX LTAD Response”).

²³ See generally First CHX LTAD Response, *id.*

²⁴ See Securities Act Release No. 79984 (February 7, 2017), 82 FR 10521 (February 13, 2017).

- Submit bids and offers at or within Designated Percentages half of those applicable to regular CHX Market Makers.²⁵
- Maintain a continuous average two-sided quotation at the NBBO of at least 10% over the course of a calendar month (“10% NBBO Requirement”).
- A LEAD MM’s Qualified Executions²⁶ in a security must comprise on an equally-weighted daily average at least 2% of all Qualified Executions in the same security over the course of a calendar month (“2% Total Volume Requirement”).
- At least 80% of the LEAD MM’s Qualified Executions in a security must result from its resting orders over the course of a calendar month (“80% Provide Volume Requirement”).

Prior to issuing the Order, the Commission received 11 comment letters,²⁷ both critical and supportive, including the First CHX LEAD Response. In the First CHX LEAD Response, the Exchange responded to various criticisms of the Notice by asserting, among other things, that (1) LEAD will benefit retail and institutional investors through enhanced price discovery and liquidity, without materially impacting the ability of retail and institutional investors to access liquidity at CHX, as demonstrated by the Exchange’s analysis of market data found under the Notice;²⁸ (2) the benefits afforded to LEAD MM are commensurate with the proposed Minimum Performance Standards, which are similar to, if not more aggressive than, the most stringent market making requirements on the NYSE or Bats BZX;²⁹ (3) LEAD will correct the risk/reward dynamic that currently discourages displayed liquidity;³⁰ (4) software-based access delays will not provide LEAD

²⁵ CHX Article 16, Rule 4(d) requires, among other things, that a CHX Market Maker maintain a continuous bid no further away from the National Best Bid (“NBB”) and a continuous offer no further away from the National Best Offer (“NBO”) than the Designated Percentage or Defined Limit, as applicable. For example, the 8% Designated Percentage for securities subject to the CHX Article 20, Rule 2A(c)(1)(A) pursuant to current CHX Article 16, Rule 4(d)(2)(A) and (B) would be 4% for LEAD MMs.

²⁶ “Qualified Executions” means all executed shares at CHX, during all trading sessions, resulting from single-sided orders, excluding any executed shares resulting from auctions. See Notice, supra note 1, at 11254.

²⁷ See Letter to Commission, from Ryan Hitch, Head of Equities Trading, XR Securities LLC (February 24, 2017) (“XR Letter”); see also Letter to Robert W. Errett, Deputy Secretary, Commission, from Douglas A. Cifu, Chief Executive Officer, Virtu Financial (February 27, 2017) (“Virtu Letter”); see also letter to Brent J. Fields, Secretary, Commission, from Joanna Mallers, Secretary, FIA Principal Traders Group (March 13, 2017) (“First FIA Letter”); see also letter to Brent J. Fields, Secretary, Commission, from Adam Nunes, Head of Business Development, Hudson River Trading LLC (March 13, 2017) (“HRT Letter”); see also letter to Brent J. Fields, Secretary, Commission, from R.T. Leuchtkafer (March 14, 2017) (“First Leuchtkafer Letter”); see also letter to Eduardo A. Aleman, Assistant Secretary, Commission, from Stephen John Berger, Managing Director, Government and Regulatory Policy, Citadel Securities (March 14, 2017) (“First Citadel Letter”); see also, Letter to Brent J. Fields, Secretary, from Tyler Gellasch, Executive Director, Healthy Market Association (March 17, 2017) (“Healthy Markets Letters”); see also Letter to Brent J. Fields, Secretary, Commission, from Elizabeth K. King, General Counsel and Corporate Secretary, New York Stock Exchange (March 20, 2017) (“NYSE Letter”); see also First CHX LEAD Response, supra note 6; see also CTC Letter, supra note 12; see also Letter to Brent J. Fields, Secretary, Commission, from Theodore R. Lazo, Managing Director and Associate General Counsel, SIFMA (May 17, 2017) (“SIFMA Letter”). All comment letters on the Notice may be found at <https://www.sec.gov/comments/sr-chx-2017-04/chx201704.htm>

²⁸ See First CHX LEAD Response, supra note 6, at 4-6.

²⁹ See First CHX LEAD Response, supra note 6, at 6-7.

³⁰ See First CHX LEAD Response, supra note 6, at 7-8.

MMs with an impermissible advantage beyond 350 microseconds;³¹ and (5) LEAD furthers the objectives of Section 6(b)(5) of the Act³² and is consistent with the requirements of Rule 602(b) under the Act³³ (“Firm Quote Rule”) and Rule 611³⁴ and Rule 600(b)(3)³⁵ under the Act (“Order Protection Rule”).³⁶

In the Order,³⁷ the Commission, among other things, posed the thirteen Questions related to the Proposal. After the Order was issued, the Commission received the Comments,³⁸ which were submitted by persons that had previously submitted critical letters on the Notice and the LTAD Notice: Citadel Securities (“Citadel”), FIA and R.T. Leuchtkafer (“Leuchtkafer”). The Exchange offers the following in response to the Questions and Comments.

2. CHX Response to the Questions

2.1. *Would the proposed minimum performance standards for LEAD MMs enhance market quality? Why or why not?*

Yes, the proposed Minimum Performance Standards will enhance market quality by ensuring that CHX quotes remain reliable and accessible. When considered with the CHX Order Cancellation Fee,³⁹ which imposes a fee for excessive order cancellation in the absence of a material contribution to CHX volume, the proposed Minimum Performance Standards will discourage LEAD MMs from engaging in excessive quote fading and other non-bona fide liquidity provision strategies. This will, in turn, facilitate even greater market quality enhancements that will be realized through the LEAD functionality itself. By minimizing the effectiveness of latency arbitrage strategies and thereby correcting the risk/reward dynamic that currently discourages liquidity provision,⁴⁰ LEAD will encourage LEAD MMs to submit larger and more aggressively priced orders. Given that LEAD is designed to be a competitive program whereby multiple LEAD MMs would compete for execution priority in a given security, LEAD will promote competition among orders and, thus, enhance market quality.

Consistent with Commission guidance regarding the permissibility of market maker benefits,⁴¹ the proposed Minimum Performance Standards are substantial market quality requirements that are proportionate to the benefits conferred. In support, the Exchange notes that

³¹ See First CHX LEAD Response, supra note 6, at 9.

³² 15 U.S.C 78f(b)(5).

³³ 17 CFR 242.602(b)

³⁴ 17 CFR 242.611.

³⁵ 17 CFR 242.600(b)(3).

³⁶ See First CHX LEAD Response, supra note 6, at 10-14.

³⁷ See Order, supra note 4, at 24416.

³⁸ See supra note 5.

