NOTICE TO MEMBERS

Nº 2021 - 032

February 23, 2021

REQUEST FOR COMMENTS

AMENDMENTS TO THE RISK MANUAL OF THE CANADIAN DERIVATIVES CLEARING CORPORATION TO INTRODUCE A NEW RISK MODEL RECALIBRATION PROCESS

On January 29, 2021, the Board of Directors of Canadian Derivatives Clearing Corporation ("CDCC") approved amendments to CDCC's Risk Manual in order to introduce a new risk model recalibration process.

Please find enclosed an analysis document as well as the proposed amendments.

Process for Changes to the Rules

CDCC is recognized as a clearing house under section 12 of the *Derivatives Act* (Québec) by the Autorité des marchés financiers ("AMF") and as a recognized clearing agency under section 21.2 of the *Securities Act* (Ontario) by the Ontario Securities Commission ("OSC").

The Board of Directors of CDCC has the power to approve the adoption or amendment of the Risk Manual of CDCC. Amendments are submitted to the AMF in accordance with the self-certification process and to the OSC in accordance with the process provided in the Recognition Order.

Comments on the proposed amendments must be submitted before **March 26, 2021**. Please submit your comments to:

<div align="center">

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A copy of these comments shall also be forwarded to the AMF and to the OSC to:

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Corporate Secretary and	Market Regulation Branch
Executive Director, Legal Affairs	*Ontario Securities Commission*
Autorité des marchés financiers	Suite 2200,
Place de la Cité, tour Cominar	20 Queen Street West
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For any question or clarification, Clearing Members may contact Martin Jannelle at 514-787-6578 or at martin.jannelle@tmx.com.

Jean-François Bertrand
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AMENDMENTS TO THE RISK MANUAL OF THE CANADIAN DERIVATIVES CLEARING CORPORATION ("CDCC") TO INTRODUCE A NEW RISK MODEL RECALIBRATION PROCESS

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I. DESCRIPTION

During the period beginning March 2020 to July 2020, variations in the securities and derivatives markets primarily caused by the impact of the COVID-19 outbreak on the financial markets have resulted in CDCC's Initial Margin (IM) models to encounter a number of backtesting breaches for equity derivatives. Such breaches were assessed as material on CDCC's impact scale.

Among other steps taken by CDCC during the period mentioned above, CDCC implemented COVID-19 related emergency measures and remediation actions in order to bring back backtesting results under the current models at appropriate levels. These COVID-19 measures, made in compliance with the Rules of CDCC, were nevertheless considered temporary solutions for the issue at stake before a permanent and general solution like a risk model recalibration or risk model change gets implemented.

In short, material risk model breaches due to the impact of the COVID-19 outbreak on the financial markets have highlighted the fact that CDCC lacks flexibility to change its models when some key risk parameters are only available in its Risk Manual. Unless CDCC can rely on current provisions of its Rules or Manuals (a solution that is not always suitable in all situations), any adjustments to the key risk parameters of CDCC's risk models would require regulatory approvals through the standard "rule change" or "significant change" process. Although appropriate for any other rule changes or significant changes, the process remains very restrictive in the context of market volatility and upswings where CDCC must act at a faster pace.

Based on the foregoing, CDCC hereby proposes changes to its Risk Manual that will provide CDCC with more flexibility and suitable responsiveness in adapting its Base Initial Margin models upon the occurrence of a "Risk Model Recalibration Event", the whole subject to a governance process that will ensure a sound assessment of the proposed changes.

Unless otherwise defined herein, all defined terms used in this analysis will have the meaning described to them in CDCC's Rules.

II. PROPOSED AMENDMENTS

The amendments proposed by CDCC are twofold:

First, all key risk parameters specifically identified (in value or otherwise) in the Risk Manual for the calculation of the Base Initial Margin of Options, Futures, Unsettled Items and Fixed-Income Transactions will be removed from the Risk Manual and kept solely in CDCC's internal model documentation. Notwithstanding the foregoing, a general description of the risk models (SPAN® and VaR - including a description of the risk parameters) will remain in the Risk Manual.

Second, CDCC will propose a new governance process entitled "Risk Model Recalibration". The Risk Model Recalibration process will not alter the current governance applied to the model validation framework of any risk model. That framework includes the current risk management oversight (validation and vetting): the risk evaluation committee, the risk management committee, the risk management advisory committee and the internal audit risk model vetting (ante & ex-post). Such a governance process will ensure, like it is the case today, that any recalibration is appropriate and vetted. This new governance process will be based on internal procedures the compliance to which will be subject to the review of CDCC's Internal Audit ex-post. The scope and frequency of such review will be determined by CDCC's

Internal Audit at its discretion from time to time. However, such a recalibration to key risk parameters will not be submitted to CDCC's board of directors for approval, and it will not be subject to CDCC regulators' approval. CDCC will notify the Clearing Members and its regulators of the key risk parameter recalibration by the publication and distribution of a notice to members.

More specifically, the Risk Model Recalibration process and its new governance can be as follows:

The Risk Model Recalibration Process

1. CDCC will proceed with the Risk Model Recalibration process upon the occurrence of a "risk model recalibration event", being defined as (i) a change in key risk parameters resulting from an external event (domestic or international financial, political or economic events or conditions), or (ii) an internal assessment performed by CDCC through backtesting and sensitivity analyses concluding to the necessity of recalibrating and improving the performance of the risk models.

2. Such recalibration will then be subject to CDCC's risk management oversight process. To the extent the risk management advisory committee does not express any concerns with the proposed recalibration, CDCC will then move the following step.

3. CDCC's risk management oversight process will include risk model vetting (ante & ex-post) of the proposed recalibrations by CDCC's Internal Audit. Not only will CDCC's Internal Audit review the proposed recalibrations post-implementation, some pre-vetting reviews will be performed on a regular basis, based on predetermined recalibration scenarios. The compliance with Risk Model Recalibration governance procedures will also be subject to CDCC's Internal Audit reviews.

4. All recalibrations made to key risk parameters will be notified to CDCC's stakeholders along with any relevant information such as the impact analysis of the recalibration.

5. The recalibration will become effective five (5) Business Days following the publication of a notice to members to that effect on CDCC's Web site.

All values resulting from the application of the risk models following the recalibrations will be disclosed and shared with CDCC's stakeholders via the quantitative and qualitative disclosures files, publications and other notices published on CDCC's Website from time to time.

Finally, it is important to mention that any material model change that goes beyond the concept of "key risk parameters" (e.g moving from an Expected Shortfall to a Value-at-Risk statistical treatments, introducing a new type of distribution assumption) will be considered a "rule change" or a "significant change" and will ultimately be submitted to CDCC's board of directors and, subsequently to CDCC's regulators and, when applicable, to the Clearing Members (or the public). In other words, the main elements that compose a risk model will remain in the Risk Manuals. The parameters that can be adjusted by CDCC from time to time will be removed from the Risk Manual, but subject to a rigorous internal review.

The proposed amendments are attached hereto. Among other amendments, explicit references to specific risk parameters have been removed from the Risk Manual's provisions dealing with the calculation of the Base Initial Margin (for Options, Futures, Unsettled Items and Fixed-Income Transactions) in order to allow a generalization of the following components within a certain value range: parametric distribution, confidence levels, Lambda, look-back periods, floors and the MPOR (list of key risk

parameters and hypothetical recalibrations in the table below). The amendments will also include the addition of the new risk model recalibration process. It is important to note that a general description of the risk models and key risk parameters will remain in the Risk Manual and any change in the nature of these models and parameters will have to be subject to a "rule change" or "significant change" process.

III.   ANALYSIS

a.   Background

Variations in the securities and derivatives markets primarily caused by the impact of the COVID-19 outbreak on the financial markets resulted in CDCC's Initial Margin (IM) risk models experiencing a certain number of backtesting breaches for equity derivatives. These breaches were considered material on CDCC's impact scale. As a result, remediation actions were proposed based on reverse backtesting and/or partial modelization analysis: (1) a 15% COVID-19 Buffer for all products and (2) a Buffered Floor for Exchange-Traded Derivatives (ETD) as described in the following paragraphs.

Hence, among other steps taken by CDCC during the period mentioned above, CDCC implemented a 15% direct increase of the Base Initial Margin (by increasing the Margin Intervals) at the product level (Futures, Options and Fixed Income Transactions) on April 3rd, 2020[1]. This remediation action was implemented pursuant to Section A-702 of CDCC's Rules, that states that the amount of Margin which may be required from a Clearing Member may be varied by CDCC at any time and from time to time without advance notice whenever CDCC, in its sole discretion, considers such variation necessary or advisable for the protection of CDCC, Clearing Members or the investing public.

On July 2nd, 2020[2], and pursuant to the provisions of Section A-702 of CDCC's Rules, CDCC removed the direct 15% increase for all products and replaced it by a temporary increase (25%) of the current volatility floor ('the Buffered Floor') for Index Futures and Interest Rate Futures only. On September 4th, 2020[3], the remaining ETD products (i.e. options and single stock futures contracts, except for STIR Futures) were also subject to this Buffered Floor. The purpose of this change was to refine the initial mitigation of 15% by finding a better balance between the risk (appropriate backtesting coverage) and the cost to the participants (level of margins), hence better addressing procyclicality concerns in a period of high margin levels. For clarity, this meant that under the Buffered Floor, rather than adding a one-size-fits-all 15% buffer over the current margin levels, margins could not fall below a certain value in the near future.

Although useful, these remediation actions were nevertheless considered temporary solutions. CDCC remained limited in its actions given the scope of the provisions of its Risk Manual and the restrictions of the various "rule change" or "significant change" protocols it is subject to. Therefore, CDCC is of the view that a permanent and general solution like a risk model recalibration process should be implemented.

b.   Objectives

With the latitude provided by the Risk Model Recalibration process, a change in the key risk parameters would be completed in a timely manner without requiring any formal "rule change" or "significant

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[1] https://www.cdcc.ca/u_avis_en/046-20_en.pdf
[2] https://www.cdcc.ca/u_avis_en/088-20_en.pdf
[3] https://www.cdcc.ca/u_avis_en/113-20_en.pdf

change" process. In certain circumstances, such latitude will allow CDCC to better protect the integrity of its market and the activities of the Clearing Members.

