## DCO Rules

## UNITED STATES
## COMMODITY FUTURES TRADING COMMISSION

## Submitter Information

**Organization Name**
Options Clearing Corporation

| **Organization Type** | **Organization Acronym** |
|---|---|
| DCO | OCC |
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## Cover Sheet

| **Submission Number** | **Submission Date** |
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**Submission Type**
40.6(a) Rule Certification

**Submission Description**
Rule Certification Concerning The Options Clearing Corporation's Implied Volatility Simulation Models

☑ **Request Confidential Treatment**

**Registered Entity Identifier Code**

**Rule Numbers**
OCC's STANS Methodology Description

**Date of Intended Implementation**
4/9/2022

## Documents

2022.3.10 CFTC Self-Certification (IVOL).pdf
2022.3.10 Exhibit A (IVOL) [CONFIDENTIAL].pdf (Confidential Treatment Requested)

## Request For Confidential Treatment - Detailed Written Justification

CFTC Confidentiality Request 3.10.2022.pdf

OCC THE FOUNDATION FOR SECURE MARKETS

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March 10, 2022

**VIA CFTC PORTAL**
Christopher J. Kirkpatrick
Office of the Secretariat
Commodity Futures Trading Commission
Three Lafayette Centre
1155 21st Street, N.W.
Washington, DC 20581

**Re: Rule Certification Concerning OCC's Implied Volatility Simulation Models**

Dear Secretary Kirkpatrick:

Pursuant to Section 5c(c)(1) of the Commodity Exchange Act, as amended ("Act"), and Commodity Futures Trading Commission ("CFTC") Regulation 40.6, The Options Clearing Corporation ("OCC") hereby certifies amendments to OCC's margin methodology, the System for Theoretical Analysis and Numerical Simulations ("STANS"), to simplify the methodology, control procyclicality in volatility modeling, provide natural offsets for volatility products with similar characteristics, and build the foundation for a single, consistent framework to model equity volatility products in margin and stress testing. The date of implementation of the rule is at least 10 business days following receipt of the certification by the CFTC. The proposal will not be implemented until OCC receives all necessary regulatory approvals in connection with a proposed rule change filed with the Securities and Exchange Commission ("SEC") (File No. SR-OCC-2022-001)[1] under Section 19(b) of the Securities Exchange Act of 1934 ("Exchange Act") and Rule 19b-4 thereunder and an advance notice filed with the SEC and the Board of Governors for the Federal Reserve System (File No. SR-OCC-2022-801)[2] pursuant to Section 806(e)(1) of Title VIII of the Dodd-Frank Wall Street Reform and Consumer Protection Act, entitled Payment, Clearing and Settlement Supervision Act of 2010 ("Clearing Supervision Act") and Rule 19b-4(n)(1)(i) under the Exchange Act.

In conformity with the requirements of Regulation 40.6(a)(7), OCC states the following:

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1 See Exchange Act Release No. 94165 (Feb. 7, 2022), 87 FR 8072 (Feb. 11, 2022) (File No. SR-OCC-2022-001).

2 See Exchange Act Release No. 94166 (Feb. 7, 2022), 87 FR 8063 (Feb. 11, 2022) (File No. SR-OCC-2022-801).

Explanation and Analysis

OCC proposes to amend its margin methodology to:

(1) implement a new model for incorporating variations in implied volatility within STANS for products based on the S&P 500 Index (such index hereinafter referred to as "S&P 500" and such proposed model being the "S&P 500 Implied Volatility Simulation Model") to provide consistent and smooth simulated volatility scenarios;

(2) implement a new model to calculate the theoretical values of futures on indexes designed to measure volatilities implied by prices of options on a particular underlying index (such indexes being "volatility indexes"; futures contracts on such volatility indexes being "volatility index futures"; and such proposed model being the "Volatility Index Futures Model") to provide consistent and stable coverage across all maturities; and

(3) replace OCC's model to calculate the theoretical values of exchange-traded futures contracts based on the expected realized variance of an underlying interest (such contracts being "variance futures," and such model being the "Variance Futures Model") with one that provides adequate margin coverage while providing offsets for hedged positions in the listed options market.

The proposed changes to OCC's STANS Methodology document are contained in confidential Exhibit A. Amendments to the existing text are marked by underlining and material proposed to be deleted is marked by strikethrough text. New sections 2.1.4 (S&P 500 Implied Volatilities Scenarios) and 2.1.8 (Volatility Index Futures), and the replacement text for section 2.1.7 (Variance Futures), specific to the proposed models, are presented without marking. Existing Section 2.1.4 through 2.1.7 have been renumbered to reflect the addition of the new sections but are otherwise unchanged. This rule certification does not require any changes to the text of OCC's By-Laws or Rules. All terms with initial capitalization that are not otherwise defined herein have the same meaning as set forth in the OCC By-Laws and Rules.[3]

[3] OCC's By-Laws and Rules can be found on OCC's public website: https://www.theocc.com/Company-Information/Documents-and-Archives/By-Laws-and-Rules.

**Background**

STANS Overview

STANS is OCC's proprietary risk management system for calculating Clearing Member margin requirements.[4] The STANS methodology utilizes large-scale Monte Carlo simulations to forecast price and volatility movements in determining a Clearing Member's margin requirement.[5] STANS margin requirements are calculated at the portfolio level of Clearing Member accounts with positions in marginable securities and consists of an estimate of two primary components: a base component and a concentration/dependence stress test add-on component. The base component is an estimate of a 99% expected shortfall[6] over a two-day time horizon. The concentration/ dependence stress test add-on is obtained by considering increases in the expected margin shortfall for an account that would occur due to (i) market movements that are especially large and/or in which certain risk factors would exhibit perfect or zero correlations rather than correlations otherwise estimated using historical data or (ii) extreme and adverse idiosyncratic movements for individual risk factors to which the account is particularly exposed. OCC uses the STANS methodology to measure the exposure of portfolios of options and futures cleared by OCC and cash instruments in margin collateral, including volatility index futures and variance futures.[7]

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4 See Exchange Act Release No. 91079 (Feb. 8, 2021), 86 FR 9410 (Feb. 12, 2021) (File No. SR-OCC-2020-016). OCC makes its STANS Methodology description available to Clearing Members. An overview of the STANS methodology is on OCC's public website: https://www.theocc.com/Risk-Management/Margin-Methodology.