³⁹ See Section E.8 of the CHX Fee Schedule.

⁴⁰ See supra note 12.

⁴¹ The Commission stated that “while exchanges may legitimately confer special benefits on market participants willing to accept substantial responsibilities to contribute to market quality, such benefits must not be disproportionate to the services provided.” See Exchange Act Release No. 67437 (July 13, 2012), 77 FR 42525, 425257 (July 19, 2012).

the NYSE offers DMMs execution parity rights in return for minimum performance standards that are similar to, if not less aggressive than, the proposed Minimum Performance Standards. It is important to highlight significance of DMM parity. DMM parity permits a DMM to sit back in the time priority queue, yet participate in trades ahead of other members that have established time priority relative to the DMM, while minimizing its risk of adverse selection during times of market transition. In this sense, both DMM parity and LEAD minimize the unreasonable risk of adverse selection borne by liquidity providers that result from a structural bias against displayed liquidity built-in to the continuous limit order book.⁴² However, unlike DMM parity, which encourages DMMs to merely join the NBBO, LEAD, when considered with the CHX Market Data Revenue Rebates Program,⁴³ would incentivize LEAD MMs to improve the price and size of the prevailing NBBO by both minimizing the risk of getting “picked off” and by providing financial incentives in the form of rebates for quotes that remain on the CHX book for at least one second, the amount of which increases in proportion to the liquidity provider’s share of the relevant quote. As such, the Exchange submits that if the market quality enhancements derived from the NYSE DMM minimum performance standards are substantial and proportionate to the benefits conferred to NYSE DMMs, then surely the market quality enhancements that will be derived from the proposed Minimum Performance Standards are substantial and proportionate to the benefits conferred to LEAD MMs.

Notwithstanding, in response to questions raised by certain commenters regarding the materiality of the proposed Minimum Performance Standards,⁴⁴ the Exchange conducted additional analysis to illustrate that the proposed Minimum Performance Standards are substantial relative to historical CHX data. Given the Exchange’s obligations related to confidentiality of certain Participant trading data, the Exchange aggregated trading data by calculating the total number of Trading Account⁴⁵ and security combinations (“Combinations”) from January 2016 and February 2017, separately, and treated each Combination as if it were a LEAD MM Trading Account assigned to a particular LEAD MM Security.⁴⁶ The Exchange then analyzed CHX trading data associated with each of these Combinations from January 2016, when CHX single-sided activity in SPY was at its peak prior to the introduction of the latency arbitrage activity in SPY,⁴⁷ and February 2017, to determine the percentage of Combinations that would have met the three proposed Minimum Performance Standards for which the Exchange has measurable data.⁴⁸

⁴² See supra Section 1.1.

⁴³ See Section P of the CHX Fee Schedule.

⁴⁴ See e.g., Healthy Markets Letter, supra note 27, at 4.

⁴⁵ See CHX Article 1, Rule 1(II) defining “Trading Accounts.”

⁴⁶ See proposed CHX Article 16, Rule 4(f)(1)(C) defining “LEAD MM Security.”

⁴⁷ See supra Section 1.1.

⁴⁸ There were no registered CHX Market Makers in January 2016 or February 2017. Given that the Exchange would only maintain Designated Percentage data for Trading Accounts associated with registered Market Makers, the Exchange is unable to measure whether non-Market Maker Trading Accounts could have met the halved Designated Percentage requirement.

As shown under Figure 1 below, in January 2016, only 18.1% of Combinations would have passed all three tests.

<i>Figure 1</i>	Percentage of Combinations that Passed			Passed All Three Tests
CHX Datacenter ⁴⁹	80% Provide Volume Requirement	2% Total Volume Requirement	10% NBBO Requirement	
CH2	95.2%	96.4%	91.6%	67.50%
NY4	100%	99.6%	0.40%	0.40%
Combined	98.7%	1.30%	24.4%	<u>18.10%</u>

Moreover, as shown under Figure 2 below, in February 2017, 35.2% of all Combinations would have passed all three tests.

<i>Figure 2</i>	Percentage of Combinations that Passed			Passed All Three Tests
CHX Datacenter	80% Provide Volume Requirement	2% Total Volume Requirement	10% NBBO Requirement	
CH2	90.1%	93%	84.5%	76.1%
NY4	99.2%	99.7%	34.4%	33.7%
Combined	98.9%	99.5%	36.2%	<u>35.2%</u>

With respect to the January 2016 data, the Exchange notes that while the Exchange did not have any registered Market Makers at that time, the SPY Combinations associated with the most active liquidity providers would have easily passed all three tests. However, this does not suggest that the proposed Minimum Performance Standards are not material, but rather, that these active SPY liquidity providers were providing valuable liquidity to the market in January 2016.⁵⁰ After the introduction of the SPY latency arbitrage activity, this liquidity evaporated, such that by February 2017, none of the active SPY liquidity providers from January 2016 would have passed all three tests. Moreover, SPY activity levels at CHX have remained depressed to this very day.⁵¹

⁴⁹ Each security traded on the Exchange is assigned to one of two Primary Matching Locations: the CH2 datacenter located in Chicago, Illinois, and the NY4 datacenter located in Secaucus, New Jersey. Each Primary Matching Location serves as a backup matching location to the other. No single security traded on the Exchange is permitted to trade at both CH2 and NY4 simultaneously. All securities with CH2 as the Primary Matching Location may be found at <http://www.chx.com/market-data/chx-data-center/>. All securities with NY4 as the Primary Matching Location may be found at <http://www.chx.com/market-data/nj-data-center/>. Throughout 2016 and 2017, while there were more Trading Account located at NY4 than at CH2, the vast majority of Exchange's single-sided matching activity occurred in securities with a Primary Matching Location at CH2.

⁵⁰ See *supra* Section 1.1.

⁵¹ See *supra* note 18; see also *supra* Section 1.1.

Given that the majority of Participants would not have passed the proposed Minimum Performance Standards and the most active SPY liquidity providers would not have met the standards as of February 2017, the Exchange submits that the proposed Minimum Performance Standards are material. Thus, in the event LEAD is implemented, displayed liquidity provision in any security, including SPY, which meets or exceeds the proposed Minimum Performance Standards, would result in materially enhanced market quality.

2.2. *What metrics would help determine any enhancement to market quality? How should enhancements to market quality be measured with the delay in effect?*

The metrics utilized under Appendix B of the Notice⁵² would be helpful in assessing any impact on market quality by LEAD. For example, one could compare the average time-weighted CHX BBO spread and average time-weighted CHX BBO size before and after LEAD MM assignment to a security. This data could then be compared against the average time-weighted total NBBO spread and average time-weighted total NBBO size, respectively, in the same securities, during the same time periods.

In the event the Notice were approved, the Exchange anticipates providing aggregated statistics and analysis on the CHX website so that the Commission and the public could track the market quality improvements realized from LEAD.

