Cboe Options Regulatory Circular RG18-038
CFE Regulatory Circular RG18-016

Date: October 16, 2018

To: Volatility Index Derivatives Market Participants

From: Regulatory Division, Market Structure Department and Research and Product Development

RE: Modified HOSS Opening Procedures and Special Opening Quotation and Settlement Methodology for Volatility Index Derivatives and Risk Inherent in Settlement Procedure

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This joint Cboe Options/CFE Regulatory circular replaces
Cboe Options Regulatory Circular 18-018 and CFE Regulatory Circular RG18-009

Cboe Exchange, Inc. (Cboe Options) and Cboe Futures Exchange, LLC (CFE) (collectively, the Exchanges) are issuing this joint regulatory circular to update content to reflect amendments to Interpretation and Policy .01 to Cboe Options Rule 6.2 that were recently approved by the Securities and Exchange Commission (*see* SEC Release No. 34-84436 and SR-CBOE-2018-062). Specifically, Interpretation and Policy .01 to Cboe Options Rule 6.2 has been modified to: (1) amend and clarify the definition of strategy order; (2) permit the entry of orders that offset imbalances after the strategy order cut-off time; and (3) clarify other definitions related to the modified Hybrid Opening System (HOSS) procedure (see also Cboe Options Regulatory Circular RG18-037 and CFE Regulatory Circular RG18-015). **The amendments to the rule will be effective for the October 17, 2018 settlement.**

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Cboe Options and CFE list derivatives on different volatility indexes that are calculated using option series traded on Cboe Options.[1] This joint regulatory circular describes, among other things, the modified HOSS procedures utilized on Cboe Options for all option series that are used to calculate the final settlement value for expiring volatility index derivatives. These option series are referred to in this circular as "constituent option series." In addition this joint regulatory circular describes the calculation of the final settlement value for volatility index derivatives traded on Cboe Options and CFE and discusses risk inherent in the settlement procedures for volatility index derivatives.

Calculating Settlement Values for VIX Derivatives

VIX derivatives are based on the Cboe Volatility Index, a measure of 30-day expected volatility of the S&P 500 Index. The final settlement value for VIX derivatives is a Special Opening Quotation (SOQ) of

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[1] The information in this circular applies in equal measure to Cboe Russell-2000 Volatility Index derivatives listed on Cboe Options and CFE. For ease of reference, VIX derivatives will be used as the example product in this circular. This circular does not apply to derivatives on volatility indexes that are calculated using option series that do not trade on Cboe Options, such as the Cboe/CBOT 10-Year U.S. Treasury Note Volatility Index futures contract.

the VIX Index calculated using opening prices of constituent SPX options that expire 30 days after the relevant VIX derivative expiration date. For example, the final settlement value for VIX derivatives expiring on November 21, 2018 will be calculated using SPX options that expire 30 days later on December 21, 2018.

The opening prices for the SPX options used to calculate the SOQ are determined through an automated auction mechanism on Cboe Options that matches locked or inverted buy and sell orders and quotes resting on the electronic order book at the opening of trading. This auction mechanism is known as HOSS, which uses modified opening procedures on expiration days for VIX derivatives. All orders and quotes better than the opening price will receive a fill, and the trade matching algorithm is pro-rata for all orders and quotes at the clearing price.

If there is no opening trade in a constituent SPX series, the opening price used in the SOQ is the average of an option's bid and ask price determined at the open. Additional information on this topic is set forth below on pages 6 to 7 at paragraphs A(2) and (E) to the section styled, "Settlement Methodology for Volatility Index Derivatives."

Opening Procedures for VIX Derivatives on Expiration Days

On expiration days for VIX derivatives, Cboe utilizes modified HOSS procedures that facilitate a single-price open for each constituent SPX series at the price that allows the most orders for that series to match.

The HOSS opening procedures are modified on expiration days for VIX derivatives because of the strategy order cut-off time for the constituent option series that will be used to calculate the final settlement value for VIX derivatives.