5 See OCC Rule 601.

6 The expected shortfall component is established as the estimated average of potential losses higher than the 99% value at risk threshold. The term "value at risk" or "VaR" refers to a statistical technique that, generally speaking, is used in risk management to measure the potential risk of loss for a given set of assets over a particular time horizon.

7 Pursuant to OCC Rule 601(e)(1), OCC also calculates initial margin requirements for segregated futures accounts on a gross basis using the Standard Portfolio Analysis of Risk Margin Calculation System ("SPAN"). CFTC Rule 39.13(g)(8), requires, in relevant part, that a derivatives clearing organization ("DCO") collect initial margin for customer segregated futures accounts on a gross basis. While OCC uses SPAN to calculate initial margin requirements for segregated futures accounts on a gross basis, OCC believes that margin requirements calculated on a net basis (i.e., permitting offsets between different customers' positions held by a Clearing Member in a segregated futures account using STANS) affords OCC additional protections at the clearinghouse level against risks associated with liquidating a Clearing Member's segregated futures account. As a result, OCC calculates margin requirements for segregated futures accounts using both SPAN on a gross basis and STANS on a net basis, and if at any time OCC staff observes a segregated futures account where initial margin calculated pursuant to STANS on a net basis exceeds

The models in STANS currently incorporate a number of risk factors. A "risk factor" within OCC's margin system is defined as a product or attribute whose historical data is used to estimate and simulate the risk for an associated product. The majority of risk factors utilized in the STANS methodology are the returns on individual equity securities; however, a number of other risk factors may be considered, including, among other things, returns on implied volatility.

Current Implied Volatilities Scenarios Model

Generally speaking, the implied volatility of an option is a measure of the expected future volatility of the option's underlying security at expiration, which is reflected in the current option premium in the market. Using the Black-Scholes options pricing model, the implied volatility is the standard deviation of the underlying asset price necessary to arrive at the market price of an option of a given strike, time to maturity, underlying asset price and the current discount interest rate. In effect, the implied volatility is responsible for that portion of the premium that cannot be explained by the current intrinsic value of the option (i.e., the difference between the price of the underlying and the exercise price of the option), discounted to reflect its time value. OCC considers variations in implied volatility within STANS to ensure that the anticipated cost of liquidating options positions in an account recognizes the possibility that the implied volatility could change during the two-business day liquidation time horizon and lead to corresponding changes in the market prices of the options.

Using its current Implied Volatilities Scenarios Model,[8] OCC models the variations in implied volatility used to re-price options within STANS for substantially all option contracts[9] available to be cleared by OCC that have a residual tenor[10] of less than three years ("Shorter Tenor

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the initial margin calculated pursuant to SPAN on a gross basis, OCC collateralizes this risk exposure by applying an additional margin charge in the amount of such difference to the account. See Exchange Act Release No. 72331 (June 5, 2014), 79 FR 33607 (June 11, 2014) (File No. SR-OCC-2014-13).

8 In December 2015, the SEC approved a proposed rule change and issued a Notice of No Objection to an advance notice filed by OCC to modify its margin methodology by more broadly incorporating variations in implied volatility within STANS. See Exchange Act Release No. 76781 (Dec. 28, 2015), 81 FR 135 (Jan. 4, 2016) (File No. SR-OCC-2015-016); Exchange Act Release No. 76548 (Dec. 3, 2015), 80 FR 76602 (Dec. 9, 2015) (File No. SR-OCC-2015-804). Initially named the "Implied Volatility Model," OCC re-titled the model the "Implied Volatilities Scenarios Model" in 2021 as part of the STANS Methodology's broader reorganization of OCC's Margin Methodology. See Exchange Act Release No. 90763 (Dec. 21, 2020), 85 FR 85788, 85792 (Dec. 29, 2020) (File No. SR-OCC-2020-016).

9 OCC's Implied Volatilities Scenarios Model excludes (i) binary options, (ii) options on commodity futures, (iii) options on U.S. Treasury securities, and (iv) Asians and Cliquets.

10 The "tenor" of an option is the amount of time remaining to its expiration.

Options").[11] To address variations in implied volatility, OCC models a volatility surface[12] for Shorter Tenor Options by incorporating certain risk factors (i.e., implied volatility pivot points) based on a range of tenors and option deltas[13] into the models in STANS. Currently, these implied volatility pivot points consist of three tenors of one month, three months and one year, and three deltas of 0.25, 0.5, and 0.75, resulting in nine implied volatility risk factors. These pivot points are chosen such that their combination allows the model to capture changes in level, skew (i.e., strike price), convexity, and term structure of the implied volatility surface. OCC uses a GARCH model[14] to forecast the volatility for each implied volatility risk factor at the nine pivot points.[15] For each Shorter Tenor Option in the account of a Clearing Member, changes in its implied volatility are simulated using forecasts obtained from daily implied volatility market data according to the corresponding pivot point and the price of the option is computed to determine the amount of profit or loss in the account under the particular STANS price simulation. Additionally, OCC uses simulated closing prices for the assets underlying the options in the account of a Clearing Member that are scheduled to expire within the liquidation time horizon of two business days to compute the options' intrinsic value and uses those values to help calculate the profit or loss in the account.[16]

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11 OCC currently incorporates variations in implied volatility as risk factors for certain options with residual tenors of at least three years ("Longer Tenor Options") by a separate process. See Exchange Act Release No. 68434 (Dec. 14, 2012), 77 FR 57602 (Dec. 19, 2012) (File No. SR-OCC-2012-14); Exchange Act Release No. 70709 (Oct. 18, 2013), 78 FR 63267 (Oct. 23, 2013) (File No. SR-OCC-2013-16). Because all Longer Tenor Options are S&P 500-based products, the proposed S&P 500 Implied Volatility Simulation Model would eliminate the separate process for Longer Tenor Options with a single methodology for all S&P 500 options.

