DATE: **February 19, 2019**

TO: **MIAX Options Members**

FROM: **MIAX Options Regulatory Department**

RE: **Options on the SPIKES™ Index**

On October 12, 2018, the Securities and Exchange Commission ("SEC") approved the Exchange's proposal to list and trade on the Exchange options on the SPIKES™ Index ("SPIKES" or the "Index"), a new index that measures expected 30-day volatility of the SPDR S&P 500 ETF Trust (commonly referred to by its ticker symbol, "SPY"). The listing and trading of options on SPIKES commences on February 19, 2019. Options on SPIKES will be cash-settled, and will have European-style exercise provisions. The Index is calculated using published real-time prices of SPY options.

PRODUCT DESCRIPTION

Symbol: SPIKE

Multiplier: $100.

Strike Interval: Minimum strike price intervals are set at $0.50 where the strike price is less than $15, $1 or greater where the strike price is between $15 and $200, and $5 or greater where the strike price is greater than $200.

Minimum Trading Increment: $0.05 for series trading below $3 and $0.10 for series trading at or above $3.

Expiration Date: The Wednesday that is thirty days prior to the third Friday of the calendar month immediately following the expiring month.

Expiration Month: Up to twelve expiration months. Short-term, quarterly and LEAPS may also be available.

Exercise Style: European.

Last Trading Day: Trading will ordinarily cease at 4:15 p.m. (New York Time) on the Tuesday preceding an expiration Wednesday.

Settlement Type: Cash.

Settlement Value Symbol: SPKCS.

CUSIP: 84851L107.

Settlement Value: The exercise and settlement value will be calculated on Wednesday at 9:30 a.m. (New York time) using opening prices, and if no trade has occurred, the mid-point of the opening orders for the SPY options used in the calculation of the Index at that time. The exercise-settlement amount will be equal to the difference between the settlement value and the exercise price of the option, multiplied by $100. Exercise will result in the delivery of cash on the business day following expiration.

Settlement of Exercise: Next business day following expiration.

Margin: Margin requirements for the purchase and sale of options on the Index are identical to those applied for broad-based index options.

Position and Exercise Limits: No position and exercise limits.

Trading Hours: 9:30 a.m. to 4:15 p.m. Eastern Time (New York time).

<u>Index Design and Composition</u>

The calculation of the Index is based on the methodology developed by T3i Pty Ltd, a firm that develops proprietary indexes, including derivatives-based indexes and options-enhanced indexes. The Index is calculated and maintained by the Exchange. The Index measures expected 30-day volatility of SPY, historically the largest and most actively traded ETF in the United States as measured by its assets under management and the value of shares traded.

Like most indices, the Index has a defined rules-based approach to selecting components—a series of options on the SPY—and weighting them to derive a single price for the Index.

Therefore, the formula for expected T-term variance is as follows:

$$\sigma^2 = \frac{1}{T}\left[2e^{RT}\sum_i \frac{\Delta K_i p_i}{K_i^2} - \left(\frac{e^{RT}\,(p_{ATM}^c - p_{ATM}^p\,)}{K_{ATM}}\right)^2\right]$$

WHERE:

T Time to options expiration (in years, with 1-second precision) [1]

[1] Since the SPIKES Index is calculated on a real-time basis, the Exchange uses 1-second precision to measure time in years (which is expressed to at least eight decimal places, by dividing the number of seconds to option expiration by the total number of seconds in a year).

K_i, p_i A list of unique options strikes, ordered from lowest to highest, and corresponding options prices;[2] of a call if $K_i > K_{ATM}$; and of a put if $K_i < K_{ATM}$; if $K_i = K_{ATM}$ then an average between the ATM put and call prices

ΔK_i Half the difference between the strikes on either side of K_i;

$$\Delta K_i = \frac{(K_{i+1} - K_{i-1})}{2}$$

For the last (highest and lowest) selected strikes, ΔK_i is simply the absolute difference between K_i and the nearest selected option's strike

R Risk-free interest rate to option's expiration

p^c_{ATM} Price of the at-the-money (ATM) call option

p^p_{ATM} Price of the ATM put option

K_{ATM} Strike closest to the point where linearly interpolated call and put prices intersect

The Index is calculated using only standard options on SPY that expire on the third Friday of each calendar month. Although weekly options on SPY are available, these are not used in the calculation of the Index.