For example, following the COVID-19 outbreak, CDCC was able to quickly identify a potential issue in one of the key risk parameters of the IM model: the floor of the volatility estimator. The level of this floor is calculated using an average of the daily EWMA volatility estimators observed over the last ten years. At the time of entering the COVID-19 period, the 2008 financial crisis had just exited the fixed 10-year reference period, leading to a potential underestimation of the floor level, in particular for equity derivatives. CDCC was able to quickly assess and measure the impact of increasing the look-back period to 15 years as a means of ensuring the inclusion of a period of stress in the floor parameter. However, given the process to which a change of Risk Manual provisions would be subject to, it was not possible to implement such a change. If CDCC had benefited from the flexibility provided by the Risk Model Recalibration process, CDCC would have been able to propose a "targeted" permanent solution better addressing procyclicality concerns, rather than the temporary solutions it had to turn to.

Please find in the table below a list of key risk parameter calibrations that will be removed from the Risk Manual and their <u>hypothetical</u> recalibrations for specific groups or subgroups of products:

Key Risk Parameter	Product Group	Actual Calibration	Hypothetical Recalibration
Parametric distribution	Index Futures	Normal	*Student-t*
Confidence level	Real Return Bonds	99.62%	*99.87%*
Confidence level	Options	99.87%	*99.92%*
Lambda	STIR Futures	99%	*98%*
Look-back period - EWMA	Bond Futures	260 days	*520 days*
Look-back period - Floor	Futures	10 years	*15 years*
Look-back period - Historical Filtered Scenarios	Fixed Income	5 years	*10 years*
Floor - Statistical treatment	Options	Average	*Median*
Margin Buffer Multiplier - Rounding	Canada Bonds	0.25	*0.1*
Minimum Scaling Factor	Real Return Bonds	0	*0.8*
MPOR	Options	2	*5*

For greater certainty, the description of the key risk parameters as used in CDCC's risk models (left column of the table above) will remain in the provisions of the Risk Manual. What will be removed from the Risk Manual are the references to specific "calibrations/recalibrations". Such deletion will allow CDCC to be more reactive (subject to the proposed governance process) in the event the market is subject to the volatility CDCC has seen during the period beginning in March 2020 to July 2020.

c.   **Comparative Analysis**

It must be recognized that CDCC is very transparent with the Clearing Members and the public regarding its risk models because it explicitly and publicly discloses certain parameter values used, for example, in its margin determination process in the Risk Manual. A comparative analysis of publicly available information from different clearing houses such as CME Clearing, ICE Clear US, LCH SA, ASX Clear (Futures) and Eurex Clearing was performed by CDCC and resulted in interesting conclusions. These clearing houses only describe their margin process at a very general level in PFMI Disclosure documents as well as other publicly available documents. Moreover, CDCC was not able to identify direct references of their risk models in their respective rules.

For example, CME Clearing[4] and LCH SA[5],[6] only mention that the margin method used is a SPAN and/or a VaR method, specifying some general information for each market (e.g. the confidence interval, the minimum look-back period, the holding period and the frequency of parameter review). In their respective rules, neither CME Clearing[7] nor LCH SA[8],[9] deals directly with models at the formula level like CDCC does today.

However, it should be noted that in the case of a material change of model, both CME Clearing and LCH SA have indicated that additional procedures are required. For CME Clearing: "*material changes to any of CME Clearing's margin methodologies are further documented and disclosed through clearing advisories and public rule filings published on the CME Group website*". For LCH SA: *"Material changes to margin methodology are subject to LCH SA's internal risk governance process, which includes both internal review and independent validation of the model, and must receive approval from both the Executive Risk Committee and the LCH SA Board. The model validation report and recommendations, for each LCH SA clearing service, are notified to internal risk governance, the Internal Audit department and to relevant Regulators."*

Based on the foregoing, CDCC would like to align the content of its Risk Manual to the scope of public information made available by other comparable clearing houses. Moreover, like it is the case with CME Clearing and LCH SA, CDCC will subject any change to the methodology or structure of a risk model and formula described in the Risk Manual to the standard "rule change" or "significant change" process.

d.   Analysis of Impacts

 i. Impacts on Market

The proposed amendments to CDCC's Risk Manual will have no immediate impact on CDCC's Initial Margin Requirements.   However, the proposed changes will provide CDCC with more flexibility and suitable responsiveness in adapting its Base Initial Margin models upon the occurrence of a "Risk Model Recalibration Event", taking into account important factors such as cost, risk and procyclicality of margins. All recalibrations made will be notified to CDCC's stakeholders, along with any relevant information such as the impact analysis of the recalibration adjustment.

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[4] https://www.cmegroup.com/clearing/risk-management/files/cme-clearing-principles-for-financial-market-infrastructures-disclosure.pdf

[5] https://www.lch.com/risk-management/risk-management-sa

[6] https://www.lch.com/system/files/media_root/CPMI-IOSCO%20Self%20Assessment%20of%20LCH%20SA%202019_Q2_2020.pdf

[7] https://www.cmegroup.com/content/dam/cmegroup/rulebook/CME/I/8/8.pdf

[8] https://www.lch.com/system/files/media_root/IV.2-2%20VA%202013-12-12.pdf

[9] https://www.lch.com/system/files/media_root/V.4-1%20VA%202019-12-27.pdf

ii. Impacts on Technology

The proposed amendments to CDCC's Risk Manual will have no impact on CDCC's technological systems (SOLA, Risk System, end-user-computing-system). CDCC is of the view that a risk model recalibration will have to be done within the existing technological systems. This implies that the system will have been tested beforehand to take into account any Risk Model Recalibration and that it will be ready to accept any change of parameters in the production environment. Subject to any provisions of CDCC's Rules and Manuals to the contrary, if the risk model recalibration requires any material modification to the existing technological systems, the recalibration will most likely be considered as requiring a "rule change" or a "significant change" process.

iii. Impacts on trading functions

The proposed amendments to CDCC's Risk Manual will have no impact on the Bourse of Montréal trading systems or rules.

iv. Public Interest

CDCC is of the view that the proposed amendments are not contrary to the public interest. With the latitude provided by the Risk Model Recalibration process, a change in the key risk parameters would be completed in a timely manner without requiring any formal "rule change" or "significant change" process. Such latitude will allow CDCC to better protect the integrity of its market and the activities of the Clearing Members which, in CDCC's view, in the best interest of the Clearing Members and the public.

IV.   PROCESS

The proposed amendments, including this analysis, must be approved by CDCC's board of directors and submitted to the Autorité des marchés financiers, in accordance with the regulatory self-certification process, and to the Ontario Securities Commission in accordance with the rules stated in Appendix "A" of Schedule "C" of CDCC Recognition Order dated April 8, 2014 (as amended from time to time). The proposed amendments and analysis will also be submitted to the Bank of Canada in accordance with the Regulatory Oversight Agreement.

V.   ATTACHED DOCUMENTS

- Appendix 1: Amended Risk Manual

APPENDIX 1: AMENDED RISK MANUAL
<u>**AMENDED VERSION**</u>

RISK MANUAL

~~JUNE 12~~, 2020

Glossary

Unless otherwise defined in this Risk Manual, capitalized terms shall have the meanings given to them in the Rules.

Adjusted Base Initial Margin: With respect to Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio. The Effective Ratio is recalibrated on a regular basis as provided in this Manual.

Additional Margin(s): Additional Margins are added to the Base Initial Margin (or Adjusted Base Initial Margin, where applicable) to form part of the Initial Margin in accordance with the methodology set out in this Manual. The Additional Margins include the following: (1) Additional Margin for Market Liquidity Risk, (2) Additional Margin for Specific Wrong-Way Risk, (3) Additional Margin for Mismatched Settlement Risk, (4) Additional Margin for Intra-Day Variation Margin Risk, (5) Additional Margin for Unpaid Option Premium Exposure Risk, (6) Additional Margin for Banking Holiday Risk, (7) Additional Margin for Variation Margin Delivery Risk, (8) Additional Margin for Capital Risk, (9) Additional Margin for Uncovered Risk of Limited Clearing Members and (10) any other additional Margins as set out in the Rules (other than required pursuant to Rule D-607). When used in the singular form, Additional Margin shall refer to one of the Additional Margins described above, whenever the context so requires.

Additional Margin for Banking Holiday Risk: The Additional Margin for Banking Holiday Risk covers the risk of uncovered exposures arising from new trades during the Banking Holiday and the additional market risk that the Corporation could face during the Banking Holiday.

Additional Margin for Capital Risk: This Margin requirement covers the credit risk of the Clearing Members that arises if the exposure of a Clearing Member to the Corporation is greater than the Clearing Member's capital level.

Additional Margin for Intra-day Variation Margin Risk: This Margin requirement covers the intra-day risk arising in circumstances in which market volatility or surges in trading volumes produce unusually large Variation Margin exposures.

Additional Margin for Market Liquidity Risk: This Margin requirement covers the liquidity risk arising when the Corporation has to close-out positions at a price different than the market price. This liquidity risk could be divided into two components: the first one is the inherent market liquidity risk which is mainly associated to the bid-ask spread, and the second one is the additional liquidity risk due to concentrated positions that cannot be liquidated within the bid-ask spread.

Additional Margin for Mismatched Settlement Risk: This Margin requirement covers the risk arising from a lag between the settlement of positions which otherwise results in a margin offset.

Additional Margin for Specific Wrong-Way Risk: This Margin requirement covers the risk that arises when the exposure of a Clearing Member in its own products is adversely correlated with the creditworthiness of that Clearing Member.