12 The term "volatility surface" refers to a three-dimensional graphed surface that represents the implied volatility for possible tenors of the option and the implied volatility of the option over those tenors for the possible levels of "moneyness" of the option. The term "moneyness" refers to the relationship between the current market price of the underlying interest and the exercise price.

13 The "delta" of an option represents the sensitivity of the option price with respect to the price of the underlying security.

14 The acronym "GARCH" refers to an econometric model that can be used to estimate volatility based on historical data. See generally Tim Bollerslev, "Generalized Autoregressive Conditional Heteroskedasticity," Journal of Econometrics, 31(3), 307-327 (1986).

15 STANS relies on 10,000 price simulation scenarios that are based generally on a historical data period of 500 business days, which are updated daily to keep model results from becoming stale.

16 For such Shorter Tenor Options that are scheduled to expire on the open of the market rather than the close, OCC uses the relevant opening price for the underlying assets.

In January 2019,[17] OCC modified the Implied Volatilities Scenarios Model after OCC's analyses of the model demonstrated that the volatility changes forecasted by the GARCH model were extremely sensitive to sudden spikes in volatility, which at times resulted in overreactive margin requirements that OCC believed were unreasonable and procyclical.[18] To reduce the oversensitivity of the Implied Volatilities Scenarios Model to large, sudden shocks in market volatility and therefore result in margin requirements that are more stable and that remain commensurate with the risks presented during periods of sudden, extreme volatility, OCC modified the Implied Volatilities Scenarios Model to use an exponentially weighted moving average[19] of forecasted volatilities over a specified look-back period rather than using raw daily forecasted volatilities. The exponentially weighted moving average involves the selection of a look-back period over which the data would be averaged and a decay factor (or weighting factor), which is a positive number between zero and one, that represents the weighting factor for the most recent data point.[20] The look-back period and decay factor are model parameters subject to monthly review, along with other model parameters that are reviewed by OCC's Model Risk Working Group ("MRWG")[21] in accordance with OCC's internal procedure for margin model parameter review and sensitivity analysis, and these parameters are subject to change upon approval of the MRWG.

The current Implied Volatilities Scenarios Model is subject to certain limitations and issues, which would be addressed by the proposed changes described herein. While the overlay of an exponentially weighted moving average reduces and delays the impact of large implied volatility

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17 In December 2018, the SEC approved a proposed rule change and issued a Notice of No Objection to an advance notice filed by OCC to modify the Implied Volatilities Scenarios Model. See Exchange Act Release No. 84879 (Dec. 20, 2018), 83 FR 67392 (Dec. 29, 2018) (File No. SR-OCC-2018-014); Exchange Act Release No. 84838 (Dec. 19, 2018), 83 FR 66791 (Dec. 27, 2018) (File No. SR-OCC-2018-804).

18 A quality that is positively correlated with the overall state of the market is deemed to be "procyclical." While margin requirements from risk-based margin models normally fluctuate with market volatility, a margin model can be procyclical if it overreacts to market conditions, such as generating drastic spikes in margin requirements in response to jumps in market volatility. Anti-procyclical features in a model are measures intended to prevent risk-based models from fluctuating too drastically in response to changing market conditions.

19 An exponentially weighted moving average is a statistical method that averages data in a way that gives more weight to the most recent observations using an exponential scheme.

20 The lower the number the more weight is attributed to the more recent data (e.g., if the value is set to one, the exponentially weighted moving average becomes a simple average).

21 The MRWG is responsible for assisting OCC's Management Committee in overseeing OCC's model-related risk and includes representatives from OCC's Financial Risk Management department, Quantitative Risk Management department, Model Validation Group, and Enterprise Risk Management department.

spikes, it does so in an artificial way that does not target the primary issues that OCC identified with the GARCH model. Consequently, the 2019 modifications were intended to be a temporary solution.

The current model uses the "nearest neighbor" method to switch pivot points in the implied volatility surface, which introduces discontinuity in the implied volatility curve for a given tenor. In addition, the implied volatility scenarios for call and put options with the same tenor and strike price are not equal. These issues introduce inconsistencies in implied volatility scenarios.[22] Due to the use of arithmetic implied volatility returns in the current model,[23] it can produce near zero implied volatility, which is unrealistic, in a few simulated scenarios.

In addition, the current model does not impose constraints on the nine pivot points to ensure that simulated surfaces are arbitrage-free because the pivots are not modeled consistently. As a result, the simulated implied volatility surfaces often allow arbitrages across options. Because of the potential for arbitrage, the implied volatilities are not adequate inputs to price variance futures and volatility index futures accurately, both of which assume an arbitrage-free condition.[24] Furthermore, the current Implied Volatilities Scenarios Model may not provide natural offsetting of risks in accounts that contain combinations of S&P 500 options, variance futures, and/or volatility index futures because the copula utilized in the current model indirectly captures the correlation effect between S&P 500 options and volatility index futures or variance futures.

Current Synthetic Futures Model

Volatility indexes are indexes designed to measure the volatility that is implied by the prices of options on a particular reference index or asset. For example, Cboe's Volatility Index ("VIX") is an index designed to measure the 30-day expected volatility of the S&P 500. Volatility index futures can consequently be viewed as an indication of the market's future expectations of the volatility of a given volatility index's underlying reference index (e.g., in the case of the VIX, providing a snapshot of the expected market volatility of the S&P 500 over the term of the options making up the index). OCC clears futures contracts on such volatility indexes.

OCC currently uses the Synthetic Futures Model to calculate the theoretical value of volatility index futures, among other products,[25] for purposes of calculating margin for Clearing

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22 The inconsistency arises from the assumption that call deltas are equivalent to put deltas plus one, which is not well justified.

23 The arithmetic return of an implied volatility over a single period of any length of time is calculated by dividing the difference between final value and initial value by the initial value.

24 Currently, the S&P 500 underlying price scenario generated from the Variance Futures Model is used as input data for variance futures. For volatility index futures, synthetic VIX futures time series generated by the Synthetic Futures Model are used as input data to calibrate model parameters, as discussed below.