Currently, the strategy order cut-off time is 8:20 a.m. CT. For more information about the strategy order cut-off time, click here. Additional information about strategy orders is set forth on pages 4 to 5 below.

Order Eligibility for Modified HOSS Procedures

All orders (including customer and professional) are eligible to rest in the book, and orders with any valid origin code may participate in the modified HOSS procedures. All orders may, but are not required to, include an "OPG" (opening rotation order) contingency.

All unexecuted OPG buy orders will be (1) considered for purposes of determining series eligibility for inclusion in the SOQ; and (2) automatically cancelled prior to dissemination of the first market by Cboe Options.

- **Market Participants and Use of Quotes, Orders or Both**

For option series where there is an appointed DPM (e.g., RUT), that DPM is required to enter opening quotes per Cboe Options Rule 8.85.[2]

All Market-Makers with an appointment in a class comprising the constituent option series may use quotes and/or orders to participate in the modified HOSS procedures.

All other market participants may only use orders (and not quotes) to participate in the modified HOSS procedures.

- **Narrowed OEPW Parameters and APR Parameters**

On expiration days for VIX derivatives, Cboe Options narrows the Opening Exchange Prescribed Width (OEPW) and Acceptable Price Range (APR) parameters, which are used to define the maximum allowable range of possible opening prices in the constituent option series that will be used to calculate the final settlement value for VIX derivatives.

For series that will have an opening trade, the width of the best Cboe Options quote bid-ask (excluding buy/sell orders) must be no wider than the OEPW value and opening trades must be able to execute at a price within a valid range. The calculation for the valid range is the midpoint of the best Cboe Options quote bid/ask (excluding buy/sell orders) plus/minus half of the OEPW. The OEPW value used to determine the value range for the opening trade price is based on the midpoint of the best Cboe Options quote bid/ask for the series.

A series with no opening trade will be allowed to open as long as the width of the best Cboe Options quote bid-ask (excluding buy/sell orders) is no wider than the APR parameter. The APR value used to determine the permissible opening quote width is based on the best Cboe Options quote bid price for the series. The APR parameter will be returned to the standard settings shortly after the open.

Click here for OEPW and APR parameters and other operational system settings applicable on expiration days for VIX derivatives.

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[2] In relevant part, Cboe Options Rule 8.85(a)(x), provides that a DPM is required to enter opening quotes within one minute of the initiation of an opening rotation in any series that is not open due to the lack of a quote (see Cboe Options Rule 6.2) and participate in other rotations described in Cboe Options Rule 6.2 (including the modified HOSS opening rotation set forth in Interpretation and Policy .01).

Messages Disseminated During Pre-Open and Rotation States until OPEN

On expiration days for VIX derivatives, expected opening information (EOI) messages are disseminated during the pre-open state regarding the constituent option series. EOI messages contain information based on resting orders and quotes in the book, and those messages may include the expected opening price (EOP), the expected opening size (EOS), any reason why a series may not open if the current conditions persisted when the series was to open (e.g., opening trade price would be outside OEPW range, need quote to open) and any imbalance information, including the size and side of an imbalance.

EOI messages are published to Cboe Option's website here on expiration days for VIX derivatives and are disseminated approximately every six (6) seconds or less during the pre-open state. EOI messages are also disseminated over Cboe Options' APIs (FIX, CMI2 and CSM) approximately every five (5) seconds during the pre-open state. Additional "top of book" (BBO) 5-layer book depth market data is available via CSM.

Order Submission Deadlines

- **Strategy Orders**

On expiration days for VIX derivatives, market participants must submit strategy orders (which orders must be entered into Cboe Options by a Cboe Options Trading Permit Holder) and changes to or cancellations of strategy orders, prior to the strategy order cut-off time. The strategy order cut-off time is currently 8:20 a.m. CT for all constituent option series.

Market participants may not change or cancel strategy orders after the strategy order cut-off time of 8:20 a.m. CT, unless the market participant submits the change or cancellation: (1) after the series is open for trading; or (2) prior to the non-strategy order cut-off time in order to correct a legitimate error. In this event, the market participant submitting the change or cancellation must prepare and maintain a memorandum setting forth the circumstances that resulted in the change or cancellation and will submit an email to the Regulatory Division at Strat_Order_Cancels@cboe.com (by no later than the next business day).