Additional Margin for Uncovered Risk of Limited Clearing Members: This Margin requirement covers the risk exposure that arises if the total value of the risk represented by a Limited Clearing Member to the Corporation is greater than the aggregate amount of the Limited Clearing Member's Adjusted Base Initial Margin and the total value of the Clearing Fund.

The risk represented by the Limited Clearing Member is determined by the Corporation by calculating the estimated loss that the Corporation would face in extreme but plausible market conditions. This Additional Margin is calculated on a daily basis and is required from Limited Clearing Members only.

Additional Margin for Unpaid Option Premium Exposure Risk: The Additional Margin for Unpaid Option Premium Exposure Risk covers the risk incurred by the Corporation in guaranteeing to each Clearing Member the settlement of the Net Daily Premium on a daily basis.

Additional Margin for Variation Margin Delivery Risk: The Additional Margin for Variation Margin Delivery Risk covers the risk incurred by the Corporation in guaranteeing to each Clearing Member having pledged specific securities to cover its Net Variation Margin Requirement, the return of such specific securities, in the event that another Clearing Member to which the specific securities were initially delivered fails to return such specific securities and becomes Non-Conforming or is Suspended. In this case, the Corporation will have to buy the specific securities in the market to return to the Clearing Member that had initially pledged the specific securities.

Banking Holiday: Remembrance Day, in Canada, or any day determined as Remembrance Day by the Corporation through its Holiday Schedule published on a yearly basis.

Base Initial Margin: The Base Initial Margin requirement covers the potential losses that may occur over the next liquidation period as a result of market fluctuations. The Base Initial Margin does not include any Additional Margins.

Boundaries: With respect to the Effective Ratio, the Boundaries refer for a specific period to the upper limit (UB) and lower limit (LB) which are respectively the highest and lowest Daily Ratios during such period.

Clearing Fund Requirement: The Clearing Fund Requirement constitutes the required contribution to the Clearing Fund for each Clearing Member (excluding Limited Clearing Members).

Combined Commodity: Group of positions that are associated with the same Underlying Interest or product or both. Combined Commodity is the lowest level at which the Base Initial Margin for Options, Futures and Unsettled Items is computed.

Daily Ratio: The Daily Ratio is determined, for any Business Day, by dividing the total amount of Clearing Fund Requirement on that Business Day by the aggregate amount of the Base Initial Margin requirement of all Clearing Members (other than Limited Clearing Members) on the same Business Day.

Effective Ratio: Ratio established by the Corporation, in accordance with the governance standards set forth in this Manual, which reflects the multiplier applicable to the Base Initial Margin for Limited Clearing Members.

Expected Shortfall: Average of all losses which are greater than or equal to the worst case. The worst case represents the $(1-\alpha)\%$ case, where α is the confidence level.

Haircut: Percentage discounted from the market value of eligible collateral pledged for Margin Deposit. The discount reflects the price movement volatility of the collateral pledged.

Historical Filtered Scenarios: Set of scenarios resulting of a weight applied to the Historical P&L Scenarios to reflect the current volatility. The current volatility is estimated by applying a volatility scaling adjustment using the exponentially weighted moving average (EWMA).

Historical P&L Distribution: Ranking of the Historical P&L Scenarios from the largest loss to the largest profit.

Historical P&L Scenarios: Set of scenarios for a Fixed Income Transaction representing the hypothetical gains and losses derived from Historical Filtered Scenarios. The gains and losses are created by calculating the difference between the price the Fixed Income Transaction under an Historical Filtered Scenario and the initial reference price.

Historical Scenarios: Set of scenarios for a Risk Factor and representing an hypothetical market observation movement reasonably likely to occur, from the current situation to a specific point in time in the future.

Initial Margin: The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins.

Inter-Commodity: Portfolio containing offsetting positions in highly correlated instruments are subject to credits which reduce the overall Base Initial Margin for Options, Futures and Unsettled Items.

Intra-Commodity: Portfolio containing offsetting positions in different maturity month in the same Combined Commodity are subject to a charge since they may not be perfectly correlated.

Margin Buffer Multiplier: Multiplier to the Base Initial Margin for Fixed Income Transaction to prevent and control potential procyclical effects.

Margin Interval (MI): Parameter established by the Corporation which reflects the maximum price fluctuation that the Underlying Interest could be expected to have during the MPOR. The MI is used to calculate the Base Initial Margin for Options, Futures and Unsettled Items.

Margin Period of Risk (MPOR): The period required by the Corporation to close-out non-concentrated positions in a particular contract (or either through liquidation, auction or by hedging or neutralizing the market risk.

Price Scan Range (PSR): The maximum price movement reasonably likely to occur, during a specified timeframe.

Risk Array: A Risk Array is a set of scenarios defined for a particular contract and representing the hypothetical gain/loss under a specific set of market conditions from the current situation to a specific point in time in the future.

Risk Factor: Factor influencing the value of a Derivative Instrument or OTCI.

Risk Engine: The system used by the Corporation for risk management, risk measurement and calculation of Initial Margin and Clearing Fund Requirement.

Risk Model Recalibration Event: A change in key risk parameters resulting from (i) an external event (domestic or international financial, political or economic events or conditions) or (ii) an internal assessment performed by CDCC through the backtesting and sensitivity analysis concluding to the necessity of recalibrating and improving the performance of the risk models.

Rules: means the Rules of the Corporation, including the Operations Manual and this Manual, as any such rules and manuals may from time to time be amended, changed, supplemented or replaced in whole or in part.

Scanning Risk: The difference between the initial reference price of an Underlying Interest and its most unfavourable projected liquidation value obtained by shocking the values of the Underlying Interest according to several scenarios representing adverse changes in normal market conditions.

Short Option Minimum: Amount included in the Base Initial Margin to cover the risk exposure arising from deep out-of-the-money short option positions. This amount is required if this amount is higher than the result of the Risk Arrays.

Variation Margin: The Variation Margin covers the risk due to the change in price of a Derivative Instrument or of an OTCI or a change in the Floating Price Rate, in each case since the previous evaluation in accordance with the Rules.

VaR Risk Group(s): Group of Fixed Income Transactions that are associated to similar Risk Factors. VaR Risk Group is the lowest level at which the Base Initial Margin for Fixed Income Transactions is computed.

Volatility Scan Range (VSR): The maximum implied volatility movement reasonably likely to occur, during a specified timeframe.

Volatility Shock(s): Parameter established by the Corporation which reflects the maximum daily volatility fluctuation of the Option contract. The Volatility Shock is used to calculate the Base Initial Margin for Options.

Zero Curve: Specific type of yield curve that associates interest rates on zero coupon bonds to different maturities (tenors). Tenors represent the Risk Factors inputs to evaluate the price of a Fixed Income Transaction using a full revaluation method.

Section 1: Margin Deposits

As set out in the Rules, every Clearing Member shall be obligated to deposit Margin with the Corporation, as determined by the Corporation. Deposits must be made in the form of eligible collateral, as specified in Section 2 of this Risk Manual, in an amount sufficient, taking into account the market value and applicable Haircuts.

The Corporation requires Margin Deposits to cover two types of requirements, namely:

- Margin requirement; and
- Clearing Fund Requirement.

1.1 MARGIN REQUIREMENT

The Margin requirement is composed of the Initial Margin and the Variation Margin.

1.1.1 Initial Margin

The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins. In order to cover the Initial Margin described below, Clearing Members shall deliver to CDCC an acceptable form of Deposits in accordance with Section 2 of this Risk Manual.

1.1.1.1 Base Initial Margin

The Base Initial Margin requirement covers the potential losses and market risk that may occur as a result of future adverse price and/or Risk Factors across the portfolio of each Clearing Member under normal market conditions.

The risk methodology for the Options, Futures and Unsettled Items incorporates the historical volatility of the daily price returns of the Underlying Interests for Options, Unsettled Items and Share Futures and the daily price returns of the Futures prices for Futures (excluding Share Futures). In addition, as part of the methodology, the Corporation uses a volatility estimator, a confidence level over 99% under the normal distribution or the student's t-distribution assumption and a variable number of days as the MPOR.

The risk methodology for Fixed Income Transactions is the Value at Risk methodology (VaR)[1]. This methodology considers a full revaluation method and it is based on Zero Curves. In addition, as part of the methodology, the Corporation uses a volatility estimator, a Margin Buffer Multiplier to prevent a large decrease in Margin requirements during periods of low volatility, a confidence level over 99% and a variable number of days as the MPOR.

Please refer to Sections 6.1 and 6.2 for additional details on the Base Initial Margin calculation. Please refer to Section 6.3 for additional details on Risk Model Recalibration.

With respect to the Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio to calculate the Adjusted Base Initial Margin. Please refer to Section 6.46.3 for additional details on Effective Ratio Recalibration.

1.1.1.2 Additional Margins

In addition to the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be), the Corporation requires Margin Deposits for the following Additional Margins:

(1) Additional Margin for Market Liquidity Risk

(2) Additional Margin for Specific Wrong-Way Risk

(3) Additional Margin for Mismatched Settlement Risk

(4) Additional Margin for Intra-day Variation Margin Risk

(5) Additional Margin for Unpaid Option Premium Exposure Risk

(6) Additional Margin for Banking Holiday Risk

(7) Additional Margin for Variation Margin Delivery Risk

(8) Additional Capital Margin Risk

(9) Additional Margin for Uncovered Risk of Limited Clearing Members

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[1] The same methodology used for Fixed Income Transactions is applied for physical delivery of Government of Canada Bond Futures.

(10) Any other additional Margins

[...]

1.1.2 Variation Margin

The Variation Margin requirement covers the risk due to the change in price of a Derivative Instrument or an OTCI or a change in the Floating Price Rate since the previous evaluation in accordance with the Rules. The following table evidences the type of Variation Margin coverage that will be required by CDCC for each type of products:

Products	Variation Margin coverage type
Options	Collateralized
Futures	Cash settled
Fixed Income Transactions	Collateralized (subject to Variation Margin process)
Unsettled Items	Collateralized

1.1.2.1 Options

For Options, the Variation Margin is collateralized every Business Day and at each Intra-Day Margin Call based on the Option Price reported by the Exchange, or the last OTCI Option Price for OTCI Securities Options[2], as the case may be, and, in the event of the unavailability or inaccuracy of such price, the Corporation shall set such price in accordance with the best information available as to the correct price.