25 OCC also applies the Synthetic Futures Model to (i) futures on the American Interbank Offered Rate ("AMERIBOR") disseminated by the American Financial Exchange, LLC,

Member portfolios. OCC's current approach for projecting the potential final settlement prices of volatility index futures models the price distributions of "synthetic" futures on a daily basis based on the historical returns of futures contracts with approximately the same tenor.[26] The Synthetic Futures Model uses synthetic time series of 500 daily proportional returns created from historical futures. Once futures mature, the synthetic time series roll from the nearer-term futures to the next further out futures on the day subsequent to the front-month maturity date. Thus, the front-month synthetic always contains returns of the front contract; the second synthetic corresponds to the next month out, and so on. While synthetic time series contain returns from different contracts, a return on any given date is constructed from prices of the same contract (e.g., as the front-month futures contract "rolls" from the current month to the subsequent month, returns on the roll date are constructed by using the same contract and not by calculating returns across months). The econometric model currently used in STANS for purposes of modeling proportionate returns of the synthetic futures is an asymmetric GARCH(1,1) with an asymmetric Standardized Normal

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which is a transaction-based interest rate benchmark that represents market-based borrowing costs; (ii) futures products linked to indexes comprised of continuous yield based on the most recently issued (i.e., "on-the-run") U.S. Treasury notes listed by Small Exchange Inc. ("Small Treasury Yield Index Futures"); and (iii) futures products linked to Light Sweet Crude Oil (WTI) listed by Small Exchange ("Small Crude Oil Futures"). See Exchange Act Release No. 89392 (July 24, 2020), 85 FR 45938 (July 30, 2020) (File No. SR-OCC-2020-007) (AMERIBOR futures); Exchange Act Release No. 90139 (Oct. 8, 2020), 85 FR 65886 (Oct. 16, 2020) (File No. SR-OCC-2020-012) (Small Treasury Yield Index Futures); Exchange Act Release No. 91833 (May 10, 2021), 86 FR 26586 (May 14, 2021) (File No. SR-OCC-2021-005) (Small Crude Oil Futures). Notwithstanding the proposed charges herein, OCC would continue to use the current Synthetic Futures Model to model prices for interest rate futures on AMERIBOR, Small Treasury Yield Index Futures and Small Crude Oil Futures.

26 A "synthetic" futures time series relates to a uniform substitute for a time series of daily settlement prices for actual futures contracts, which persists over many expiration cycles and thus can be used as a basis for econometric analysis. One feature of futures contracts is that each contract may have a different expiration date, and at any one point in time there may be a variety of futures contracts on the same underlying interest, all with varying dates of expiration, so that there is no one continuous time series for those futures. Synthetic futures can be used to generate a continuous time series of futures contract prices across multiple expirations. These synthetic futures price return histories are inputted into the existing Copula simulation process in STANS alongside the underlying interests of OCC's other cleared and cross-margin products and collateral. The purpose of this use of synthetic futures is to allow the margin system to better approximate correlations between futures contracts of different tenors by creating more price data points and their margin offsets.

Reciprocal Inverse Gaussian (or "NRIG")-distributed logarithmic returns.[27] The correlation between S&P 500 options and VIX futures are controlled by a copula.

The current synthetic modeling approach suffers from limitations and issues similar to the current Implied Volatilities Scenarios Model. For one, the current synthetic model relies on the GARCH variance forecast, which, as described above, is prone to volatility shocks. To address this, the Synthetic Futures Model employs an anti-procyclical floor for variance estimates.[28] Secondly, the current synthetic model makes the rolling volatility futures contracts take on different variances from calibration at futures roll dates, which could translate to jumps in margin.

Current Model for Variance Futures

Variance futures are commodity futures for which the underlying interest is a variance.[29] Variance futures differ from volatility index futures in that the underlying variance is calculated using only historical daily closing values of the reference variable while an underlying volatility index represents the implied volatility component of bid and ask premium quotations for options on a reference variable. When a variance futures contract is listed, it defines the initial variance strike. This initial variance strike represents the estimated future variance at contract expiration. The final settlement value is determined based on a standardized formula for calculating the realized variance of the S&P 500 measured from the time of initial listing until expiration of the contract. At maturity, the buyer of the contract pays the amount of predefined strike to the seller and the seller pays the realized variances. Therefore, the buyer profits if the realized variance at maturity exceeds the

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27 See Exchange Act Release No. 85873 (May 16, 2019), 84 FR 23620 (May 22, 2019) (File No. SR-OCC-2019-002); Exchange Act Release No. 85870 (May 15, 2019), 84 FR 23096 (May 21, 2019) (File No. SR-OCC-2019-801).

28 In order to incorporate a variance level implied by a longer time series of data, OCC calculates a floor for variance estimates based on the underlying index (e.g., VIX) which is expected to have a longer history that is more reflective of the long-run variance level that cannot be otherwise captured using the synthetic futures data. The floor therefore reduces the impact of a sudden increase in margin requirements from a low level and therefore mitigates procyclicality in the model.

29 A variance is a statistical measure of the variability of price returns relative to an average (mean) price return. Accordingly, OCC believes that an underlying variance is a "commodity" within the definition of Section 1a(4) of the Commodity Exchange Act ("CEA"), which defines "commodity" to include "all . . . rights, and interests in which contracts for future delivery are presently or in the future dealt in." 7 U.S.C. 1a(9). OCC believes a variance is neither a "security" nor a "narrow-based security index" as defined in Section 3(a)(10) and Section 3(a)(55)(A) of the Exchange Act, respectively, and therefore is within the exclusive jurisdiction of the CFTC. OCC clears this product in its capacity as a DCO registered under Section 5b of the CEA. See Exchange Act Release No. 49925 (June 28, 2004), 69 FR 40447 (July 2, 2004) (File No. SR-OCC-2004-08).

predefined variance strike. S&P 500 variance futures are exchange-traded futures contracts based on the realized variance of the S&P 500.