- **Non-Strategy Orders**

On expiration days for VIX derivatives, market participants must submit non-strategy orders (which orders must be entered into Cboe Options by a Cboe Options Trading Permit Holder) prior to the non-strategy order cut-off time. The current non-strategy order cut-off time is currently the opening of trading in a series.

Strategy Order Definition

Cboe Options deems individual orders (considered collectively) a market participant submits for participation in the modified opening procedure to be a "strategy order," based on related facts and circumstances considered by Cboe Options, only if the orders:

(1) relate to the market participant's positions in expiring volatility index derivatives;

(2) are for option series with the expiration that the Exchange will use to calculate the exercise or final settlement value, as applicable, of the applicable volatility index derivative;

(3) are for option series with strike prices approximating the range of series that are later determined to constitute the constituent option series for the applicable expiration.

(4) are for put (call) options with strike prices equal to or less (greater) than the "at-the-money" strike price; and

(5) have quantities approximating the weighting formula used to determine the exercise or final settlement value, as applicable, in accordance with the applicable volatility index methodology.

Non-Strategy Order Definition

The term "non-strategy order" means any order (including an order in a constituent option series) a market participant submits for participation in the modified opening procedure that is not a strategy order (or a change to or cancellation of a strategy order). Examples of non-strategy orders include, but are not limited to:

(1) A buy (sell) order in a constituent option series if an EOI disseminated no more than two minutes prior to the time a market participant submitted the order included a sell (buy) imbalance and the size of the order is no larger than the size of the imbalance in the EOI, regardless of whether the market participant previously submitted a strategy order or has positions in expiring volatility index derivatives; or

(2) A Cboe Options Market-Maker bid or offer in a constituent option series, as set forth in paragraph (e) of Interpretation and Policy .01 to Cboe Options Rule 6.2 and described below.

Market-Maker Bids and Offers

A Cboe Options Market-Maker with an appointment in a class with constituent option series may submit bids and offers in those series for bona fide market-making purposes in accordance with Cboe Options Rule 8.7 and the Exchange Act for its market-maker account prior to the open of trading for participation in the modified opening procedure. Cboe Options will deem these bids and offers to be non-strategy orders, and will not deem them to be changes or cancellations of previously submitted strategy orders, if:

(1) Cboe Options Trading Permit Holder with which the Market-Maker is affiliated has established, maintains, and enforces reasonably designed written policies and procedures (including information barriers, as applicable), taking into consideration the nature of the Cboe Options Trading Permit Holder's business and other facts and circumstances, to prevent the misuse of material nonpublic information (including the submission of strategy orders); and

(2) When submitting these bids and offers, the Market-Maker has no actual knowledge of any previously submitted strategy orders.

Settlement Methodology for Volatility Index Derivatives

Cboe Options, in its capacity as a reporting authority, calculates the SOQ for volatility index derivatives using the following procedure:

A. Collect the following information for each eligible constituent option series of the applicable volatility index:

1) The opening traded price, if any; and
2) If there is no opening traded price, the first bid and offer disseminated to OPRA by Cboe Options. If the first bid disseminated to OPRA by Cboe Options is zero, the limit price of the best unexecuted OPG buy order(s) with quantity remaining, if any, is used as the opening bid.

B. Determine the applicable forward index level, (F), for each eligible derivative expiration based on at-the-money put and call option prices. The at-the-money strike is the strike price at which the difference between the mid-quote prices for calls and puts is smallest.

C. Determine K_0 – the strike price immediately below the forward index level.

D. Select the constituent option series:

1) Sort all of the options in ascending order by strike price;
2) Select call options that have strike prices greater than K_0 and have bid prices greater than zero[3], beginning with the strike price closest to K_0 and moving to the next higher strike prices in succession. Once two consecutive calls with a bid price of zero have been encountered, no calls with higher strike prices will be selected.
3) Select put options that have strike prices less than K_0 and have bid prices greater than zero, beginning with the strike price closest to K_0 and then moving to the next lower strike prices in succession. Once two consecutive puts with a bid price of zero have been encountered, no puts with lower strike prices will be selected.
4) Select both the put and call with strike price K_0.