1.1.2.2 Futures

For Futures, the Variation Margin is cash settled every Business Day based on the last Settlement Price reported by the Exchange, and, in the event of the unavailability or inaccuracy of such price, the Corporation shall set the last Settlement Price in accordance with the best information available as to the correct price.

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[2] Please refer to Section 6.54 for additional details on the theoretical price calculation of OTCI Securities Options.

1.1.2.3 Fixed Income Transactions

The Variation Margin Requirement[3] in respect of each Fixed Income Transaction is calculated on a daily basis and represents the sum of the Price Valuation Requirement and the Repo Rate Requirement, each as defined in Section D-601 of the Rules.

PRICE VALUATION REQUIREMENT

The Price Valuation Requirement represents, in respect of a Repurchase Transaction, an amount which is the aggregate amount calculated in respect of the difference between (i) the Market Value of the Purchased Security and (ii) the Repurchase Price of the Repurchase Transaction, plus any Coupon Income payable to the holder between the calculation date and the Repurchase Date, and, in respect of a Cash Buy or Sell Trade, an amount which is the difference between (i) the Market Value of the Purchased Security and (ii) the Purchase Price of the Cash Buy or Sell Trade; which amount is owed to the Corporation by a Fixed Income Clearing Member that is a party to such Repurchase Transaction or Cash Buy or Sell Trade or by the Corporation to such Fixed Income Clearing Member.

REPO RATE REQUIREMENT

The Repo Rate Requirement represents a change in the current Floating Price Rate and means, in respect of a Repurchase Transaction, an amount which is calculated in respect of the difference between the Floating Price Rate and the Repo Rate; which amount is owed to the Corporation <u>by a Fixed Income Clearing Member that is a party to such Repurchase Transaction or by the Corporation to</u> such Fixed Income Clearing Member.

1.1.2.4 Unsettled Items

The Variation Margin for Unsettled Items with respect to both Options and Futures is collateralized. With respect to

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[3] The Variation Margin Requirement for Fixed Income Transactions is not applied for physical delivery of Government of Canada Bond Futures. The applicable Variation Margin Requirement for Fixed Income Transactions is rounded up to the nearest $1 of nominal value.

Variation Margin for Unsettled Items related to Options, the Corporation calculates a Variation Margin requirement equal to the intrinsic value of the Option multiplied by the position and the contract size. With respect to Variation Margin for Unsettled Items related to Futures, the Corporation calculates a Variation Margin requirement equal to the difference between the last Settlement Price of the Futures and the price of the Underlying Interest related to the Futures, multiplied by the position and the contract size.

1.1.3 Account Structure, Netting and Risk Aggregation

1.1.3.1 Short Positions, Account Types and Positions Netting

Clearing Members shall not be required to deposit Margin in respect of Short Positions in Futures or Options for which they have deposited the Underlying Interest in accordance with Section A-706 of the Rules.

The Corporation uses three types of accounts for Margin calculation purposes and positions management: Firm Account, Multi-Purpose Account and Client Account.

- For all account types, the Margin requirement for Futures positions and Fixed Income Transactions is calculated on a net basis.

- The Margin requirement for Options is calculated on a net basis for the Firm Account and the Multi-Purpose Account, but on a gross basis for the Client Account, which means that only short Options are considered when computing the Initial Margin.

1.1.3.2 Margin Aggregation

The total Margin requirement of each Clearing Member is composed of the Initial Margin requirement and the Variation Margin requirement.

The calculation is made at the account level and then aggregated at the Clearing Member level. However, operationally the Margin requirement is subject to the

following aggregation, subject to the applicable type of products being cleared by the Clearing Member:

INITIAL MARGIN REQUIREMENT (including the Variation Margin for Options and Unsettled Items)

The Initial Margin requirement for all products is aggregated with the Variation Margin for Options and Unsettled Items as follows:

a) The Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) is calculated at the account level. For Options, Futures and Unsettled Items, the margin results are calculated at the Combined Commodity level and the Base Initial Margin corresponds to the sum of all Combined Commodities. For Fixed Income Transactions, the Base Initial Margin represents the sum of all VaR Risk Groups. The Base Initial Margin at the account level corresponds to the sum of the Base Initial Margin for Options, Futures and Unsettled Items and the Base Initial Margin for Fixed Income Transactions.

b) The Variation Margin for Options and Unsettled Items is calculated at the account level and then added to the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be).

- If the Variation Margin for Options and Unsettled Items is negative, this will result in a margin credit[4] decreasing the aggregate value of the Base Initial Margin for Options and Unsettled Items.

- If the Variation Margin for Options and Unsettled Items is positive, this will result in a margin debit increasing the aggregate value of the Base Initial Margin for Options and Unsettled Items.

c) The Margin requirement in respect of each Clearing Member is calculated by aggregating for all accounts the value of (1) the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Variation

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4   For a given account, the margin credit is capped to the Base Initial Margin for Options, Futures and Unsettled Items.

Margin for Options and Unsettled Items and (2) the following Additional Margins calculated at the Clearing Member level: Additional Margin for Market Liquidity Risk, Additional Margin for Specific Wrong-Way Risk, Additional Margin for Mismatched Settlement Risk, Additional Margin for Intra-Day Variation Margin Risk, Additional Margin for Unpaid Option Premium Exposure Risk, Additional Margin for Banking Holiday Risk, Additional Margin for Variation Margin Delivery Risk, Additional Capital Margin Risk, Additional Margin for Uncovered Risk of Limited Clearing Members and any other Additional Margins as set out in the Rules (other than required pursuant to Rule D-607).

VARIATION MARGIN FOR FUTURES

The Variation Margin for Futures (the net value of Gains and Losses) is aggregated at the Clearing Member level.

VARIATION MARGIN FOR FIXED INCOME TRANSACTIONS

The Variation Margin Requirement for Fixed Income Transactions is aggregated at the Clearing Member level.

[...]

Section 2: Eligible Collateral

[...]

2.6.1 Haircuts for Government Securities

The Corporation calculates the Haircuts based on any of the following criteria:

- Valuation of the market, credit, liquidity and foreign exchange risks based on historical daily returns;

- The volatility estimator uses the exponentially weighted moving average ("EWMA") approach as defined in Appendix 6.65, and the assumption that the bond can be liquidated at a reasonable price in "n" days. ("n" is determined according to the type of products and prevailing market conditions). In addition, a floor for the EWMA volatility estimator is calculated as the 25th percentile of a daily EWMA volatility estimator observed over the last 10 years;

- Liquidity risk valued according to the bid-ask spread of the issues using the same EWMA volatility estimator and the floor (if this spread is unavailable, the liquidation window will be expanded and will depend on market conditions);

- Bonds of the same issuer and comparable maturities.

Once the quantitative analysis is performed, CDCC reserves the right to increase the Haircuts based on qualitative criteria, such as:

- Comparative analysis of CDCC's Haircuts in relation to the Haircuts of the Bank of Canada;

- Comparative analysis of CDCC's Haircuts in relation to the Haircuts of other clearing houses;

- The congruence of the different Haircuts to the credit rating spreads of the different issuers; and

- Any other factor considered relevant by CDCC, acting reasonably.

[...]

Section 3: Monitoring Program

[...]

Section 4: Contract Adjustment

[...]

Section 5: Acceptability of Underlying Interests

[...]

Section 6: Appendix

6.1 BASE INITIAL MARGIN CALCULATION FOR OPTIONS, FUTURES AND UNSETTLED ITEMS[5]

For greater certainty, this sections only applies to Options, Futures and Unsettled Items.

To calculate the Base Initial Margin the risk methodology is based on the PSR and the VSR which are then converted into the Scanning Risk parameter. The Scanning Risk parameter represents the difference between the most unfavourable projected liquidation value and the initial reference price[6]. The most unfavourable projected liquidation value amongst the Risk Array is obtained by varying the values of the Underlying Interest and implied volatility according to several scenarios representing adverse changes in normal market conditions. The projected liquidation values are obtained using specific valuation models such as Black 76, Black-Scholes, Binomial and others.

The Scanning Risk is calculated at the Combined Commodity level and is denominated in the same currency as the contract. For contracts belonging to the same Combined Commodity, the Risk Array results are added up for all contracts under the same scenario. The highest loss represents the Scanning Risk.

The other variables influencing the value of the Base Initial Margin are the Intra-Commodity, the Inter-Commodity and the Short Option Minimum. The following table summarizes the variables used in the calculation.

Input variables to calculate the Base Initial Margin	Options	Futures	Unsettled Items
Scanning Risk	●	●	●
Intra-Commodity		●	

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[5] Unsettled Items resulting of a physical delivery of Government of Canada Bond Futures are margined under the VaR methodology.

[6] The initial reference price is the market price or the theoretical price derived from market observations.

Inter-Commodity[7]		●	
Short Option Minimum	●		

6.1.1 Scanning Risk

The Scanning Risk parameter represents the difference between the most unfavourable projected liquidation value and the initial reference price. The most unfavourable projected liquidation value amongst the Risk Array is obtained by varying the values of the Underlying Interest and implied volatility according to several scenarios representing adverse changes in normal market conditions. The table at the end of this section shows all the risk scenarios. The projected liquidation values are obtained using specific valuation models such as Black 76, Black-Scholes, Binomial and others. If the largest loss is negative, the Scanning Risk is set to zero. The Scanning Risk is then compared to the Short Option Minimum. This amount is required if the Short Option Minimum is higher than the result of the Risk Arrays.

6.1.1.1 Price Scan Range

The term PSR represents the potential variation of the contract value and it is calculated through the following formula:

$$PSR = \ Price \ \times MI \ \times Contract \ Size$$

The methodology for the MI is detailed in Section 6.65.