OCC uses the current Variance Futures Model to calculate the theoretical value of variance futures for purposes of calculating margin for Clearing Member portfolios. OCC's current Variance Futures Model was introduced in 2007 and is an econometric model designed to capture long- and short-term conditional variance of the underlying S&P 500 to generate variance futures prices. OCC's current approach to modeling variance futures has several disadvantages. OCC currently models variance futures by simulating a final settlement price rather than a near-term variance futures price. This approach is not consistent with OCC's two-day liquidation horizon. In addition, the current Variance Futures Model is based on an econometric model that assumes the S&P 500 return variance can be described by the GARCH(1,1) model and that the long-term variation follows and Ornstein-Uhlenbeck process.[30] As with the use of GARCH for the Implied Volatilities Scenarios Model, this approach has several limitations, including (1) the current approach does not provide appropriate risk offsets with other instruments closely related to the S&P 500 implied volatility, such as VIX futures; and (2) the margin rates it generates are too conservative for short positions and too aggressive for long positions, which causes model backtesting to fail.

**Proposed Change**

OCC is proposing to replace the Implied Volatilities Scenarios Model for S&P 500-based products, the Synthetic Futures Model for volatility index-based products, and the Variance Future Model for variance futures with new models that would simplify the STANS methodology, control procyclicality in volatility modeling, provide natural offsets for volatility products with similar characteristics, and build the foundation for a single, consistent framework to model equity volatility products in margin and stress testing.

<u>Proposed Changes to the Implied Volatilities Scenarios Model for S&P 500-Based Products</u>

OCC proposes to replace the current Implied Volatilities Scenarios Model with the proposed S&P 500 Implied Volatility Simulation Model for the S&P 500 product group.[31] The purpose of the

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30 See Uhlenbeck, G. E. and L.S. Ornstein, "On the Theory of Brownian Motion," <u>Physical Review</u>, 36, 823-841 (1930) (explaining the Gaussian Ornstein-Uhlenbeck process).

31 The S&P 500 Implied Volatility Model has been designed to model implied volatility dynamics for options written on the S&P 500 and related indexes, such as S&P 500 index options ("SPX") and S&P 500 Exchange Traded Funds ("SPY") options, options on S&P 500 futures, and related implied volatility derivatives such as VIX futures and Miax's SPIKES Volatility Index ("SPIKES"). While OCC would continue to use the current Implied Volatilities Scenarios Model for the products other than S&P 500-based products to which the model currently applies, the S&P 500 Implied Volatility Simulation Model is intended to provide a foundation upon which OCC can build a single consistent framework

proposed S&P 500 Implied Volatility Simulation Model is to establish a consistent and robust framework for implied volatility simulation, provide appropriate control for procyclicality in S&P 500 implied volatility modeling, and provide natural offsets for volatility products with similar characteristics to S&P 500 implied volatility (e.g., VIX futures and options). The output of the S&P 500 Implied Volatility Simulation Model would be used by OCC's options pricing model, as well as the proposed Volatility Index Futures Model and Variance Futures Model.

*Proposed S&P 500 Implied Volatility Simulation Model Description*

The proposed S&P 500 Implied Volatility Simulation Model is a Monte Carlo simulation model that captures the risk dynamics in S&P 500 implied volatility surface including its term structure and skew. This proposed model aims to provide enhanced treatment for simulating the dynamics of S&P 500 options and replace the nine-pivot approach in STANS, to provide appropriate control for procyclicality in S&P 500 implied volatility modeling, and to provide natural offsets for volatility products with similar characteristics of S&P 500 implied volatility (e.g., VIX futures and options).

The proposed approach would model the implied volatility surface in the space of standardized log-moneyness and tenor. Based on the approximation of the Bergomi-Guyon expansion,[32] the dynamics of S&P 500 implied volatility surface would be characterized by an affine model. In the model, the dynamics of S&P 500 at-the-money ("ATM") implied volatility would be specified precisely in the form of stochastic differential equations[33] for a fixed number of key tenors. The changes of S&P 500 ATM implied volatility across different tenors would be characterized by the volatility-of-volatility of the anchor tenor with a power law decay term structure and a residual term-specific random process. The power law decay parameter would be modeled as a function of S&P 500 1-month ATM implied volatility. For any arbitrary tenors within the key tenor range, the term-specific correlation structure would be given by a linear interpolation across the nearest two key tenors. For any arbitrary tenors outside the key tenor range, the term-specific correlation structure would be determined by the shortest or longest key tenor, respectively.

OCC assumes changes of skew (i.e., skew shock) evolve proportionally across different standardized log-moneyness and also follow a power law decay term structure. OCC would model the S&P 500 1-month implied volatility skew shock via a linear regression approach conditional on the changes of S&P 500 1-month ATM implied volatility and an idiosyncratic term.

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to model single-name and index/futures equity volatility products for margin and stress testing.

32 See Bergomi, Lorenzo, and Julien Guyon, "Stochastic volatility's orderly smiles," Risk 25.5 (2012): 60.

33 A stochastic differential equation is a differential equation in which one or more of the terms is a stochastic process, resulting in a solution which is also a stochastic process.

OCC would generate the simulated scenarios of S&P 500 implied volatility surface by first applying shocks across term structure and then skew shock across moneyness to the initial S&P 500 implied volatility surface (obtained through OCC's smoothing algorithm).[34] Along with other risk factors in STANS, the standard uniform draws of the S&P 500 1-month ATM implied volatility risk factor is generated from Copula. First, the log-return scenarios of S&P 500 1-month ATM implied volatility would be simulated from a Hansen's skewed t distribution with pre-determined degrees-of-freedom and skewness parameters. The forecasted volatility-of-volatility for S&P 500 1-month ATM implied volatility would be estimated based on the 30-day VVIX, Cboe's option-implied volatility-of-volatility index. An equal-weighted look-back moving average would be applied to smooth the daily 30-day VVIX. To control for procyclicality, a dynamic scaling factor would be applied to the smoothed 30-day VVIX. The log-return scenarios of S&P 500 ATM implied volatility for a given listed tenor would be generated based on the log-return scenarios of the 1-month ATM implied volatility with a power law decay and the term-specific residuals for tenors longer than 1 month. The random variables for the term-specific residual diffusion process would be drawn from a multivariate Student's t distribution with common degrees-of-freedom.