The calculation linearly interpolates between the variances of two monthly expirations—near-term (the closest expiration more than two full days into the future) and next-term (the monthly expiration following the near-term). This expiration selection method is used to avoid using highly irregular option prices close to the options settlement date. The 30-day point is typically in between these two expirations and the Index is interpolated between the volatilities of these two terms. When the closest expiration is too close to expiry (less than two full days), rolling to the third-closest expiration occurs. This rolling rule serves to reduce spurious variability in the Index by means of minimizing the period of "extrapolation" between the two expirations. The switch from closest to third-closest expiry rarely has any noticeable impact on the actual Index value, as the weight of the switched term is close to zero.

Determine Option Prices

SPIKES uses a proprietary "price dragging" technique to determine the ongoing price for each individual option used in the calculation of the Index ("Reference Price"), to calculate the Index, as follows:

- Initially set all prices to 0;
- If there is a trade, the price of the option is always set to the trade price;

[2] This price is also known as the Reference Price, as defined and discussed in more detail below, in the following subsection 1, Determine Option Prices.

- If there is not yet a trade, on the opening quote, the opening bid is used as the current price;
- For newly-placed ask (bid) quotes, if the ask (bid) is lower (higher) than current Reference Price, the option price is set to ask (bid).

The price dragging technique is used for intraday calculation of the Index.

Select the Options

Another key feature of SPIKES is its exclusion rule (truncation method). The exclusion rule determines how far away from the money to exclude strikes from the volatility calculation. For each of the expirations, the securities to be used in the calculation are selected by removing in-the-money and OTM options, as follows:

- To determine the ATM strike, find the intersection of the put and call linearly interpolated price curves. Select the strike closest to the value of the intersection of the curves—this becomes the ATM strike. If the intersection falls exactly in the middle of two strikes, or if the whole segments overlap (i.e., when four neighboring calls and puts have the same price), use the lower strike. In case of more than one intersection point (in rare cases of highly irregular market prices), use the one closest to the current value of SPY.
- Use all listed puts below the ATM strike and all listed calls above the ATM strike, and both the ATM call and put. When two consecutive option prices of $0.05 or less are encountered when moving away from the ATM, exclude all the strikes beyond that level, from each of the put and call side.

The purpose of the exclusion rule is to remove option inputs from the calculation that could be deemed less reliable and thus potentially negatively impact the calculation outcome.

Weight the Options and Estimate Volatility

For each term, the volatility is estimated using the variance swap approximation, with the selected options' prices weighted according to the SPIKES formula. Each eligible option's contribution is proportional to the change in the strike (half the difference between the strike on either side of the option) and the price, and inversely proportional to the square of the option's strike. After calculating for each option, these are summed and multiplied by two times the exponential of the risk free rate times time-to-expiration. The next step is to subtract from this value, the square of, the difference between the ATM call and put prices, times the exponential of the risk free rate times time-to-expiration, divided by the ATM strike. Lastly, divide the result by the time to expiration to arrive at the final value.

Calculate the Index

Compute the 30-day weighted average of the near- and next-term variances, take the square root, and multiply by 100.

Index Calculation and Maintenance

The Index is maintained and calculated by the Exchange. The Exchange also has in place a third-party back-up calculator, in the event the Exchange is unable to calculate the index itself. The level of the Index reflects the current expected volatility of SPY. The Index is calculated and disseminated every 100 milliseconds on each trading day beginning at 9:30 a.m. and ending at 4:15 p.m. (New York time). If the current published value of a component is not available, the last published value will be used in the calculation. Values of the Index are disseminated to the Options Price Reporting Authority ("OPRA"). In the event the Index ceases to be maintained or calculated, or its values are not disseminated at least every 15 seconds by a widely available source, the Exchange will not list any additional series for trading, and may, for the purpose of maintaining a fair and orderly market and protecting investors, limit transactions in certain options on the Index to closing transactions only.

Exercise and Settlement Value

On the expiration date for expiring SPIKES options, the Exchange will calculate the final settlement value of the Index for expiring SPIKES options. The expiration date for expiring SPIKES options is the same day that the final settlement value of the Index is calculated for those options. This date is the Wednesday that is thirty days prior to the third Friday of the calendar month immediately following the month in which the applicable SPIKES options expire. If that Wednesday or the Friday that is thirty days following that Wednesday is an Exchange holiday, the final settlement value shall be calculated on the business day immediately preceding that Wednesday. The exercise-settlement amount is equal to the difference between the final settlement value of the Index and the exercise price of the option, multiplied by $100.