6.1.1.2 Volatility Scan Range

The term VSR represents the potential variation of the implied volatility and it is calculated through the following formula:

$$VSR = \ Volatility \ Shock \ \times \sqrt{n}$$

Where 'n' is the MPOR, and 'Volatility Shock' ~~represents~~is calculated using the ~~95% confidence level of the~~distribution of historical daily fluctuations for the series volatility over ~~a~~

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[7] Not applicable for Share Futures.

one year look-backthe reference period. The daily fluctuations are scaled up with the use of MPOR. VSR values are subject to a floor value and a cap value.

Risk Scenarios	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Underlying Price Variation *	0	0	1/3	1/3	-1/3	-1/3	2/3	2/3	-2/3	-2/3	1	1	-1	-1	2	-2
Volatility Variation *	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	0	0
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	35%	35%

* Expressed in scan range

The MI, MPOR and Volatility Shocks and Short Option Minimum values are updated by the Corporation from time to time.

6.1.2 Intra-Commodity

Long positions on Futures maturing in one month are automatically matched with short positions on Futures maturing in another month. The resulting Base Initial Margin on these two Futures belonging to the same Combined Commodity, could be lower than the real risk associated with the combination of the two contracts. In order to cover this inter-month spread risk, a charge is included in the Base Initial Margin.

For Depending on the term structure of the Futures, contracts, CDCC either calculates the Intra-Commodity which is an additional dollar amount charge applied to each combinationfor combinations of two or three different Futures (spread or butterfly strategies, respectively), or evaluates a single Intra-Commodity charge to cover for rolling contracts. The final Intra-Commodity charge is applied at the strategy level, close-maturity group level or Combined Commodity level. The combinations and the spread priorities for the Intra-Commodity are updated by CDCC from time to time.

,For spread and butterfly strategies, the Intra-Commodity is determined as follows:

$$Intra-Commodity = \ \alpha \times \sqrt{n} \times \sigma$$

Where 'n' is the number of MPOR, ~~'~~$'\alpha'$ is equal to ~~the~~a confidence value equivalent to a minimum of 99~~.87% (three standard deviations)~~% of the cumulative normal distribution ~~(applicable to all products except for the Three-Month Canadian Bankers' Acceptance Futures (BAX) and CORRA Futures (COA & CRA)) or equal to the confidence value equivalent to 99% of the cumulative~~or an equivalence using the cumulative student's t-distribution ~~with 4 degrees of freedom (applicable to the BAX and CORRA Futures).~~. 'σ' is the volatility estimator of the Futures combination's daily profit and loss over the reference period and is computed using the EWMA approach. Further details on the EWMA are described in Appendix 6.6~~5~~.

In addition, CDCC considers a floor for the EWMA volatility estimator. The level of such floor is calculated ~~as an average~~using the distribution of daily EWMA volatility ~~estimator~~estimators observed over ~~the last~~a minimum of 10 years. The EWMA volatility estimator that will be used to calculate the Intra-Commodity cannot be lower than the calculated floor.

~~With respect to the BAX and CORRA Futures (COA & CRA), CDCC calculates the Intra-Commodity for all combinations of spreads and butterfly strategies and applies a same charge for a same group of combinations with close maturities. If multiple Intra-Commodity are defined, the Corporation will prioritize the ones providing the lowest Base Initial Margin.~~

~~The combinations and the spread priorities for the Intra-Commodity are updated by CDCC from time to time.~~

6.1.3 Inter-Commodity

The Corporation may consider the correlation that exists between different Futures when calculating the Base Initial Margin. The Corporation will grant a credit according to the historical correlation of the returns of the two Futures. If multiple Inter-Commodity are defined, the Corporation will prioritize the ones with the highest correlation.

The Inter-Commodity and the spread priorities are updated by CDCC from time to time.

6.2 BASE INITIAL MARGIN CALCULATION FOR FIXED INCOME TRANSACTIONS

For greater certainty, this section only applies to Fixed Income Transactions.

To calculate the Base Initial Margin, the VaR methodology is based on Historical Scenarios for all relevant Risk Factors. The Historical Scenarios consist of a set of scenarios for a Risk Factor over a relevant historical period that represents an hypothetical market observation movement (shocked market observation based on market history) reasonably likely to occur, from the current situation to a specific point in time in the future.

For Fixed Income Transactions, the Risk Factors are the Zero Curves. On any given Business Day, the shocks derived from the Historical Scenarios are applied to the initial reference market inputs values. The difference between the initial reference price and the shocked historical price represents an Historical P&L Scenario. The initial reference price and historical shocked price are derived respectively from the initial reference Zero Curves and the shocked Zeros Curve using a full revaluation method.

The Historical P&L Scenarios are calculated at the VaR Risk Group level and are denominated in the same currency as the Fixed Income Transactions. For Fixed Income Transactions belonging to the same VaR Risk Group, the Historical P&L Scenarios results are added up for Fixed Income Transactions.

Lastly, the Historical P&L Scenarios are ranked to derive the Historical P&L Distribution that is used to calculate the average loss of the portfolio using the Expected Shortfall method. A Margin Buffer Multiplier is then applied to the Expected Shortfall value to obtain the Base Initial Margin.

The main steps to calculate the Base Initial Margin are described in the section below.

6.2.1 Historical Filtered Scenarios

The Historical Filtered Scenarios are generated using the initial reference Risk Factors value and historical observations of different tenors on the Zero Curves.

The shocked Risk Factors are calculated using the following formula:

$$y'_{t,\tau} = y_{T,\tau}(1 + R_{t,\tau}c_{t,\tau})$$

Where c is the scaling factor for the volatility scaling adjustment and R is the daily relative market return over the ~~Margin Period of Risk~~MPOR 'n'. CDCC uses a look-back period of ~~5 years~~a minimum of 1 year.

The scaling factor formula at time t and for a given tenors is calculated using the following formula:

$$c_{t,\tau} = Max\left(\frac{\sigma_{T,\tau} + \sigma_{t,\tau}}{2\,\sigma_{t,\tau}}, Min\,SF\right)$$

Where σ is the EWMA volatility forecast and Min SF is the minimal scaling factor.

The implemented formula for the EWMA volatility forecast is:

$$\sigma_{t,\tau}^2 = (1 - \lambda)R_{t-1,\tau}^2 + \lambda\sigma_{t-1,\tau}^2\ ,$$

Where R is the relative market return over the ~~Margin Period of Risk~~MPOR 'n' and λ is the decay factor. ~~CDCC uses $\lambda = 0.99$. The Min SF is updated by CDCC from time to time.~~

6.2.2 Historical P&L Scenario generation

The Historical P&L Scenarios are valued by calculating the difference between the shocked prices of Fixed Income Transactions under an Historical Filtered Scenario and the initial reference prices. The Historical P&L Scenarios results are added up for all Fixed Income Transactions within a VaR Risk Group.

The initial reference prices are calculated using a full revaluation method and the initial reference Risk Factors. The shocked prices are calculated using a full revaluation method and the shocked Risk Factors.

6.2.3 Expected Shortfall

For each VaR Risk Group, the Historical P&L is sorted from largest loss to largest profit to construct the Historical P&L Distribution. Using a confidence value equivalent to a minimum of 99.~~62~~% and the Historical P&L Distribution, the Expected Shortfall is determined by averaging the losses exceeding the confidence value.

6.2.4 Margin Buffer Multiplier

The Base Initial Margin for each VaR Risk Group is obtained by applying a Margin Buffer Multiplier to the Expected Shortfall value.

The Margin Buffer Multiplier is based on the ratio of the ~~average 10 years~~ volatility distribution over a minimum of 10 years and the ~~previous month~~ volatility~~.~~ over a short period of time. CDCC will change the Margin Buffer Multiplier level if it is deemed stable ~~for at least 3 consecutive months.~~over the reference period. The ratio is then rounded and subject to ~~the nearest 0.25. A~~a floor ~~of 1~~and a cap value ~~of 1.5 are applied~~.

The Margin Buffer Multiplier is updated by CDCC from time to time.

6.3 RISK MODEL RECALIBRATION

The Base Initial Margin requirement of each Clearing Member is subject to, when applicable, a Risk Model Recalibration. The recalibration will apply to the risk parameters pertaining to the Base Initial Margin Calculation methodologies.

Objective and Trigger: The Risk Model Recalibration ensures that, following the occurrence of a Risk Model Recalibration Event, CDCC will determine the nature of the recalibration to be made to the risk parameters for the Base Initial Margin calculation for Options, Futures, Unsettled Item and Fixed Income Transactions described within the Rules.

6.3.1 Risk Model Recalibration Governance

- **Upon the occurrence of a Risk Model Recalibration Event**, and following the determination by CDCC of the nature of the recalibration to be made to the risk parameters, CDCC will promptly report to the Risk Management Advisory Committee (RMAC) the expected impacts of the recalibration on the Clearing Members.

6.3.2 Entry in force

- Clearing Members will be notified in writing of the recalibration of the risk parameters, along with any relevant information including the impact analysis of the recalibration adjustment.

- Risk model recalibrations shall become effective five (5) Business Days following the publication by CDCC of notice to that effect on its Web site.

6.36.4 RECALIBRATION OF THE EFFECTIVE RATIO

[…]

6.46.5 OTCI SECURITIES OPTIONS

[…]

6.56.6 MARGIN INTERVAL

The MI is calculated using the following formula:

$$MI = \alpha \times \sqrt{n} \times \sigma$$

Where 'n' is the MPOR, $'\alpha'$ is equal to the confidence level equivalent to 99.87% (three standard deviations) of the cumulative normal distribution (applicable to all products except for the BAX, the S&P/MX International Cannabis Index Futures and CORRA Futures) or equal to the confidence value equivalent to 99% of the cumulative student's t-distribution with 4 degrees of freedom (applicable to the BAX, the S&P/MX International Cannabis Index Futures and CORRA Futures). a minimum of 99% of the cumulative normal distribution or an equivalence using the cumulative student's t-distribution. 'σ' is the volatility estimator of the contract's returns and is computed using an exponentially weighted moving average (EWMA) approach.