Secondly, OCC would simulate the S&P 500 1-month implied volatility skew shock conditional on the log-return scenarios of S&P 500 1-month ATM implied volatility and an idiosyncratic term. OCC would generate the skew shock scenarios for listed options with arbitrary tenors and standardized log-moneyness by applying the power law decay and scaling by the stylized standardized log-moneyness scenarios. Finally, OCC would add the skew shock scenario to the shocked S&P 500 ATM implied volatility scenario to obtain the final S&P 500 implied volatility scenario for an arbitrary tenor and standardized log-moneyness. OCC would use the simulated S&P 500 implied volatility scenarios to generate option prices used in margin estimation and stress testing.

*Proposed S&P 500 Implied Volatility Simulation Model Performance*

The proposed S&P 500 Implied Volatility Simulation Model simplifies the STANS methodology by minimizing the number of implied volatility risk factors. Under the current model, the nine implied volatility pivots used to simulate volatility scenarios have significantly increased the dimension of the Student's t copula by adding nine risk factors to every index or security that has listed options. The proposed S&P 500 Implied Volatility Simulation Model would employ a simpler approach to model the S&P 500 implied volatility surface so that key risk factors driving the implied volatility surface are explicitly modeled within the model itself. By modeling the implied volatility surface directly, instead of using the nine-pivot approach, the simulated implied volatility surface would be smooth and continuous in both term structure and moneyness dimensions. In addition, put and call options with the same tenors and strike prices would have the same implied volatility

[34] The smoothing algorithm is the process that OCC uses to estimate fair values for plain vanilla listed options based on closing bid and ask price quotes. See Exchange Act Release No. 86731 (Aug. 22, 2019), 84 FR 45188, 45189 (Aug. 28, 2019) (File No. SR-OCC-2019-005).

scenarios under the proposed model. Thus, the S&P 500 Implied Volatility Simulation Model would address issues with the current model's implied volatility surface and scenarios as discussed above.

To compensate for the procyclicality in the GARCH process, the current model employs an exponentially weighted moving average overlay to reduce and delay the impact of large implied volatility spikes. In the proposed S&P 500 Implied Volatility Simulation Model, the forecasted variance of the S&P 500 1-Month ATM implied volatility would be simulated using the smoothed 30-day VVIX, which is a proxy of the option-implied volatility-of-volatility, scaled by a dynamic factor to control for procyclicality. OCC believes the proposed model would be a better and sounder method to produce consistent and smooth simulated implied volatility scenarios in both term structure and skew dimensions for S&P 500 and to control the procyclicality in margin requirements. As borne out by observations on the performance of the proposed model discussed below, OCC believes that these proposed changes also reduce the oversensitivity observed with the GARCH process under the current Implied Volatilities Scenarios Model to large, sudden shocks in market volatility and produce margin requirements that are more stable and that remain commensurate with the risks presented during stressed periods.

Based on its analysis of the S&P 500 Implied Volatility Simulation Model's performance, OCC concludes that the proposed model accurately recovers the correlation structure of the S&P 500 ATM implied volatilities as well as the VIX futures across different tenors, which benefits margin coverage of portfolios containing S&P 500 options, VIX futures, and S&P 500 options and VIX futures. Moreover, the proposed model provides adequate margin coverages for both upward and downward movements of implied volatility over the margin risk horizon. The margin coverage is stable across time and low, medium, and high volatility market conditions. The model parameters would periodically be recalibrated to incorporate more recent data and backtesting performance.

In addition, the implied volatility scenarios generated by the proposed model observed fewer arbitrage violations and tighter consistency between VIX and S&P 500 option price scenarios.[35] The proposed methodology's mitigation of arbitrage is sufficient to allow OCC to use S&P 500 Implied Volatility Simulation model in pricing volatility index futures and variance futures, which assume an arbitrage-free condition. In this way, the proposed changes support enhanced margin offsetting between S&P 500 options, VIX futures, and S&P 500 variance futures, which is naturally captured by the proposed models.

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35 OCC believes that the proposed model's improvements to the number of arbitrage violations is explained by two factors: (i) replacing the current model's approximate delta-based function for the volatility curve—which leads to arbitrage prices between call and put options of the same strike and expiration—with the proposed model's standardized log-moneyness approach, and (ii) replacing the current model's nine pivot points method with a methodology that produces an implied volatility surface that is continuous in strike and time space.

OCC has performed backtesting of the current models and proposed models, including the proposed Volatility Index Futures Model, to compare and evaluate the performance of each model from a margin coverage perspective. Overall, the proposed models, when tested along with other models in STANS, provided adequate margin coverage under different market conditions over the backtesting period. Moreover, compared to the current models, the margin coverage from the proposed model is more stable and less procyclical, especially under stressed market conditions.

Proposed Changes to the Synthetic Futures Model for Volatility Index-Based Products

OCC proposes to use the Volatility Index Futures Model, rather than the current Synthetic Futures Model, to derive the theoretical fair values of volatility index futures.[36] OCC would also use the Volatility Index Futures Model to calculate the implied forward price for options on volatility indexes, including options on VIX and SPIKES.[37] The purpose of the proposed change is to replace the current method for pricing volatility index futures with an industry-standard method based on Cboe's option replication formula augmented with a convexity correction. As discussed below, OCC believes that the proposed model will produce more accurate and stable results than the current Synthetic Futures Model, which suffers from the limitations discussed above, including that (i) the Synthetic Futures Model produces results that are not strongly correlated with S&P 500 option prices and volatility and are more susceptible to volatility shocks due to the sensitivity of the GARCH process; and (ii) the Synthetic Futures Model depends on the historical calibration for various parameters, which can create artifacts due to the roll dates of VIX futures.