2.3. *How would the proposal affect price volatility during stressed trading conditions?*

LEAD would most likely not introduce any incremental price volatility during stressed trading conditions. While LEAD MMs quotes would likely widen during stressed trading conditions, as market maker quotes would today at other exchanges, LEAD MMs would be subject to the proposed Minimum Performance Standards, which may have a mitigating effect on price volatility. Moreover, the Exchange believes that the current circuit breakers,⁵³ including Limit Up-Limit Down,⁵⁴ provide an adequate market wide remedy for extraordinary market volatility.

2.4. *How would the proposal affect transaction costs for retail and institutional investors?*

As described under Section II of the First CHX LEAD Response,⁵⁵ LEAD will reduce transaction costs for retail and institutional investors. Aside from the obvious benefit to retail and

⁵² See Notice, *supra* note 1, Appendix B.

⁵³ See CHX Article 20, Rule 2.

⁵⁴ See CHX Article 20, Rule 2A.

⁵⁵ Under the First CHX LEAD Response, the Exchange noted the following:

By minimizing the effectiveness of latency arbitrage, LEAD will reduce the cost of providing liquidity to the LEAD MM, which will in turn permit LEAD MMs to quote tighter spreads and display larger size.⁵⁵ This will provide valuable liquidity and price discovery to all market participants, particularly retail and institutional investors who rely upon efficient price discovery to evaluate the quality of their executions, regardless of where they occur in the NMS. Contrary to some claims, there is no evidence that suggests that LEAD will result in CHX quotes becoming less accessible to natural buyers and sellers. To the contrary, if LEAD had been implemented at CHX in SPY from May through July 2016, only 20 liquidity taking orders not attributed to latency arbitrage activity out of a total of 18,316 orders executed during that time period would have not received an execution. Notwithstanding, the Exchange is proposing to adopt the Minimum Performance Standards to ensure that CHX displayed

institutional investors that would result from tighter spreads and larger displayed size, cost savings to retail investors would be realized by way of decreased profitability for wholesalers in trading against retail order flow.

Specifically, wholesalers price the majority of the retail orders they handle off the prevailing NBBO. However, they rarely post displayed liquidity as part of the NBBO and expose themselves to the associated market risks, including latency arbitrage. Because wholesalers base execution price on the NBBO, a slight narrowing of the average NBBO spread will favorably affect the pricing that wholesalers provide for retail orders, at the expense of the wholesalers' bottom line. The Exchange notes that the Commission has recognized the positive impact of enhanced displayed liquidity on reducing investor transaction costs.⁵⁶

While there is no well-recognized source for quantifying retail trading volume, an alternative way to estimate the number of retail shares executed each day is to utilize a wholesaler's Rule 605 data. For example, in the first quarter of 2017, Citadel executed a total of 23,974,000,000 shares, excluding more than 257,000,000 shares Citadel routed away. This is approximately 381 million shares per day executed by Citadel. Assuming that Citadel executes more than 35% of retail volume in NMS securities,⁵⁷ the average daily total retail share volume is approximately 1.088 billion shares per day. Each \$0.0001 narrowing of the average NBBO spread would pass along an estimated savings of \$27,417,600 per year. Narrowing the average NBBO spread by \$0.0005 would save retail customers approximately \$137,088,000 million per year. At 35% market share, Citadel's cost for a \$0.0005 narrower spread would be just under \$48 million each year. The savings passed on to retail investors as a result of tighter spreads would be substantial by any standard. Thus, Citadel's repeated criticisms of both LTAD and LEAD should come as no surprise to the Commission.

In contrast, unlike retail order flow, institutional order flow is not directed to wholesalers. Some institutional orders are executed during opening and closing auctions and, thus, LEAD would have no impact on those transactions. Most institutional orders are broken down into much smaller "child orders" which are executed in the marketplace using a variety of algorithms. In general, execution costs for these smaller child orders would be reduced when average NBBO spreads are narrowed. Therefore, to the extent that implementation of LEAD increases competition among orders and narrows the average NBBO spread, institutional order flow would also experience lower execution costs.

liquidity remains reliable and accessible. When coupled with the CHX Order Cancellation Fee, which penalizes excessive order cancellations in the absence of material contributions to CHX volume, the Exchange submits that the benefits conferred upon LEAD MMs will directly flow to retail and institutional investors in the form of enhanced displayed liquidity and price discovery that is both accessible and reliable. The Exchange notes that while LEAD would obviously diminish the effectiveness of latency arbitrage at CHX, the enhanced displayed liquidity that will result from LEAD will also negatively impact broker internalizers that profit from wider spreads and smaller displayed size. See First CHX LEAD Response, supra note 6, at 5 (emphasis added).

⁵⁶ "Because of the enormous volume of trading in NMS stocks, even a small percentage improvement in depth and liquidity could lead to very significant dollar benefits for investors in the form of reduced transaction costs." See Regulation NMS Adopting Release, supra note 7, at 37512.

⁵⁷ See Second Citadel Letter, supra note 5, at 1.

2.5. How would the proposal affect an institutional investor's experience providing liquidity and removing liquidity on CHX?

With respect to an institutional investor's experience providing liquidity at CHX, as illustrated under Example 2 of the Notice,⁵⁸ a liquidity providing order submitted by a non-LEAD MM will be subject to the 350 microsecond delay, but upon release from the delay, the order will be ranked on the CHX book based on time of original receipt. Since all liquidity taking orders will be delayed 350 microseconds, a LEAD MM liquidity providing order received while a precedent non-LEAD MM liquidity providing order is in the delay queue will never be executed ahead of the non-LEAD MM liquidity providing order. That is, except for the fact that LEAD MM liquidity providing orders may be displayed ahead of a non-LEAD MM liquidity provide order that is in the delay queue, LEAD will not result in any exceptions to the Exchange's current execution priority rules.⁵⁹

The advantage to LEAD MMs relative to non-LEAD MMs lies in the ability of LEAD MMs to cancel or adjust resting orders without delay. However, assuming that institutional investors trade at a much slower pace than high-frequency market makers or latency arbitrageurs, institutional investors would not derive incremental benefit from the ability to cancel or adjust resting orders without delay.⁶⁰ In other words, where a high-frequency market maker may view a particular execution of its liquidity providing order as having been "picked off," a similar execution would most likely be considered by an institutional investor as a favorable liquidity event. Moreover, since LEAD is designed to be a competitive program whereby numerous LEAD MMs would be assigned to a given security, the Exchange believes that it is highly unlikely that a qualified market participant that wishes to register as a LEAD MM in a given security would be unable to do so. Thus, the various comments stating that, during a market transition, a LEAD MM would be able to avoid adverse selection at the cost of non-LEAD MMs displaying orders at the same price, are incorrect.⁶¹

With respect to an institutional investor's experience taking liquidity, all liquidity taking orders will be delayed under LEAD and, thus, institutional investors will have the same experience as any other liquidity taker, which is no different than what institutional investors experience today at IEX or will experience at NYSE MKT when their recently-approved⁶² access delay rules are implemented. Moreover, under the Notice,⁶³ the Exchange demonstrated that LEAD would not have a materially negative affect on liquidity takers not engaged in latency arbitrage strategies, such as retail and institutional investors, to access displayed liquidity at CHX.⁶⁴

⁵⁸ See Notice, *supra* note 1, at 11259, Fig 2(j).