To determine the final settlement value of the Index, the Exchange performs an Index settlement price calculation which includes all SPY options that expire 30 days after the SPIKES settlement that are included in the settlement (the "constituent options"). In order to perform the Index settlement price calculation, each constituent option is assigned a Settlement Reference Price or "SRP". Each SRP is determined through a new "SPIKES Special Settlement Auction," which is conducted once per month, in the constituent options traded on the Exchange, on final settlement day. The SPIKES Special Settlement Auction utilizes the Exchange's standard, existing Opening Process, as defined and fully-described in Exchange Rule 503(f), with a new modification to account for situations where there remains an order imbalance that must be filled at the opening price after the requisite number of iterations of the imbalance process takes place under the Exchange's existing Opening Process (the

Exchange's existing Opening Process provides that the Exchange can open with an imbalance after the requisite number of iterations of the imbalance process takes place).

The Exchange assigns an SRP to each constituent option to facilitate the calculation of the final settlement price of the Index. If the System opens the constituent option with a trade, the System assigns the constituent option an SRP equal to the trade price in that option. If there is no locking or crossing interest and the System opens the constituent option without a trade, and the bid-ask spread is at or within a range as defined by the Exchange in an SRP opening width table and communicated via Regulatory Circular, the System assigns the constituent option an SRP equal to the midpoint of the bid and ask prices. If the bid-ask spread is not within a range as defined in the SRP opening width table, the System will conduct an additional process to determine the SRP of the constituent option, as follows.

> First, the System will start a settlement reference price timer ("SRPT") (the duration of which will be defined by the Exchange not to exceed sixty seconds and communicated via Regulatory Circular). If, during the SRPT, there is a trade on the Exchange, the System will set the SRP equal to the trade price. If, during the SRPT, the bid-ask spread changes so that it is within a range defined in the settlement price opening width table, the System will set the SRP equal to the midpoint of the bid and ask price.
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> If the SRPT expires, the System will set the SRP equal to the Reference Price (the current price of that option utilizing the cash index calculation formula, described above) of the constituent option if it is equal to or inside the MBBO. If the Reference Price is non-zero and less than the Exchange's bid, then the System will set the SRP equal to the Exchange's bid. If the Reference Price is non-zero and greater than the Exchange's ask, then the System will set the SRP equal to the Exchange's ask. If the Reference Price is zero and if one or both adjacent constituent options have a non-zero SRP, the constituent option will be excluded from the calculation. If the Reference Price is zero and there are multiple adjacent constituent options with a current Reference Price of zero, the System will use the midpoint of the NBBO for the SRP if the NBBO bid-ask spread is at or within a range defined in the settlement price opening width table. If the NBBO bid-ask spread is not within a range defined in the settlement price opening width table, the System will wait for either a trade, or a bid-ask spread that is within a range defined in the settlement price opening width table. Once all constituent options have been assigned an SRP, the System will perform the final settlement price calculation of the Index.

SPIKES Special Settlement Auction

The SPIKES Special Settlement Auction will utilize the Exchange's standard, existing Opening Process, as defined and fully-described in Exchange Rule 503(f), with a new proposed modification to account for situations where there remains an order imbalance that must be filled at the opening price after the requisite number of iterations of the imbalance process takes place under the Exchange's existing Opening Process (the Exchange's existing Opening

Process provides that the Exchange can open with an imbalance after the requisite number of iterations of the imbalance process takes place). This new proposed modification to the Exchange's existing Opening Process to facilitate the execution of this remaining must-fill interest is referred to as the special settlement imbalance process ("SSIP"), which will be governed by new Interpretations and Policies .03 to Exchange Rule 503.

The Exchange's existing Opening Process runs to completion and precedes the engagement of the new SSIP. The existing Opening Process cannot occur prior to 9:30 a.m. Eastern Time and only begins following the dissemination of a quote or trade in the market for the underlying security. Following the dissemination of a quote or trade in the market for the underlying security, the System will pause for a period of time no longer than one half second to allow the marketplace to absorb this information. When there is an imbalance, the System will broadcast a System Imbalance Message (which includes the symbol, side of the market, quantity of matched contracts, the imbalance quantity, must fill quantity (i.e., the number of contracts that must be filled in order for that option to open on the Exchange at the indicated price), quantity of routable contracts, and price of the affected series) to subscribers of the Exchange's data feeds and begin an Imbalance Timer not to exceed three seconds. Under the existing Opening Process the Exchange may repeat this process up to three times. The Exchange's imbalance process is transparent, as every subscriber to the Exchange's data feed receives the imbalance messages, and every Member of the Exchange can participate in the imbalance process.