The implemented formula for the estimator at any time *t* is:

$$IM = \alpha \times \sqrt{n} \times \sigma$$

$$\sigma_t = \sqrt{\frac{(1-\lambda)\sum_{i=1}^{T260}\lambda^{i-1}(R_{t-i}-\bar{R})^2}{(1-\lambda^{T260})}}$$

Where R is the daily price returns of the Underlying Interests for Options and Share Futures and the daily price returns of the Futures prices for

Futures (excluding Share Futures), $\overline{R}$ is the mean return over the specified period and λ is the decay factor. ~~CDCC uses $\lambda = 0.99$.~~

In addition, CDCC considers a floor for the EWMA volatility estimator defined above. The level of such floor is calculated ~~as an average~~<u>using the distribution</u> of daily EWMA volatility ~~estimator~~<u>estimators</u> observed over ~~the last~~<u>a minimum of 10 years. CDCC also considers a cap for products whose decay factor used by CDCC is below 0.99. The level of such cap is calculated using the distribution of historical daily price returns over a minimum of</u> 10 years. The volatility estimator that will be used to calculate the MI cannot be lower than the calculated floor<u>, or higher than the calculated cap</u>.

RISK MANUAL

~~JUNE 12~~, 2020

Glossary

Unless otherwise defined in this Risk Manual, capitalized terms shall have the meanings given to them in the Rules.

Adjusted Base Initial Margin: With respect to Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio. The Effective Ratio is recalibrated on a regular basis as provided in this Manual.

Additional Margin(s): Additional Margins are added to the Base Initial Margin (or Adjusted Base Initial Margin, where applicable) to form part of the Initial Margin in accordance with the methodology set out in this Manual. The Additional Margins include the following: (1) Additional Margin for Market Liquidity Risk, (2) Additional Margin for Specific Wrong-Way Risk, (3) Additional Margin for Mismatched Settlement Risk, (4) Additional Margin for Intra-Day Variation Margin Risk, (5) Additional Margin for Unpaid Option Premium Exposure Risk, (6) Additional Margin for Banking Holiday Risk, (7) Additional Margin for Variation Margin Delivery Risk, (8) Additional Margin for Capital Risk, (9) Additional Margin for Uncovered Risk of Limited Clearing Members and (10) any other additional Margins as set out in the Rules (other than required pursuant to Rule D-607). When used in the singular form, Additional Margin shall refer to one of the Additional Margins described above, whenever the context so requires.

Additional Margin for Banking Holiday Risk: The Additional Margin for Banking Holiday Risk covers the risk of uncovered exposures arising from new trades during the Banking Holiday and the additional market risk that the Corporation could face during the Banking Holiday.

Additional Margin for Capital Risk: This Margin requirement covers the credit risk of the Clearing Members that arises if the exposure of a Clearing Member to the Corporation is greater than the Clearing Member's capital level.

Additional Margin for Intra-day Variation Margin Risk: This Margin requirement covers the intra-day risk arising in circumstances in which market volatility or surges in trading volumes produce unusually large Variation Margin exposures.

Additional Margin for Market Liquidity Risk: This Margin requirement covers the liquidity risk arising when the Corporation has to close-out positions at a price different than the market price. This liquidity risk could be divided into two components: the first one is the inherent market liquidity risk which is mainly associated to the bid-ask spread, and the second one is the additional liquidity

risk due to concentrated positions that cannot be liquidated within the bid-ask spread.

Additional Margin for Mismatched Settlement Risk: This Margin requirement covers the risk arising from a lag between the settlement of positions which otherwise results in a margin offset.

Additional Margin for Specific Wrong-Way Risk: This Margin requirement covers the risk that arises when the exposure of a Clearing Member in its own products is adversely correlated with the creditworthiness of that Clearing Member.

Additional Margin for Uncovered Risk of Limited Clearing Members: This Margin requirement covers the risk exposure that arises if the total value of the risk represented by a Limited Clearing Member to the Corporation is greater than the aggregate amount of the Limited Clearing Member's Adjusted Base Initial Margin and the total value of the Clearing Fund.

The risk represented by the Limited Clearing Member is determined by the Corporation by calculating the estimated loss that the Corporation would face in extreme but plausible market conditions. This Additional Margin is calculated on a daily basis and is required from Limited Clearing Members only.

Additional Margin for Unpaid Option Premium Exposure Risk: The Additional Margin for Unpaid Option Premium Exposure Risk covers the risk incurred by the Corporation in guaranteeing to each Clearing Member the settlement of the Net Daily Premium on a daily basis.

Additional Margin for Variation Margin Delivery Risk: The Additional Margin for Variation Margin Delivery Risk covers the risk incurred by the Corporation in guaranteeing to each Clearing Member having pledged specific securities to cover its Net Variation Margin Requirement, the return of such specific securities, in the event that another Clearing Member to which the specific securities were initially delivered fails to return such specific securities and becomes Non-Conforming or is Suspended. In this case, the Corporation will have to buy the specific securities in the market to return to the Clearing Member that had initially pledged the specific securities.

Banking Holiday: Remembrance Day, in Canada, or any day determined as Remembrance Day by the Corporation through its Holiday Schedule published on a yearly basis.

Base Initial Margin: The Base Initial Margin requirement covers the potential losses that may occur over the next liquidation period as a result of market fluctuations. The Base Initial Margin does not include any Additional Margins.

Boundaries: With respect to the Effective Ratio, the Boundaries refer for a specific period to the upper limit (UB) and lower limit (LB) which are respectively the highest and lowest Daily Ratios during such period.

Clearing Fund Requirement: The Clearing Fund Requirement constitutes the required contribution to the Clearing Fund for each Clearing Member (excluding Limited Clearing Members).

Combined Commodity: Group of positions that are associated with the same Underlying Interest or product or both. Combined Commodity is the lowest level at which the Base Initial Margin for Options, Futures and Unsettled Items is computed.

Daily Ratio: The Daily Ratio is determined, for any Business Day, by dividing the total amount of Clearing Fund Requirement on that Business Day by the aggregate amount of the Base Initial Margin requirement of all Clearing Members (other than Limited Clearing Members) on the same Business Day.

Effective Ratio: Ratio established by the Corporation, in accordance with the governance standards set forth in this Manual, which reflects the multiplier applicable to the Base Initial Margin for Limited Clearing Members.

Expected Shortfall: Average of all losses which are greater than or equal to the worst case. The worst case represents the $(1-\alpha)\%$ case, where α is the confidence level.

Haircut: Percentage discounted from the market value of eligible collateral pledged for Margin Deposit. The discount reflects the price movement volatility of the collateral pledged.

Historical Filtered Scenarios: Set of scenarios resulting of a weight applied to the Historical P&L Scenarios to reflect the current volatility. The current volatility is estimated by applying a volatility scaling adjustment using the exponentially weighted moving average (EWMA).

Historical P&L Distribution: Ranking of the Historical P&L Scenarios from the largest loss to the largest profit.

Historical P&L Scenarios: Set of scenarios for a Fixed Income Transaction representing the hypothetical gains and losses derived from Historical Filtered Scenarios. The gains and losses are created by calculating the difference between the price the Fixed Income Transaction under an Historical Filtered Scenario and the initial reference price.

Historical Scenarios: Set of scenarios for a Risk Factor and representing an hypothetical market observation movement reasonably likely to occur, from the current situation to a specific point in time in the future.

Initial Margin: The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins.

Inter-Commodity: Portfolio containing offsetting positions in highly correlated instruments are subject to credits which reduce the overall Base Initial Margin for Options, Futures and Unsettled Items.

Intra-Commodity: Portfolio containing offsetting positions in different maturity month in the same Combined Commodity are subject to a charge since they may not be perfectly correlated.

Margin Buffer Multiplier: Multiplier to the Base Initial Margin for Fixed Income Transaction to prevent and control potential procyclical effects.

Margin Interval (MI): Parameter established by the Corporation which reflects the maximum price fluctuation that the Underlying Interest could be expected to have during the MPOR. The MI is used to calculate the Base Initial Margin for Options, Futures and Unsettled Items.

Margin Period of Risk (MPOR): The period required by the Corporation to close-out non-concentrated positions in a particular contract (or either through liquidation, auction or by hedging or neutralizing the market risk.

Price Scan Range (PSR): The maximum price movement reasonably likely to occur, during a specified timeframe.

Risk Array: A Risk Array is a set of scenarios defined for a particular contract and representing the hypothetical gain/loss under a specific set of market conditions from the current situation to a specific point in time in the future.

Risk Factor: Factor influencing the value of a Derivative Instrument or OTCI.

Risk Engine: The system used by the Corporation for risk management, risk measurement and calculation of Initial Margin and Clearing Fund Requirement.

Risk Model Recalibration Event: A change in key risk parameters resulting from (i) an external event (domestic or international financial, political or economic events or conditions) or (ii) an internal assessment performed by CDCC through the backtesting and sensitivity analysis concluding to the necessity of recalibrating and improving the performance of the risk models.

Rules: means the Rules of the Corporation, including the Operations Manual and this Manual, as any such rules and manuals may from time to time be amended, changed, supplemented or replaced in whole or in part.

Scanning Risk: The difference between the initial reference price of an Underlying Interest and its most unfavourable projected liquidation value obtained by shocking the values of the Underlying Interest according to several scenarios representing adverse changes in normal market conditions.

Short Option Minimum: Amount included in the Base Initial Margin to cover the risk exposure arising from deep out-of-the-money short option positions. This amount is required if this amount is higher than the result of the Risk Arrays.

Variation Margin: The Variation Margin covers the risk due to the change in price of a Derivative Instrument or of an OTCI or a change in the Floating Price Rate, in each case since the previous evaluation in accordance with the Rules.

VaR Risk Group(s): Group of Fixed Income Transactions that are associated to similar Risk Factors. VaR Risk Group is the lowest level at which the Base Initial Margin for Fixed Income Transactions is computed.