⁵⁹ See CHX Article 20, Rule 8(b).

⁶⁰ Under the First CHX LEAD Response, the Exchange noted that "[t]hose Participants that are not latency sensitive or otherwise unconcerned with latency arbitrage activity would have no reason to register as a LEAD MM and would thus be able to effectively engage in liquidity provisions strategies side-by-side with LEAD MMs without the benefit of LEAD." See First CHX LEAD Response, *supra* note 6, at 7.

⁶¹ See e.g., Second Citadel Letter, *supra* note 5, at 3; see also e.g., Second Leuchtkafer Letter, *supra* note 5, at 10.

⁶² See Exchange Act Release No. 80700 (May 16, 2017), 82 FR 23381 (May 22, 2017).

⁶³ See First CHX LEAD Response, *supra* note 6, at 5.

⁶⁴ Under the Notice, the Exchange noted the following:

[I]f LEAD had been in effect for the period of May 2016 through July 2016,[...] LEAD would have had a negative impact on only 20 liquidity taking orders not attributed to SPY latency

- 2.6.** *Would the proposal provide an unfair advantage to LEAD MMs providing liquidity vis-à-vis other liquidity providers and in particular when the price of a security moves?*

No. In support, the Exchange refers the Commission to Sections 2.1 and 2.5 above.

- 2.7.** *Do commenters agree with the Exchange's assertion that the proposed rule change would increase displayed liquidity on the Exchange?*

The Exchange notes that none of the Comments deny that LEAD will result in increased displayed liquidity. However, certain Comments claim that the CHX quotes will become inaccessible.⁶⁵ In response, the Exchange refers the Commission to Section 2.1 above, which explains why the proposed Minimum Performance Standards will ensure that CHX quotes remain reliable and accessible. The Exchange also notes that Commission had previously received comments stating that displayed liquidity at CHX would be improved as a result of LEAD.⁶⁶

- 2.8.** *Do the obligations for LEAD MMs to comply with the proposed minimum performance standards justify the LEAD MMs' speed advantage?*

Yes. In support, the Exchange refers the Commission to Sections 1 and 2.1 above.

- 2.9.** *According to several commenters, liquidity provided by LEAD MMs would be "fleeting" because they could update their quotations while incoming orders are delayed. Do commenters agree? If so, what are commenters' views on how significant "fleeting" liquidity would be in comparison to the overall liquidity provided on the Exchange?*

No, the Exchange does not agree that liquidity provided by LEAD MMs would be fleeting, except from the perspective of latency arbitrageurs, who will experience diminished latency arbitrage opportunities. In support, the Exchange refers the Commission to the Appendix C of the Notice,⁶⁷ which shows that liquidity takers not engaged in latency arbitrage will not experience a materially negative effect on their ability to access displayed liquidity at CHX.

Moreover, an order attempting to take liquidity at any national securities exchange today may be seeking liquidity that will not be present when the order reaches the exchange's limit order book. This is a fact under Regulation NMS that has nothing to do with the presence of intentional delays. Thus, when considering that any protected quotation today may be cancelled or adjusted prior to execution, LEAD would not render CHX quotes any more "fleeting" than they are today.

The Exchange notes that because LEAD will not delay certain liquidity providing orders submitted by LEAD MMs, LEAD MM quotes will be disseminated to the market via the SIP and CHX book feed faster than quotes displayed on Investors Exchange LLC ("IEX"), which subjects all

arbitrage activity. These 20 orders comprised 0.11% of the 18,316 orders executed during the period. That is, during the measurement period of 63 trading days, LEAD would have had an adverse effect on approximately one order every three trading days. Thus, LEAD can make a significant contribution to leveling the playing field between LEAD MMs and latency arbitrageurs with minimal adverse effect on other liquidity taking orders. See Notice, supra note 1, at Appendix C.

⁶⁵ See e.g., Second Leuchtkofer Letter, supra note 5, at 8.

⁶⁶ See Virtu Letter, supra note 27, at 2; see also CTC Letter, supra note 11, at 3.

⁶⁷ See Notice, supra note 1, at Appendix C; see also supra note 64.

incoming order-related messages to its 350-microsecond POP/coil delay (“IEX Delay”). In this respect, LEAD will enhance price discovery in a way that IEX cannot.

2.10. *How would the proposal affect the national market system if exchanges with a larger percentage of overall trading volume were to adopt a similar proposal? In particular, how would the proposal affect market quality?*

The Exchange believes that if the larger exchanges adopted a proposal similar to LEAD, latency arbitrage would no longer become a profitable strategy on the lit markets. With the risks involved in liquidity provision related to latency arbitrage significantly reduced, the risk-adjusted rate of return required by liquidity providers would decrease, which will result in liquidity providers who provide displayed liquidity on exchanges to become more competitive on price and size of their quotes. Moreover, as published quotes narrow or their size grow, wholesalers who handle retail order flow would be compelled to base their executions on tighter and/or deeper markets.⁶⁸ In turn, wholesaler returns would also go down as they matched the narrower protected quotes constituting the NBBO. Thus, the result of larger markets adopting a delay similar to LEAD would be even tighter and deeper markets, fueled by enhanced competition among orders and trading centers, which would further lower execution costs to both retail and institutional investors, at the expense of latency arbitrageurs and wholesalers.

2.11. *One of the stated goals of the proposal is to minimize the effectiveness of latency arbitrage strategies. What metrics would help determine if latency arbitrage is currently a problem on CHX?*

The Exchange has presented compelling evidence and market data analysis clearly demonstrating that latency arbitrage is currently a problem on CHX.⁶⁹ SPY activity levels at CHX have not recovered to pre-SPY latency arbitrage activity levels⁷⁰ and remain depressed because the threat of latency arbitrage remains ever present. The Comments present absolutely no evidence to the contrary to refute the Exchange’s findings.