*Proposed Volatility Index Futures Model Description*

The proposed Volatility Index Futures Model would alleviate the issues observed with the current Synthetic Futures Model by adopting a parameter-free approach based on the replication of log-contract, which measures the expected realized volatility using S&P 500 options, as discussed in

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[36] In addition to the VIX index, Cboe calculates several other volatility indexes including the Cboe Short Term Volatility Index (VXST), which reflects the 9-day expected volatility of the S&P 500, as well as the Cboe Nasdaq-100 Volatility Index (VXN), Cboe DJIA Volatility Index (VXD), Cboe Russell 2000 Volatility Index (RVX) and Cboe S&P 500 3-Month Volatility Index (VXV) and the Cboe S&P 500 6-Month Volatility Index (VXMT). The Volatility Index Futures Model may apply to futures contracts written on these and other volatility indexes if and when such futures contracts are listed, depending on OCC's assessment of whether those futures contracts meet the model assumptions and subject to OCC obtaining all necessary regulatory approval to apply the Volatility Index Futures Model to such futures contracts.

[37] OCC calculates the implied forward price for options on indexes using the basis futures price. See Exchange Act Release No. 86296 (July 3, 2019), 84 FR 32821 (July 9, 2019) (File No. SR-OCC-2019-005) (enhancing OCC's smoothing algorithm).

Cboe's VIX white paper.[38] The proposed model would derive the theoretical fair value of volatility index futures via replication through a portfolio of vanilla S&P 500 options[39] using the proposed S&P 500 Implied Volatility Simulation Model and convexity adjustments, which reflect the concavity of the square root function used to convert variance into volatility. A basis adjustment would be computed to reflect the difference between the market price and the theoretical value at the base level and then applied to the simulated volatility index futures prices at the scenario level to align the simulation to the market. The output from the Volatility Index Futures Model would be an input to the options pricing model, which treats the volatility index Futures as the underlying of the options contract. By providing a direct link between the volatility index futures price and the underlying S&P 500 options price, OCC believes that the Volatility Index Futures Model would result in more sensible margin charges compared to the current model.

*Proposed Volatility Index Futures Model Performance*

Based on its analysis of the Volatility Index Futures Model's performance, OCC has concluded the proposed model would provide more consistent and better-behaved margin coverage across the term structure when compared to the current Synthetic Futures Model. The Volatility Index Futures Model demonstrates desirable anti-procyclicality properties, providing adequate margin coverage during periods of high volatility without being too conservative in periods of low volatility. Furthermore, the propose model generates adequate margin coverage for short-term futures which is manifested in the pronounced Samuelson effect.[40] OCC believes three reasons account for the improved performance of the Volatility Index Futures Model: (1) the proposed model provides a direct link between the futures price and the underlying option prices via replication; (2) the margin coverage of VIX futures is closely coupled with the S&P 500 Implied Volatility Simulation Model with procyclicality control, whereas the Synthetic Futures Model relies on the GARCH variance forecast process, which is prone to overreaction to shocks; and (3) unlike the Synthetic Futures Model, the Volatility Index Futures Model is not subject to the calibration artifact due to the 500-day lookback window, nor does it require the rolling VIX futures contracts to take on different variances from calibration at futures roll dates, which translate to discontinuities in margin under the current method.

For VIX futures portfolios[41] hedged with S&P 500 options, the proposed models provide more efficient margin coverage. The improvement in margin coverage can be attributed to the direct

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38 See Cboe, VIX White Paper (2021), available at https://cdn.cboe.com/resources/vix/vixwhite.pdf.

39 In some cases with limited listed strikes, additional strikes will be interpolated or extrapolated to provide more robust results.

40 The Samuelson effect refers to a decrease in volatility with increasing time to maturity.

41 VIX futures are commonly incorporated into a large S&P 500 portfolio as hedging instruments for volatility risk. For example, one could gain pure exposure to underlying spot

coupling between VIX futures and S&P 500 options, which gives rise to risk-offsetting effect from the volatility. This result demonstrates that the replication method in conjunction with the S&P 500 Implied Volatility Simulation Model is better able to capture the correlations between VIX futures and S&P 500 options and produce cross-hedging benefits for Clearing Members.

Proposed Changes to the Variance Futures Model

OCC proposes to replace the current Variance Futures Model in its entirety. As discussed above, OCC uses the current Variance Futures Model to derive the theoretical fair values of variance futures for calculating margin and clearing fund requirements based on Clearing Member portfolios. Like the proposed Volatility Index Futures Model, the proposed Variance Futures Model would employ an industry-standard fundamental replication technique using the log-contract to price variance futures.[42] OCC expects that this approach would not only provide more accurate prices, but also offer natural risk offsets with the options of the same underlying security. In addition, the proposed Variance Futures Model would no longer be reliant on a GARCH variance forecast process, thereby addressing the sensitivity and procyclicality of that process to volatility shocks observed with the current model. Furthermore, the proposed method would simulate a near-term variance futures price rather than a final settlement price, consistent with OCC's two-day liquidation assumption.

*Proposed Variance Futures Model Description*

The theoretical variances produced by the proposed Variance Futures Models would be comprised of two components. The first component, as under the current Variance Futures Model, would be the realized variance calculated by the realized daily returns of S&P 500 option prices.[43] The second component captures the unrealized variance, which OCC would approximate using a portfolio of out of the money ("OTM") call and put European options. The proposed model would calculate the implied component of variance futures via replication through a portfolio of OTM option prices generated using the proposed S&P 500 Implied Volatility Simulation Model.

*Proposed Variance Futures Model Performance*

Based on its analysis of the current and proposed Variance Futures Model, the proposed model shows significant improvement in margin coverage. The proposed model naturally captures the correlations between S&P 500 options, variance futures, and VIX. Compared to the current

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movements of the S&P 500 by buying/selling VIX futures to hedge the vega risk (i.e., risk of changes in implied volatility) of S&P 500 options.

42 This approach is based on Cboe's published method for pricing S&P 500 variance futures. See Cboe, S&P 500 Variance Futures Contract Specification (Dec. 10, 2012), available at http://www.cboe.com/products/futures/va-s-p-500-variance-futures/contract-specifications.

43 Additional strikes may be interpolated or extrapolated from listed strikes to provide more robust results.

model, the proposed model provides adequate long and short coverage for periods of high volatility and reasonable levels for periods of low volatility. In particular, the proposed model significantly reduces long-side coverage exceedances. The proposed model produces higher correlation for neighboring variance futures and adequate coverage without being overly conservative on the short side. OCC expects that any changes to the overall margins of Clearing Member accounts would be limited; over the twelve-month period between May 2019 and April 2020, only four margin accounts held variance futures positions and the total risk from variance futures positions was less than one percent of the total risk of all the positions for each of those accounts.