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[3] Unfilled OPG orders are cancelled immediately after the opening trade match, or opening of the series for those which open without a trade, but prior to dissemination of the first bid/ask quote disseminated to OPRA by Cboe Options. Importantly, un-filled OPG buy orders are considered when determining if a series has a "non-zero" bid price, which is relevant when determining if that series is eligible for inclusion in the SOQ. This means that a series may be included in the SOQ calculation even if the first quote disseminated by Cboe for that series contains a zero bid price. This can occur when there are OPG buy orders with volume remaining after the opening trade match or the opening of the series without a trade.

E.   Calculate the volatility index SOQ using the options selected.[4] The price of each option used in the calculation is the opening price of that option. For volatility indexes that are composed of multiply listed constituent option series, **the volatility index SOQ uses only the opening prices of the constituent option series traded on Cboe Options.** In the event that there is no opening traded price for an option, the opening price used in the SOQ calculation is the average of the first bid and offer immediately after the series is opened but prior to the cancellation of any remaining OPG orders. If the first bid disseminated to OPRA by Cboe Options in a particular series is zero, the limit price of the best unexecuted OPG buy order(s) with quantity remaining, if any, is used as the opening bid.

F.   The "time to expiration" used to calculate the SOQ for volatility indexes varies depending on the settlement type (A.M.-settlement, P.M.-settlement) of the constituent option series and the trading hours of the constituent option series. For example, the "time to expiration" used to calculate the SOQ for "standard" VIX derivatives, which are based on A.M.-settled SPX option series expiring on the third Friday of each month, is exactly 30 days. Another example is the "time to expiration" used to calculate the SOQ for "weekly" (non-standard) VIX derivatives based on P.M.-settled SPXW option series that generally expire on every Friday other than the third Friday of each month, which is 30 days, *plus* 390 minutes in order to reflect the extra time to trade the constituent SPXW option series until 3:00 p.m. CT.

The "time to expiration" used to calculate the SOQ accounts for the actual number of days and minutes from the opening of trading in the constituent option series on the expiration date for VIX derivatives until the expiration date for the constituent option series. For example, if Cboe Options announces that the opening of trading in the constituent option series is delayed, the amount of time until expiration for the constituent option series used to calculate the final settlement value may be reduced to reflect the actual opening time of the constituent option series. Another example would be when Cboe Options is closed on a Wednesday due to a Cboe Options holiday, the SOQ would be calculated on the previous business day. The amount of time until expiration for the constituent option series used to calculate the final settlement value would be increased to reflect the extra day of trading in the constituent option series.

G.   The final settlement value for the applicable volatility index derivative is equal to the respective volatility index SOQ. The final settlement value is rounded to the nearest $0.01. If the final settlement value is not available or the normal settlement procedure cannot be utilized due to a trading disruption or other unusual circumstance, the final settlement value will be determined in accordance with the rules and bylaws of The Options Clearing Corporation.

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[4] All Cboe volatility indexes are calculated in the same manner as VIX. A more detailed description of the VIX formula and methodology is available on the Cboe Options' website at: http://www.cboe.com/micro/vix/vixwhite.pdf.

Why Some Traded Series are Excluded from the SOQ

Not all eligible option series with a traded price are included in the SOQ that is used to settle expiring volatility index derivatives. This is because the selection of option series used to calculate the SOQ is based on the following criteria:

- A series must have a "non-zero" bid price after the opening trade match, or opening of the series for those which open without a trade, in order to be used in the SOQ calculation; and
- The VIX Index formula does not use option series with a traded price (even if those series have "non-zero bid" prices) that are farther out of the money once two consecutive series which have "zero" bid prices are encountered.