2.12. *Is 350 microsecond necessary to minimize the effectiveness of latency arbitrage strategies? Should the delay be shorter or longer to accomplish this goal? Is the 350 microsecond delay appropriate for trading at both CHX’s Chicago data center and its East Coast data center? Why or why not?*

Yes, 350 microseconds is long enough to minimize the effectiveness of latency arbitrage strategies, yet short enough as to not provide liquidity providers with an unfair advantage (i.e., overcorrect the risk/reward dynamic that currently discourages displayed liquidity). Under the Appendix C of the Notice,⁷¹ the Exchange explained that during the period of May 2016 through July 2016, an intentional delay of 350 microseconds would have prevented 32.24% of stale quotes in SPY from being “picked off.” Assuming that CHX liquidity providers could have made enhancements to their own message delivery protocols, the Exchange believes that the prevention rate would have likely increased to better than 50%. Thus, even with a 350 microsecond delay, a material risk of a stale quote being “picked off” would remain, which is appropriate since LEAD is not designed to

⁶⁸ See supra Section 2.4.

⁶⁹ See supra Section 1.1.

⁷⁰ See supra note 18.

⁷¹ See Notice, supra note 1, at Appendix C; see also supra note 64.

eliminate the risk of providing displayed liquidity, but rather, to bring the risk of providing displayed liquidity back to levels commensurate with its rewards.⁷² Based on this analysis of SPY activity, which is currently traded at the CH2 datacenter,⁷³ the Exchange submits that 350 microseconds is an appropriate delay for securities with a Primary Matching Location at CH2.

As for NY4, given that the Commission approved the IEX Delay,⁷⁴ which was designed to address latency arbitrage concerns among the exchange datacenters located in the New York metropolitan area, the Exchange believes that a 350 microsecond is also an appropriate delay for securities with a Primary Matching Location at NY4.

2.13. *Does the proposal's protection against latency arbitrage strategies for LEAD MMs warrant the benefits of the delay?*

Yes, the benefits to enhanced displayed liquidity and price discovery that would result from minimizing the effectiveness of latency arbitrage strategies warrant the benefits of the delay. In support, the Exchange refers the Commission to Sections 1.1 and 2.1 above. The Exchange also refers the Commission to comments submitted by two leading electronic market makers, Virtu and CTC, both of whom stated that LEAD would enhance displayed liquidity, while recognizing the chilling effect latency arbitrage has on displayed liquidity.⁷⁵

2.14. *Is the delay short enough that it would not harm liquidity takers or providers other than those engaging in latency arbitrage?*

Yes, the delay is short enough that it would not harm liquidity takers or providers other than those engaging in in latency arbitrage. In support, the Exchange refers the Commission to Appendix C of the Notice.⁷⁶

2.15. *What are commenters' views on how the proposal would affect liquidity providers on CHX other than LEAD Market Makers as well as liquidity providers on other markets?*

Currently, the Exchange has few liquidity providers and no registered Market Makers. The Exchange anticipates that implementation of LEAD will result in many of the Exchange's top liquidity providers registering as LEAD MMs. Current liquidity providers may chose not to register as LEAD MMs as they would either be unable to meet the proposed Minimum Performance Standards or do not view the benefits of LEAD to provide incremental benefit to their liquidity provision strategies.

⁷² See First CHX LEAD Response, supra note 6, at 7. Moreover, as rightly noted by one commenter, the 350 microsecond delay will reduce "the disadvantage incurred by participating market makers *who are slower by the smallest margin* than the corresponding liquidity takers." CTC Letter, supra note 11, at 3. LEAD MMs that are slower than 350 microseconds will not benefit from LEAD.

⁷³ See supra note 49.

⁷⁴ See Securities Exchange Act Release No. 78101 (June 17, 2016), 81 FR 41141, 41155 (June 23, 2016) ("IEX Approval Order").

⁷⁵ Virtu stated that "LEAD MMs will be more inclined to post larger displayed orders at better prices in assigned securities on CHX with confidence that their orders will not be 'picked off' by speed arbitrageurs." Virtu Letter, supra note 27, at 2. CTC stated that "[b]y helping to establish a market structure where massive technology expenditures are no longer as critical in preventing trading losses, the Proposal will foster a fairer marketplace with superior liquidity provision and tighter bid-ask spreads as liquidity providers are able to improve their quoted markets." CTC Letter, supra note 11, at 3.

⁷⁶ See Notice, supra note 1, at Appendix C; see also supra note 64.

Moreover, since LEAD is designed to be a competitive program whereby numerous LEAD MMs would be assigned to a given security, the Exchange believes that it is highly unlikely that a qualified market participant that wishes to register as a LEAD MM in a given security would be unable to do so.

Moreover, the Exchange believes that LEAD will result in increased competition with liquidity providers of other markets, which furthers a primary goal of Regulation NMS.⁷⁷ Such liquidity providers will have to provide enhanced liquidity or risk losing market share to LEAD MMs.

The Exchange also anticipates that LEAD MMs will compete with wholesalers. As described above,⁷⁸ tighter average NBBO spreads and/or increased size will directly impact the profitability of wholesalers. Because wholesalers prefer to trade at or inside the NBBO, when the NBBO is narrowed, wholesalers will either have to choose among matching the better price, improving the better price, or routing the customer order to the better price. Either way the customer benefits.

3. CHX Response to Second Citadel Letter

Generally, the Exchange refers the Commission to the Notice, First CHX LEAD Response and Sections 1 and 2 above in response to the Second Citadel Letter. Notwithstanding, the Exchange would like to highlight its response to the following claims.

Citadel claims that the Exchange has failed to “demonstrate the existence of a market-wide problem” that would justify LEAD and, in particular, states that the Exchange has failed to demonstrate a “(a) market-wide trading data showing any issues with trading the SPY, (b) an explanation of why similar market share declines did not occur for other securities listed on CHX, and (c) an explanation of other metrics that could be relevant in analyzing how the SPY is traded on CHX, such as the higher cancel-to-trade ratios and lower trade-to-order ratios on CHX compared to other exchanges.”⁷⁹

To the contrary, pursuant to the CHX ETF Analysis, the Exchange demonstrated that the SPY latency arbitrage activity negatively impacted displayed liquidity in SPY market wide. In particular, the Exchange stated the following (footnotes omitted, emphasis added):⁸⁰

Although the Time-weighted Average NMS Size At The NBBO in SPY increased by 22.83% during the After Period, the increase in SPY did not follow much greater increases in the Time-weighted Average NBBO Size in the Control Group, which increased by 128.82% during the After Period. Moreover, during the After Period, the Time-weighted Average CHX Size At The NBBO for SPY decreased by 90.61% and, as a % of total NMS Size At The NBBO in SPY, from 44.36% to 3.39%. These calculations suggest that the SPY latency arbitrage activity materially impacted displayed liquidity in SPY marketwide. The dramatic decrease in displayed liquidity in SPY at CHX during the After Period explains why the increase in Time-weighted Average NBBO Size in SPY lagged behind the increase in Time-weighted Average NBBO Size in the Control Securities. Had CHX Size At The NBBO remained at least

⁷⁷ See Regulation NMS Adopting Release, supra note 7, at 37514; see also supra Section 2.10.