**Implementation Timeframe**

OCC expects to operate the proposed model in parallel with the current model for a period of at least thirty (30) days before implementing the proposed model into production to give Clearing Members an opportunity to understand the practical effects of the proposed changes. OCC further expects to implement the proposed changes within sixty (60) days after the date that OCC receives all necessary regulatory approvals for the proposed changes. OCC will announce the implementation date of the proposed change by an Information Memorandum posted to its public website at least 2 weeks prior to implementation.

**Consistency with DCO Core Principles**

OCC reviewed the DCO core principles ("Core Principles") as set forth in the Act, the regulations thereunder, and the provisions applicable to a DCO that elects to be subject to the provisions of 17 CFR Subpart C ("Subpart C DCO"). During this review, OCC identified the following as potentially being impacted:

**Risk Management.** OCC believes that implementing the proposed rule change will be aligned with the requirements of Core Principle D.[44] Core Principle D requires, in part, that each DCO limit, through the use of margin and other risk control mechanisms, its potential losses from defaults by members and participants of the DCO to ensure that its operations would not be disrupted and that its non-defaulting members or participants are not exposed to losses they cannot anticipate or control.[45] Core Principle D further requires that each DCO have margin requirements sufficient to cover potential exposures in normal market conditions and that such margin requirements be set using risk-based models and parameters.[46]

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[44] 7 U.S.C. 7a-1(c)(2)(D).

[45] See 7 U.S.C. 7a-1(c)(2)(D)(iii).

[46] See 7 U.S.C. 7a-1(c)(2)(D)(iv) – (v). CFTC Regulation 39.13(g)(2)(i) further implements Core CFTC Regulation 39.13(g)(2)(i) by requiring, in part, that each DCO establish initial margin requirements that are commensurate with the risks of each product and portfolio, including any unusual characteristics of, risks associated with, particular products or portfolios. See 17 CFR 39.13(g)(2)(i).

As described above, the volatility changes forecasted by OCC's current Implied Volatilities Scenarios Model are sensitive to large, sudden spikes in volatility, which can at times result in overreactive margin requirements that OCC believes are unreasonable and procyclical (for the reasons set forth above). Such sudden, unreasonable increases in margin requirements may stress certain Clearing Members' ability to obtain liquidity to meet those requirements, particularly in periods of extreme volatility, and could result in a Clearing Member being delayed in meeting, or ultimately failing to meet, its daily settlement obligations to OCC. A Clearing Member's failure to meet its daily settlement obligations could, in turn, cause the suspension of such Clearing Member and the liquidation of its portfolio, which could harm investors. While the current Implied Volatilities Scenarios Model addresses this issue with an exponentially weighted moving average that reduces and delays the impact of large implied volatility spikes, it does so in an artificial way that does not target the primary issues with the GARCH process that OCC has identified. By modeling implied volatility in a more direct, coherent manner, the proposed S&P 500 Implied Volatility Simulation Model would therefore reduce the likelihood that OCC's models would produce extreme, overreactive margin requirements that could strain the ability of certain Clearing Members to meet their daily margin requirements at OCC by controlling procyclicality in OCC's margin methodology and ensuring more stable and appropriate changes in margin requirements across volatile market periods while continuing to capture changes in implied volatility and produce margin requirements that are commensurate with the risks presented. The proposed model would be used by OCC to calculate margin requirements designed to limit its credit exposures to participants, and OCC uses the margin it collects from a defaulting Clearing Member to protect other Clearing Members and their customers from losses as a result of the default and ensure that OCC is able to continue the prompt and accurate clearance and settlement of its cleared products.

Specifically, both the Volatility Index Futures Model and the Variance Futures Model exhibit procyclicality issues as a result of their reliance on the GARCH variance forecast process, which is prone to volatility shocks. The proposed Volatility Index Futures Model and Variance Futures Model would address these issues by adopting a fundamental replication technique using the log-contract to price volatility index futures and variance futures. In addition to providing a consistent modeling approach to modeling equity volatility products that provides accurate prices, this approach also offers natural risk offsets with the options of the same underlying security. This model is also expected to alleviate concerns around high margin requirements for S&P 500 variance futures generated by current STANS systems. As discussed above, collecting margins that are commensurate with risk helps to avoid collection of excessive margin that may stress certain Clearing Members' ability to obtain liquidity to meet those requirements, particularly in periods of extreme volatility, and could result in Clearing Member defaults that could harm investors and other Clearing Members. These changes would also provide natural offsets between S&P 500 options, volatility index Futures and variance futures. The proposed models would be used by OCC to calculate margin requirements designed to limit its credit exposures to participants. OCC uses the margin it collects from a defaulting Clearing Member to protect other Clearing Members from losses as a result of the default and ensure that OCC is able to continue the prompt and accurate clearance and settlement of its cleared products. In these ways, OCC believes the proposed change promotes compliance with Core Principle D under the Act.

## Opposing Views

No substantive opposing views were expressed related to the rule amendments by OCC's Board members, Clearing Members or market participants. Public comment on the rule amendments, if any, can be found in the SEC comment files for File Numbers SR-OCC-2022-001 and SR-OCC-2022-801.[47]

## Notice of Pending Rule Certification

OCC hereby certifies that notice of this rule filing has been be given to Clearing Members of OCC in compliance with Regulation 40.6(a)(2) by posting a copy of the proposed rule change on OCC's website concurrently with the filing of this submission.

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47 See Options Clearing Corporation (OCC) Rulemaking, https://www.sec.gov/rules/sro/occ.htm; OCC Advance Notice Rulemaking, https://www.sec.gov/rules/sro/occ-an.htm.

Certification

OCC hereby certifies that the rule set forth at Exhibit A of the enclosed filing complies with the Act and the CFTC's regulations thereunder.

Should you have any questions regarding this matter, please do not hesitate to contact me.

Sincerely,

/s/ Mark C. Brown
Associate General Counsel

Enclosure: Confidential Exhibit A