Submission of Orders or Quotes with Improper Purpose

Market participants may be subject to disciplinary action if, when they submit orders or quotes during the modified HOSS procedures, they do so for a purpose inconsistent with the Exchanges' rules. Investigations, when deemed warranted, may include, but are not limited to, a review of whether orders or quotes were entered for the purpose of: (1) creating or inducing a false, misleading or artificial appearance of activity; or (2) unduly or improperly influencing the opening price or settlement value of volatility index derivatives; or (3) making a price which does not reflect the true state of the market.[5]

Risk Inherent in Settlement Procedure

The final settlement value of each volatility index derivative is calculated from the actual opening trade prices on Cboe Options of the constituent option series on the expiration date, unless there is no opening trade in a series. In contrast, all other volatility index values disseminated during the life of a volatility index derivative are "indicative" values – namely, values that are calculated using the mid-point of the disseminated bid and offer premium quotations on Cboe Options of each of the constituent option series at a particular time.

Because actual trade prices are used to compute the final settlement value of volatility index derivatives while mid-market options quotes are used to compute indicative (spot or cash) volatility index values, there is an inherent risk of a significant disparity between the final settlement value of an expiring volatility index derivative and: (1) the opening indicative volatility index value on the expiration date; (2) the closing indicative volatility index value on the previous day's close; and (3) the closing indicative volatility index 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. This is because the opening trade price for each of the option series that is used to calculate the final settlement value will typically be at

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[5] Separately, in connection with the Exchanges' self-regulatory organization responsibilities, requests for information to market participants may be made in order to evaluate the purpose for the submission of quotes or orders during the modified HOSS procedures.

or near either the bid or the ask quotation, depending on the forces of supply and demand for that series, and not at the midpoint between the bid and ask quotations. In fact, such disparities have occurred in the past with respect to VIX derivatives and other volatility index derivatives. Accordingly, because volatility index derivatives settle based on the traded prices of the constituent option series established during the opening, rather than on quotes, **investors should be aware that the possibility exists, as occurred in the past, that there could be a significant difference between the final settlement value for a volatility index derivative and the three "in-time" indicative volatility index values described above on the expiration date.**

For example, traders who want to replicate the volatility exposure represented by an expiring VIX position might trade the SPX options expected to be used to calculate the final settlement value for the expiring VIX derivatives, in order to seek convergence with the VIX final settlement value. To the extent (1) the traders who are seeking to replicate an expiring VIX position are on one side of the market (e.g., seek to buy the particular SPX options) and (2) those traders' orders predominate over other orders during the SPX opening on the expiration date for VIX derivatives, those trades may contribute to an order imbalance[6] during the SPX opening on that date. If the order imbalances are significantly weighted on the same side of the market in a predominant number of SPX option series used in the final settlement, there will be a disparity between the final settlement value and the three "in-time" indicative VIX index values described above. In fact, these circumstances do occur, and have led to this type of imbalance and disparity during previous SPX openings for VIX expirations days. The same risk is equally applicable to other volatility index derivatives.

In order to avoid exposure to such disparities, investors in volatility index derivatives holding speculative or un-hedged volatility index derivatives may wish to close out their positions prior to settlement.

Market participants should also be aware that the daily settlement price of volatility index futures are calculated in a different manner from both the final settlement value of those derivatives and the indicative value of the volatility index. Specifically,

- The daily settlement price for volatility index futures is generally calculated from the average of the last best bid and last best offer for the future on CFE during the applicable business day, and
- The final settlement value and indicative values are calculations of the volatility index itself.

Accordingly, disparities can and do exist between the daily settlement prices of volatility index futures on the day before their expiration date and the three "in-time" indicative volatility index values described above and the final settlement value of volatility index derivatives.

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[6] An order imbalance is an excess of contracts to buy over contracts to sell (or vice versa) for executions that must be resolved in order for a series to open.

Additional Information

For questions, please contact the Regulatory Interpretations team at RegInterps@cboe.com or (312) 786-8141 or CFERegInterps@cboe.com or (312) 786-7229 for additional information.