⁷⁸ See supra Section 2.3.

⁷⁹ Second Citadel Letter, supra note 5, at 2.

⁸⁰ See Notice, supra note 1, at 11264.

constant during the After Period, NBBO Size in SPY would have been at least 32.7% higher in July 2016, as shown below:

Figure 3

	NMS Size at NBBO			Change Attribution	
	Jan-16	Jul-16	Change	CHX	Others
SPY	9,513	11,686	2,172	-3,824	5,996
DIA	2,569	4,711	2,142	1,227	915
IWM	5,222	10,026	4,804	536	4,268
QQQ	14,100	35,354	21,253	3,900	17,353
Control Average	7,297	16,697	9,400	1,888	7,512

Moreover, as noted above,⁸¹ while the Exchange did observe latency arbitrage activity in other less active S&P500 correlated ETFs during the relevant period, the Exchange chose to concentrate its analysis on SPY, given CHX's material contribution to SPY volume prior to the SPY latency arbitrage activity. Beyond that, the Exchange observed no latency arbitrage activity in other securities, which the Exchange attributes to the general lack of matching activity in those securities at CHX.⁸²

In addition, as the Exchange noted in the First CHX LTAD Response,⁸³ the unique cancel-to-trade and trade-to-order ratios in SPY at CHX are consistent with the nature of SPY liquidity provision at CHX. In sum, CHX liquidity in SPY and other S&P 500-correlated securities is provided as part of an arbitrage strategy that requires constant tracking of index market data from a derivatives market, particularly those markets located in the Chicagoland area. Since each change in the correlated index market data from a derivatives market could necessitate a corresponding adjustment to the SPY quote at CHX, it logically flows that adjustments rates for SPY at CHX would be higher than at other markets, as the Exchange believes that this type of liquidity provision is unique to CHX.⁸⁴

Citadel states that the Exchange has failed to provide "the necessary data to allow market participants and the Commission to evaluate the purportedly heightened quoting and trading obligations for LEAD MMs"⁸⁵ and claims that the Exchange's "selective comparison [to the market maker requirements on NYSE and Bats] does not assist market participants or the Commission in evaluating whether the LEAD Obligations are substantial and proportionate to the benefits conferred to LEAD MMs."⁸⁶ In response, the Exchange refers the Commission to Section 2.1 above.

⁸¹ See supra note 15.

⁸² See id.

⁸³ See First CHX LTAD Response, supra note 22, at 11.

⁸⁴ As of June 30, 2017, no other equities exchange maintains primary matching engines in Chicago.

⁸⁵ Second Citadel Letter, supra note 5, at 2.

⁸⁶ Second Citadel Letter, supra note 5, at 3.

Citadel also claims that “the asymmetric application of the Access Delay unfairly discriminates in favor of LEAD MMs to the detriment of other market participants, including liquidity providers that are not LEAD MMs as well as any market participant seeking to have its order filled on CHX,” which “constitutes an undue burden on competition.”⁸⁷ The Exchange disagrees and refers the Commission to Sections 2.1 and 2.5 above. The Exchange notes that the current structural bias that serves to discourage displayed liquidity provision is in itself an undue burden on competition.⁸⁸ By correcting the risk/reward dynamic that currently discourages displayed liquidity, the Exchange believes that LEAD will enhance competition among orders and, thus, the Proposal is not an undue burden on competition, consistent with the requirements of Section 6(b)(8) of the Act.⁸⁹

Citadel further claims that “[LEAD] is thus plainly not *de minimis*, as it creates a new competitive balance between both (a) LEAD MMs and other liquidity providers that are not able to benefit from the structural advantage, and (b) LEAD MMs and liquidity takers seeking to access displayed liquidity on CHX.” The Exchange disagrees. First, LEAD will not so much create a new competitive balance as it will correct a competitive imbalance that serves to discourage displayed liquidity. In addition, the Exchange refers the Commission to Sections 2.5 and 2.9 above.

4. CHX Response to Second FIA Letter

Generally, the Exchange refers the Commission to the Notice, First CHX LEAD Response and Sections 1 and 2 above in response to the Second FIA Letter. In addition, the Exchange would like to specifically address the claim that “[w]ithout the proposed speed-bump, as far as we are aware, it is possible to cancel a resting order just as quickly as it is to send a new marketable order.”⁹⁰ This statement is misplaced. As described above,⁹¹ since order-related messages are processed serially upon time of receipt, a cancel message must beat the marketable order in order to successfully avoid being “picked off” when reacting to the same symmetric information. It is this asymmetry that the LEAD is designed to address.

5. CHX Response to Second Leuchtkafer Letter

The Exchange notes that much of the Second Leuchtkafer Letter is based on a lack of understanding of the LEAD functionality. It is unfortunate and discouraging that a commenter can hide behind the cloak of anonymity to divest oneself of the responsibility of truly understanding what one is criticizing. Nevertheless, since the Second Leuchtkafer Letter is now a matter of public record, the Exchange is compelled to set the record straight. Given that much of the Second Leuchtkafer Letter repeats assertions made under the First Leuchtkafer Letter, the Exchange refers the Commission to the Notice, First CHX LEAD Response and Sections 1 and 2 above in response thereto. In addition, the Exchange would like to specifically address the following claims.

⁸⁷ Second Citadel Letter, supra note 5, at 3.

⁸⁸ See supra Section 1.1.

⁸⁹ 15 U.S.C 78f(b)(8).

⁹⁰ Second FIA Letter, supra note 5, at 2.

⁹¹ See supra Section 1.1.

With respect to claims alleging that LEAD would provide LEAD MMs with “an exclusive first look at price discovery,”⁹² the Exchange refers the Commission to CTC’s response correctly identifying the circuitous and suspect logic of the claim.⁹³

5.1. Example

Leuchtkafer offers an elaborate example in an attempt to support his claim that software-based delays are somehow more unreliable than hardware based delays.⁹⁴ In response, the Exchange refers the Commission to its recently approved order for NYSE MKT’s software based access delay, which suggests that the question regarding the reliability of software-based delays is moot. Moreover, the Exchange offers the following example to illustrate that the Leuchtkafer example is misleading.

Assumptions:

- There are three exchanges each of which receives identical order flow at identical times:
 - CHX with LEAD’s 350 microsecond intentional in effect.
 - IEX with its 350 microsecond intentional hardware delay in effect.
 - ARCA with no intentional delay in effect.
- All three exchanges have matching engines that take 100 microseconds to process the average message.
- As used under Leuchtkafer’s examples:
 - market moving news breaks at 10:00:00.000000;
 - Table 1 below shows the sequence of orders:

⁹² Second Leuchtkafer Letter, supra note 5, at 1 and 6.