Volatility Scan Range (VSR): The maximum implied volatility movement reasonably likely to occur, during a specified timeframe.

Volatility Shock(s): Parameter established by the Corporation which reflects the maximum daily volatility fluctuation of the Option contract. The Volatility Shock is used to calculate the Base Initial Margin for Options.

Zero Curve: Specific type of yield curve that associates interest rates on zero coupon bonds to different maturities (tenors). Tenors represent the Risk Factors inputs to evaluate the price of a Fixed Income Transaction using a full revaluation method.

Section 1: Margin Deposits

As set out in the Rules, every Clearing Member shall be obligated to deposit Margin with the Corporation, as determined by the Corporation. Deposits must be made in the form of eligible collateral, as specified in Section 2 of this Risk Manual, in an amount sufficient, taking into account the market value and applicable Haircuts.

The Corporation requires Margin Deposits to cover two types of requirements, namely:

- Margin requirement; and
- Clearing Fund Requirement.

1.1 MARGIN REQUIREMENT

The Margin requirement is composed of the Initial Margin and the Variation Margin.

1.1.1 Initial Margin

The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins. In order to cover the Initial Margin described below, Clearing Members shall deliver to CDCC an acceptable form of Deposits in accordance with Section 2 of this Risk Manual.

1.1.1.1 Base Initial Margin

The Base Initial Margin requirement covers the potential losses and market risk that may occur as a result of future adverse price and/or Risk Factors across the portfolio of each Clearing Member under normal market conditions.

The risk methodology for the Options, Futures and Unsettled Items incorporates the historical volatility of the daily price returns of the Underlying Interests for Options, Unsettled Items and Share Futures and the daily price returns of the Futures prices for Futures (excluding Share Futures). In addition, as part of the methodology, the Corporation uses a volatility estimator, a confidence level over 99% under the normal distribution or the student's t-distribution assumption and a variable number of days as the MPOR.

The risk methodology for Fixed Income Transactions is the Value at Risk methodology (VaR)[8]. This methodology considers a full revaluation method and it is based on Zero Curves. In addition, as part of the methodology, the Corporation uses a volatility estimator, a Margin Buffer Multiplier to prevent a large decrease in Margin requirements during periods of low volatility, a confidence level over 99% and a variable number of days as the MPOR.

Please refer to Sections 6.1 and 6.2 for additional details on the Base Initial Margin calculation. Please refer to Section 6.3 for additional details on Risk Model Recalibration.

With respect to the Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio to calculate the Adjusted Base Initial Margin. Please refer to Section 6.4 for additional details on Effective Ratio Recalibration.

1.1.1.2   Additional Margins

In addition to the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be), the Corporation requires Margin Deposits for the following Additional Margins:

(1) Additional Margin for Market Liquidity Risk

(2) Additional Margin for Specific Wrong-Way Risk

(3) Additional Margin for Mismatched Settlement Risk

(4) Additional Margin for Intra-day Variation Margin Risk

(5) Additional Margin for Unpaid Option Premium Exposure Risk

(6) Additional Margin for Banking Holiday Risk

(7) Additional Margin for Variation Margin Delivery Risk

(8) Additional Capital Margin Risk

(9) Additional Margin for Uncovered Risk of Limited Clearing Members

(10) Any other additional Margins

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[8]   The same methodology used for Fixed Income Transactions is applied for physical delivery of Government of Canada Bond Futures.

[...]

1.1.2 Variation Margin

The Variation Margin requirement covers the risk due to the change in price of a Derivative Instrument or an OTCI or a change in the Floating Price Rate since the previous evaluation in accordance with the Rules. The following table evidences the type of Variation Margin coverage that will be required by CDCC for each type of products:

Products	Variation Margin coverage type
Options	Collateralized
Futures	Cash settled
Fixed Income Transactions	Collateralized (subject to Variation Margin process)
Unsettled Items	Collateralized

1.1.2.1 Options

For Options, the Variation Margin is collateralized every Business Day and at each Intra-Day Margin Call based on the Option Price reported by the Exchange, or the last OTCI Option Price for OTCI Securities Options[9], as the case may be, and, in the event of the unavailability or inaccuracy of such price, the Corporation shall set such price in accordance with the best information available as to the correct price.

1.1.2.2 Futures

For Futures, the Variation Margin is cash settled every Business Day based on the last Settlement Price reported by the Exchange, and, in the event of the unavailability or inaccuracy of such price, the Corporation shall set the last Settlement Price in accordance with the best information available as to the correct price.

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[9] Please refer to Section 6.5 for additional details on the theoretical price calculation of OTCI Securities Options.

1.1.2.3 Fixed Income Transactions

The Variation Margin Requirement[10] in respect of each Fixed Income Transaction is calculated on a daily basis and represents the sum of the Price Valuation Requirement and the Repo Rate Requirement, each as defined in Section D-601 of the Rules.

PRICE VALUATION REQUIREMENT

The Price Valuation Requirement represents, in respect of a Repurchase Transaction, an amount which is the aggregate amount calculated in respect of the difference between (i) the Market Value of the Purchased Security and (ii) the Repurchase Price of the Repurchase Transaction, plus any Coupon Income payable to the holder between the calculation date and the Repurchase Date, and, in respect of a Cash Buy or Sell Trade, an amount which is the difference between (i) the Market Value of the Purchased Security and (ii) the Purchase Price of the Cash Buy or Sell Trade; which amount is owed to the Corporation by a Fixed Income Clearing Member that is a party to such Repurchase Transaction or Cash Buy or Sell Trade or by the Corporation to such Fixed Income Clearing Member.

REPO RATE REQUIREMENT

The Repo Rate Requirement represents a change in the current Floating Price Rate and means, in respect of a Repurchase Transaction, an amount which is calculated in respect of the difference between the Floating Price Rate and the Repo Rate; which amount is owed to the Corporation <u>by a Fixed Income Clearing Member that is a party to such Repurchase Transaction or by the Corporation to</u> such Fixed Income Clearing Member.

1.1.2.4 Unsettled Items

The Variation Margin for Unsettled Items with respect to both Options and Futures is collateralized. With respect to

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[10] The Variation Margin Requirement for Fixed Income Transactions is not applied for physical delivery of Government of Canada Bond Futures. The applicable Variation Margin Requirement for Fixed Income Transactions is rounded up to the nearest $1 of nominal value.

Variation Margin for Unsettled Items related to Options, the Corporation calculates a Variation Margin requirement equal to the intrinsic value of the Option multiplied by the position and the contract size. With respect to Variation Margin for Unsettled Items related to Futures, the Corporation calculates a Variation Margin requirement equal to the difference between the last Settlement Price of the Futures and the price of the Underlying Interest related to the Futures, multiplied by the position and the contract size.

1.1.3 Account Structure, Netting and Risk Aggregation

1.1.3.1 Short Positions, Account Types and Positions Netting

Clearing Members shall not be required to deposit Margin in respect of Short Positions in Futures or Options for which they have deposited the Underlying Interest in accordance with Section A-706 of the Rules.

The Corporation uses three types of accounts for Margin calculation purposes and positions management: Firm Account, Multi-Purpose Account and Client Account.

- For all account types, the Margin requirement for Futures positions and Fixed Income Transactions is calculated on a net basis.

- The Margin requirement for Options is calculated on a net basis for the Firm Account and the Multi-Purpose Account, but on a gross basis for the Client Account, which means that only short Options are considered when computing the Initial Margin.

1.1.3.2 Margin Aggregation

The total Margin requirement of each Clearing Member is composed of the Initial Margin requirement and the Variation Margin requirement.

The calculation is made at the account level and then aggregated at the Clearing Member level. However, operationally the Margin requirement is subject to the

following aggregation, subject to the applicable type of products being cleared by the Clearing Member:

INITIAL MARGIN REQUIREMENT (including the Variation Margin for Options and Unsettled Items)

The Initial Margin requirement for all products is aggregated with the Variation Margin for Options and Unsettled Items as follows:

a) The Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) is calculated at the account level. For Options, Futures and Unsettled Items, the margin results are calculated at the Combined Commodity level and the Base Initial Margin corresponds to the sum of all Combined Commodities. For Fixed Income Transactions, the Base Initial Margin represents the sum of all VaR Risk Groups. The Base Initial Margin at the account level corresponds to the sum of the Base Initial Margin for Options, Futures and Unsettled Items and the Base Initial Margin for Fixed Income Transactions.

b) The Variation Margin for Options and Unsettled Items is calculated at the account level and then added to the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be).

- If the Variation Margin for Options and Unsettled Items is negative, this will result in a margin credit[11] decreasing the aggregate value of the Base Initial Margin for Options and Unsettled Items.

- If the Variation Margin for Options and Unsettled Items is positive, this will result in a margin debit increasing the aggregate value of the Base Initial Margin for Options and Unsettled Items.

c) The Margin requirement in respect of each Clearing Member is calculated by aggregating for all accounts the value of (1) the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Variation

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[11] For a given account, the margin credit is capped to the Base Initial Margin for Options, Futures and Unsettled Items.

Margin for Options and Unsettled Items and (2) the following Additional Margins calculated at the Clearing Member level: Additional Margin for Market Liquidity Risk, Additional Margin for Specific Wrong-Way Risk, Additional Margin for Mismatched Settlement Risk, Additional Margin for Intra-Day Variation Margin Risk, Additional Margin for Unpaid Option Premium Exposure Risk, Additional Margin for Banking Holiday Risk, Additional Margin for Variation Margin Delivery Risk, Additional Capital Margin Risk, Additional Margin for Uncovered Risk of Limited Clearing Members and any other Additional Margins as set out in the Rules (other than required pursuant to Rule D-607).

VARIATION MARGIN FOR FUTURES

The Variation Margin for Futures (the net value of Gains and Losses) is aggregated at the Clearing Member level.