Where an imbalance exists in constituent options and the final imbalance process has been conducted as part of the Exchange's standard, existing Opening Process, instead of cancelling that must fill interest back to the entering Member, the Exchange will conduct the SSIP, where the Exchange will satisfy that must fill interest. The Exchange does not want to cancel any must fill interest, as this liquidity could represent previously hedged interest that must be unwound.

In the SPIKES Special Settlement Auction, in addition to any order types that may be regularly accepted by the Exchange, the Exchange will also accept settlement auction only orders ("SAO Orders") at any time after the opening of the Live Order Window ("LOW") and the Live Quote Window ("LQW").

All orders for participation in the SPIKES Special Settlement Auction that are related to positions in, or a trading strategy involving, SPIKES Index options ("SPIKES strategy orders"), and any change to or cancellation of any such order: (i) must be received prior to the applicable SPIKES strategy order cut-off time for the constituent option series, as determined by the Exchange, which may be no earlier than the opening of the LOQ or the LQW, and no later than the opening of trading in the series. The Exchange will announce all determinations regarding changes to the applicable SPIKES strategy order cut-off time via Regulatory Circular at least one day prior to implementation (however the Exchange anticipates initially establishing the cut-off time at 9:20 a.m. Eastern); and (ii) may not be cancelled or modified after the applicable SPIKES strategy order cut-off time, unless the SPIKES strategy order is not executed in the SPIKES Special Settlement Auction and the cancellation or modification is submitted after the SPIKES Special Settlement Auction is concluded (provided that any such SPIKES strategy order may be modified or cancelled after the applicable SPIKES strategy order cut-off time and prior to the applicable non-SPIKES strategy order cut-off time in order to correct a legitimate error, in which case the Member submitting the change or cancellation will prepare and maintain a memorandum setting forth the circumstances that resulted in the change or cancellation and will file a copy of the memorandum with the Exchange no later than the next business day in a form and manner prescribed by the Exchange).

The Exchange will consider orders to be SPIKES strategy orders for purposes of Rule 503 Interpretation and Policy .03, if the orders possess the following three characteristics: (A) are for options with the expiration that will be used to calculate the exercise or final settlement value of the applicable volatility index option contract; (B) are for options spanning the full range of strike prices for the appropriate expiration for options that will be used to calculate the exercise or final settlement value of the applicable volatility index option contract, but not necessarily every available strike price; and (C) are for put options with strike prices less than the “at-the-money” strike price and for call options with strike prices greater than the “at-the-money” strike price. They may also be for put and call options with “at-the-money” strike prices.

The SSIP will be deployed if there is a must-fill imbalance. To begin the SSIP, the System will broadcast a system imbalance message to all subscribers of the Exchange’s relevant data feed and begin an SSIP Imbalance Timer, the duration of which is to be determined by the Exchange, not to exceed ten seconds, and communicated via Regulatory Circular. During the SSIP Imbalance Timer, the System accepts all quote and order types supported during the standard Opening Process. Next, the System will evaluate the must fill imbalance and adjust the EQR by a defined amount by appending to the EQR (adding to offers or subtracting from bids) the EQR value (as previously determined by the Exchange and communicated via Regulatory Circular). During the SSIP, the allowable EQR will be increased .5 times the EQR value upon each iteration of the SSIP. The SSIP will be repeated until a price is reached at which there is no remaining must fill imbalance.

Once there is no remaining must fill imbalance, SAOs, AOC Orders, AOC eQuotes, OPG Orders, and OPG eQuotes submitted into the SPIKES Special Settlement Auction are cancelled. Any unfilled day limit orders and GTC orders that are priced at the Opening Price are placed on the Book and managed by the System.

Risks Inherent in Settlement Process

The final settlement value of the SPIKES derivative is calculated from the actual opening trade prices on MIAX Options of the constituent option series on the expiration date, unless there is no opening trade in a series. In contrast, all other SPIKES index values disseminated during the life of a SPIKES derivative are “indicative” values – namely, values that are calculated using trade and quote prices on MIAX Options of each of the constituent option series at a particular time. There is an inherent risk of a significant disparity between the final settlement value of a

SPIKES derivative and: (1) the opening indicative SPIKES value on the expiration date; (2) the closing indicative SPIKES value on the previous day's close; and (3) the closing indicative SPIKES value at the end of extended trading hours (as applicable) on the expiration date (hereafter referred to as "three 'in-time' indicative volatility index values"). It is to be expected that there will be at least some divergence between the final settlement value for an expiring volatility index derivative and the three "in-time" indicative volatility index values.

Regulatory inquiries should be directed to Regulatory@MIAXOptions.com or (609) 897-7309.