⁹³ See CTC Letter, supra note 11, at 4-5.

⁹⁴ See Second Leuchtkafer Letter, supra note 5, at 2-5.

Table 1. Inbound Orders⁹⁵			
Sequence Number	Time of Initial Receipt		Delayable Message?
	First	Last	
1	11		Y
2	11		N
3	12		Y
4	12		Y
...	12	49	Y
2002	50		Y
2003	50		N
2004	51		Y
...	51	150	Y
4002	150		Y
4003	150		N
4004	151		Y
...	151	300	Y
6002	300		Y
6003	300		N
6004	301		Y
...	301	330	Y
8002	330		Y
8003	330		N
8004	331		Y
...	331	360	Y
10002	360		Y
10003	360		N
10004	360		Y
10005	360		Y
10006	360		Y

⁹⁵

For simplicity, all times are shown as microseconds after 10:00:00.

Comparison:

The red herring in Leuchtkafer's example is the failure to conduct a comparative analysis of how disparate markets would perform under the same messaging scenario.

Tables 2, 3, and 4 below show the sequence in which these orders would be processed at ARCA (no intentional delay), IEX (350 microsecond intentionally delay of all orders), and at CHX (350 microsecond intentionally delay on all but 6 orders in the example).

Table 2. Handling of Orders at ARCA							
Sequence Number	Initial Time of Receipt	Time Matching System Starts Processing		Time Matching System Ends Processing		Unintentional Delay	
		First	Last	First	Last	First	Last
1	11	11		111		0	
2	11	111		211		100	
3	12	211		311		199	
4	12	311		411		299	
...	12 - 49	411	200011	511	200111	399	199962
2002	50	200111		200211		200061	
2003	50	200211		200311		200161	
2004	51	200311		200411		200260	
...	51 - 150	200411	400011	200511	400111	200360	399960
4002	150	400111		400211		399961	
4003	150	400211		400311		400061	
4004	151	400311		400411		400160	
...	151 - 300	400411	600011	400511	600111	400260	599960
6002	300	600111		600211		599811	
6003	300	600211		600311		599911	
6004	301	600311		600411		600010	
...	301 - 330	600411	800011	600511	800111	600110	799960
8002	330	800111		800211		799781	
8003	330	800211		800311		799881	
8004	331	800311		800411		799980	
...	331 - 360	800411	1000011	800511	1000111	800080	999960
10002	331	1000111		1000211		999780	
10003	331	1000211		1000311		999880	
10004	360	1000311		1000411		999951	
10005	360	1000411		1000511		1000051	

Table 3. Handling of Orders at IEX							
		Time Matching System Starts Processing		Time Matching System Ends Processing		Unintentional Delay	
Sequence Number	Initial Time of Receipt	First	Last	First	Last	First	Last
1	11	361		461		0	
2	11	461		561		100	
3	12	561		661		199	
4	12	661		761		299	
...	12 - 49	761	200361	861	200461	399	199962
2002	50	200461		200561		200061	
2003	50	200561		200661		200161	
2004	51	200661		200761		200260	
...	51 - 150	200761	400361	200861	400461	200360	399962
4002	150	400461		400561		399961	
4003	150	400561		400661		400061	
4004	151	400661		400761		400160	
...	151 - 300	400761	600361	400861	600461	400260	599962
6002	300	600461		600561		599811	
6003	300	600561		600661		599911	
6004	301	600661		600761		600010	
...	301 - 330	600761	800361	600861	800461	600110	799962
8002	330	800461		800561		799781	
8003	330	800561		800661		799881	
8004	331	800661		800761		799980	
...	331 - 360	800761	1000361	800861	1000461	800080	999962
10002	331	1000461		1000561		999780	
10003	331	1000561		1000661		999880	
10004	360	1000661		1000761		999951	
10005	360	1000761		1000861		1000051	

Table 4. Handling of Orders at CHX

Sequence Number	Initial Time of Receipt	Time Matching System Starts Processing		Time Matching System Ends Processing		Unintentional Delay	
		First	Last	First	Last	First	Last
2	11	11		111		0	
2003	12	111		211		99	
4003	150	211		311		61	
6003	300	311		411		11	
8003	330	411		511		81	
10003	360	511		611		151	
1	11	611		711		250	
3	12	711		811		349	
4	12	811		911		449	
...	12 - 49	911	200511	1011	200611	549	200149
2002	50	200611		200711		200211	
2004	51	200711		200811		200310	
...	51 - 150	200811	400411	200911	400511	200410	400010
4002	150	400511		400611		400011	
4004	151	400611		400711		400110	
...	151 - 300	400711	600311	400811	600411	400210	599810
6002	300	600411		600511		599761	
6004	301	600511		600611		599860	
...	301 - 330	600611	800211	600711	800311	599960	799560
8002	330	800311		800411		799631	
8004	331	800411		800511		799730	
...	331 - 360	800511	1000111	800611	1000211	799830	999430
10002	331	1000211		1000311		999530	
10004	360	1000311		1000411		999601	
10005	360	1000411		1000511		999701	

Table 5 below summarizes the time of unintentional delay. The time of unintentional delay for each order is shown. The shaded rows identify orders which would not be subject to the LEAD queue at CHX A comparison between unintentional delays CHX vs. ARCA and CHX vs. IEX is also shown.

Table 5. Unintentional Delay Times						
Sequence Number	Initial Time of Receipt	ARCA	IEX	CHX	CHX - ARCA	CHX - IEX
1	11	0	0	250	250	250
2	11	100	100	0	(100)	(100)
3	12	199	199	349	150	150
4	12	299	299	449	150	150
2001	49	199962	199962	200149	187	187
2002	50	200061	200061	200211	150	150
2003	50	200161	200161	99	(200062)	(200062)
2004	51	200260	200260	200310	50	50
4001	150	399960	399960	400010	50	50
4002	150	399961	399961	400011	50	50
4003	150	400061	400061	61	(400000)	(400000)
4004	151	400160	400160	400110	(50)	(50)
6001	300	599960	599960	599810	(150)	(150)
6002	300	599811	599811	599761	(50)	(50)
6003	300	599911	599911	11	(599900)	(599900)
6004	301	600010	600010	599860	(150)	(150)
8001	330	799960	799960	799560	(400)	(400)
8002	330	799781	799781	799631	(150)	(150)
8003	330	799881	799881	81	(799800)	(799800)
8004	331	799980	799980	799730	(250)	(250)
10001	360	999960	999960	999430	(530)	(530)
10002	360	999780	999780	999530	(250)	(250)
10003	360	999880	999880	151	(999729)	(999729)
10004	360	999951	999951	999601	(350)	(350)
10005	360	1000051	1000051	999701	(350)	(350)

Result:

As can clearly be seen above, at all three exchanges, extreme queuing occurs because messages are arriving much faster than any exchange's matching engine can process them. The extraordinarily long unintentional delays resulting from queuing have nothing to do with whether or not a speed bump is in use or whether that speed bump is implemented through hardware or software. Rather, as the Exchange had previously stated:

This is an inherent consequence of queuing which results from processing messages for a given security serially. Because such delays and queuing are a function of finite

network and processing resources, and consequently exist in every market, the Exchange does not believe they are relevant to the present question.⁹⁶

Using the assumptions provided, on all three exchanges, by the time the 10005th order arrives, there is an unintentional delay of nearly one second in handling order 10005. The unintentional delay in handling the 10005th order is the same for ARCA, but for the 350 microsecond intentional delay at CHX. In fact, IEX (hardware implemented speed bump) produces an unintentional delay which is identical to that at CHX.

The example clearly rebuts Leuchtkafer's claim that "unpredictable"⁹⁷ delays result from a software implementation of an intentional delay. The unpredictability of delays is a direct result of the unpredictability of overall message traffic.

Leuchtkafer writes: "In sharp contrast to IEX's speed bump implementation, while CHX's speed bump might maintain sequential integrity among delayable messages, it does not appear to maintain relative time integrity, an inescapable flaw of software-based speed bumps."⁹⁸ Again, the tables above demonstrate that Leuchtkafer's statement is inaccurate. This can be shown by comparing the times that various orders are processed by the matching engines at IEX and CHX:

- Consider the order with sequence number 2002. The CHX matching engine begins processing that order at time 200611.⁹⁹ The IEX matching engine begins processing that order at time 200461. This is 150 microseconds before CHX would be processing it.
- Consider the order with sequence number 4002. The CHX matching engine begins processing that order at time 400511. The IEX matching engine begins processing that order at time 400461. This is 50 microseconds before CHX would be processing it.
- Consider the order with sequence number 6002. The CHX matching engine begins processing that order at time 600411. The IEX matching engine begins processing that order at time 600461. This is 50 microseconds after CHX would be processing it.
- Consider the order with sequence number 8002. The CHX matching engine begins processing that order at time 800311. The IEX matching engine begins processing that order at time 800461. This is 150 microseconds after CHX would be processing it.
- Consider the order with sequence number 10002. The CHX matching engine begins processing that order at time 1000211. The IEX matching engine begins processing that order at time 1000461. This is 250 microseconds after CHX would be processing it.

The slight drift in the difference between when IEX and CHX would process these messages is entirely explained by the fact that CHX processed messages 2003, 4003, 6003, 8003, and 10003 sooner than IEX because they were not required to go into the LEAD queue. This initially added to the unintended delay of other messages. When IEX processed message 2003, it pushed back the processing of all subsequent messages by the 100 microseconds it took to process message 2003.

⁹⁶ First CHX LEAD Response, *supra* note 6, at 9.

⁹⁷ Second Leuchtkafer Letter, *supra* note 5, at 4.

⁹⁸ Second Leuchtkafer Letter, *supra* note 5, at 3-4.

⁹⁹ Clock time is 10:00:00.200611.

Similarly, when IEX processed message 4003, it again pushed back processing of all subsequent message by 100 microseconds.

By the time message 10004 is reached, CHX and IEX have each processed 10003 messages consuming 1,000,300 microseconds of time. However, CHX began processing messages at 11 and IEX began processing messages at 361 (*i.e.*, 11 + the mandatory intentional delay of all messages). As a result, IEX starts processing message 10004 350 microseconds after CHX starts processing the same message. Thus, Leuchtkafer's claim that LEAD would not retain "relative time integrity"¹⁰⁰ is shown by his own example to be incorrect.

Leuchtkafer continues on a faulty assumption. Leuchtkafer writes, "At 10:00:00.000.361 the LEAD queue will presumably release all delayable messages received at 10:00:00.000.011."¹⁰¹ This is incorrect.

Leuchtkafer also says that, "Under load, however, and depending on how it's designed, this component might struggle to maintain the LEAD queue, checking for delayable and releasable messages, processing new book snapshots, inserting or appending new messages, and performing other housekeeping functions."¹⁰² He bases his conclusion on a faulty assumption. To the contrary, LEAD will be implemented in a manner which minimizes these inefficiencies.

Leuchtkafer then writes:

In contrast, and so far as I know, the architecture of IEX's universal, hardware-implemented speed bump completely avoids these inequalities by maintaining not just sequential integrity but time integrity among messages. If a message is sent down IEX's speed bump coil at 10:00:00.000.011.000 it will exit the coil at 10:00:00.000.361.000 every single time. If a thousand messages are sent down the coil distributed between 10:00:00.000.011.000 and 10:00:00.000.011.999 (one each nanosecond, in other words), the first message will exit the coil to be processed by IEX's matching engine 350.000 microseconds later and the last message will exit the coil to be processed 350.999 microseconds later, every single time. In contrast to any software-based speed bump, IEX's speed bump is designed to maintain sequential and relative time integrity among messages.¹⁰³

In response, the Exchange notes that, assuming that all of the 1000 messages in this example are delayable messages which would be placed into the LEAD queue, CHX's technology will also release the same 1000 messages to be processed by the matching engine in the same sequence – one at a time. This is exactly what IEX's hardware speed bump does.

* * *

¹⁰⁰ Second Leuchtkafer Letter, supra note 5, at 4.

¹⁰¹ Id.

¹⁰² Id.

¹⁰³ Id.

As the Exchange has asserted before, not all market participants would benefit from enhanced displayed liquidity, optimized public price discovery, tighter spreads and de-emphasis on speed as a key to trading success, all of which LEAD is designed to achieve. In fact, certain market participants have greatly profited from the status quo and thus have a clear interest in ensuring that LEAD and other similar innovations are not approved by the Commission, which harms the public investor. The Exchange submits that the Commission should embrace innovations designed to make our markets fairer and more efficient and requests that the Commission be mindful of these considerations when reviewing the Proposal and the persuasiveness of any comments submitted thereto. As noted by one commenter, “zero comment letters from retail brokerage firms have been posted in opposition to this filing.”¹⁰⁴ The Exchange believes that it has convincingly demonstrated that LEAD is consistent with the requirements of the Act and the rules and regulations thereunder and, accordingly, respectfully requests that the Commission approve the Proposal.

Sincerely,



James G. Ongena

cc: Chairman Jay Clayton
Commissioner Kara M. Stein
Commissioner Michael S. Piwowar
Heather Seidel, Director, Division of Trading and Markets
John Roeser, Associate Director, Division of Trading and Markets
Theodore Venuti, Assistant Director, Division of Trading and Markets

¹⁰⁴ CTC Letter, supra note 12, at 2.