VARIATION MARGIN FOR FIXED INCOME TRANSACTIONS

The Variation Margin Requirement for Fixed Income Transactions is aggregated at the Clearing Member level.

[...]

Section 2: Eligible Collateral

[...]

2.6.1 Haircuts for Government Securities

The Corporation calculates the Haircuts based on any of the following criteria:

- Valuation of the market, credit, liquidity and foreign exchange risks based on historical daily returns;

- The volatility estimator uses the exponentially weighted moving average ("EWMA") approach as defined in Appendix 6.65, and the assumption that the bond can be liquidated at a reasonable price in "n" days. ("n" is determined according to the type of products and prevailing market conditions). In addition, a floor for the EWMA volatility estimator is calculated as the 25th percentile of a daily EWMA volatility estimator observed over the last 10 years;

- Liquidity risk valued according to the bid-ask spread of the issues using the same EWMA volatility estimator and the floor (if this spread is unavailable, the liquidation window will be expanded and will depend on market conditions);

- Bonds of the same issuer and comparable maturities.

Once the quantitative analysis is performed, CDCC reserves the right to increase the Haircuts based on qualitative criteria, such as:

- Comparative analysis of CDCC's Haircuts in relation to the Haircuts of the Bank of Canada;

- Comparative analysis of CDCC's Haircuts in relation to the Haircuts of other clearing houses;

- The congruence of the different Haircuts to the credit rating spreads of the different issuers; and

- Any other factor considered relevant by CDCC, acting reasonably.

[…]

Section 3: Monitoring Program

[...]

Section 4: Contract Adjustment

[...]

Section 5: Acceptability of Underlying Interests

[...]

Section 6: Appendix

6.1 BASE INITIAL MARGIN CALCULATION FOR OPTIONS, FUTURES AND UNSETTLED ITEMS[12]

For greater certainty, this section only applies to Options, Futures and Unsettled Items.

To calculate the Base Initial Margin the risk methodology is based on the PSR and the VSR which are then converted into the Scanning Risk parameter. The Scanning Risk parameter represents the difference between the most unfavourable projected liquidation value and the initial reference price[13]. The most unfavourable projected liquidation value amongst the Risk Array is obtained by varying the values of the Underlying Interest and implied volatility according to several scenarios representing adverse changes in normal market conditions. The projected liquidation values are obtained using specific valuation models such as Black 76, Black-Scholes, Binomial and others.

The Scanning Risk is calculated at the Combined Commodity level and is denominated in the same currency as the contract. For contracts belonging to the same Combined Commodity, the Risk Array results are added up for all contracts under the same scenario. The highest loss represents the Scanning Risk.

The other variables influencing the value of the Base Initial Margin are the Intra-Commodity, the Inter-Commodity and the Short Option Minimum. The following table summarizes the variables used in the calculation.

Input variables to calculate the Base Initial Margin	Options	Futures	Unsettled Items
Scanning Risk	●	●	●
Intra-Commodity		●	

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[12] Unsettled Items resulting of a physical delivery of Government of Canada Bond Futures are margined under the VaR methodology.

[13] The initial reference price is the market price or the theoretical price derived from market observations.

Inter-Commodity[14]		●	
Short Option Minimum	●		

6.1.1 Scanning Risk

The Scanning Risk parameter represents the difference between the most unfavourable projected liquidation value and the initial reference price. The most unfavourable projected liquidation value amongst the Risk Array is obtained by varying the values of the Underlying Interest and implied volatility according to several scenarios representing adverse changes in normal market conditions. The table at the end of this section shows all the risk scenarios. The projected liquidation values are obtained using specific valuation models such as Black 76, Black-Scholes, Binomial and others. If the largest loss is negative, the Scanning Risk is set to zero. The Scanning Risk is then compared to the Short Option Minimum. This amount is required if the Short Option Minimum is higher than the result of the Risk Arrays.

6.1.1.1 Price Scan Range

The term PSR represents the potential variation of the contract value and it is calculated through the following formula:

$$PSR = \ Price \ \times MI \ \times Contract \ Size$$

The methodology for the MI is detailed in Section 6.5.

6.1.1.2 Volatility Scan Range

The term VSR represents the potential variation of the implied volatility and it is calculated through the following formula:

$$VSR = \ Volatility \ Shock \ \times \sqrt{n}$$

Where 'n' is the MPOR, and 'Volatility Shock' is calculated using the distribution of historical daily fluctuations for the series volatility over the reference period. The daily

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[14] Not applicable for Share Futures.

fluctuations are scaled up with the use of MPOR. VSR values are subject to a floor value and a cap value.

Risk Scenarios	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Underlying Price Variation *	0	0	1/3	1/3	-1/3	-1/3	2/3	2/3	-2/3	-2/3	1	1	-1	-1	2	-2
Volatility Variation *	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	0	0
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	35%	35%

* Expressed in scan range

The MI, Volatility Shocks and Short Option Minimum values are updated by the Corporation from time to time.

6.1.2 Intra-Commodity

Long positions on Futures maturing in one month are automatically matched with short positions on Futures maturing in another month. The resulting Base Initial Margin on these two Futures belonging to the same Combined Commodity could be lower than the real risk associated with the combination of the two contracts. In order to cover this inter-month spread risk, a charge is included in the Base Initial Margin.

Depending on the term structure of the Futures contracts, CDCC either calculates the Intra-Commodity charge for combinations of two or three different Futures (spread or butterfly strategies, respectively), or evaluates a single Intra-Commodity charge to cover for rolling contracts. The final Intra-Commodity charge is applied at the strategy level, close-maturity group level or Combined Commodity level. The combinations and the spread priorities for the Intra-Commodity are updated by CDCC from time to time.

For spread and butterfly strategies, the Intra-Commodity is determined as follows:

$$Intra - Commodity = \ \alpha \times \sqrt{n} \times \sigma$$

Where 'n' is the number of MPOR, $'\alpha'$ is equal to a confidence value equivalent to a minimum of 99% of the cumulative normal

distribution or an equivalence using the cumulative student's t-distribution. 'σ' is the volatility estimator of the Futures combination's daily profit and loss over the reference period and is computed using the EWMA approach. Further details on the EWMA are described in Appendix 6.6.

In addition, CDCC considers a floor for the EWMA volatility estimator. The level of such floor is calculated using the distribution of daily EWMA volatility estimators observed over a minimum of 10 years. The EWMA volatility estimator that will be used to calculate the Intra-Commodity cannot be lower than the calculated floor.

6.1.3 Inter-Commodity

The Corporation may consider the correlation that exists between different Futures when calculating the Base Initial Margin. The Corporation will grant a credit according to the historical correlation of the returns of the two Futures. If multiple Inter-Commodity are defined, the Corporation will prioritize the ones with the highest correlation.

The Inter-Commodity and the spread priorities are updated by CDCC from time to time.

6.2 BASE INITIAL MARGIN CALCULATION FOR FIXED INCOME TRANSACTIONS

For greater certainty, this section only applies to Fixed Income Transactions.

To calculate the Base Initial Margin, the VaR methodology is based on Historical Scenarios for all relevant Risk Factors. The Historical Scenarios consist of a set of scenarios for a Risk Factor over a relevant historical period that represents an hypothetical market observation movement (shocked market observation based on market history) reasonably likely to occur, from the current situation to a specific point in time in the future.

For Fixed Income Transactions, the Risk Factors are the Zero Curves. On any given Business Day, the shocks derived from the Historical Scenarios are applied to the initial reference market inputs values. The difference between the initial reference price and the shocked historical price represents an Historical P&L Scenario. The initial reference price and historical shocked price are derived respectively from the initial reference Zero Curves and the shocked Zeros Curve using a full revaluation method.

The Historical P&L Scenarios are calculated at the VaR Risk Group level and are denominated in the same currency as the Fixed Income Transactions. For Fixed Income Transactions belonging to the same VaR Risk Group, the Historical P&L Scenarios results are added up for Fixed Income Transactions.

Lastly, the Historical P&L Scenarios are ranked to derive the Historical P&L Distribution that is used to calculate the average loss of the portfolio using the Expected Shortfall method. A Margin Buffer Multiplier is then applied to the Expected Shortfall value to obtain the Base Initial Margin.

The main steps to calculate the Base Initial Margin are described in the section below.

6.2.1 Historical Filtered Scenarios

The Historical Filtered Scenarios are generated using the initial reference Risk Factors value and historical observations of different tenors on the Zero Curves.

The shocked Risk Factors are calculated using the following formula:

$$y'_{t,\tau} = y_{T,\tau}(1 + R_{t,\tau}c_{t,\tau})$$

Where c is the scaling factor for the volatility scaling adjustment and R is the daily relative market return over the MPOR 'n'. CDCC uses a look-back period of a minimum of 1 year.

The scaling factor formula at time t and for a given tenors is calculated using the following formula:

$$c_{t,\tau} = Max\left(\frac{\sigma_{T,\tau} + \sigma_{t,\tau}}{2\,\sigma_{t,\tau}}, Min\,SF\right)$$

Where σ is the EWMA volatility forecast and Min SF is the minimal scaling factor.

The implemented formula for the EWMA volatility forecast is:

$$\sigma^2_{t,\tau} = (1 - \lambda)R^2_{t-1,\tau} + \lambda\sigma^2_{t-1,\tau}\,,$$

Where R is the relative market return over the MPOR 'n' and λ is the decay factor.

6.2.2 Historical P&L Scenario generation

The Historical P&L Scenarios are valued by calculating the difference between the shocked prices of Fixed Income Transactions under an Historical Filtered Scenario and the initial reference prices. The Historical P&L Scenarios results are added up for all Fixed Income Transactions within a VaR Risk Group.

The initial reference prices are calculated using a full revaluation method and the initial reference Risk Factors. The shocked prices are calculated using a full revaluation method and the shocked Risk Factors.

6.2.3 Expected Shortfall

For each VaR Risk Group, the Historical P&L is sorted from largest loss to largest profit to construct the Historical P&L Distribution. Using a confidence value equivalent to a minimum of 99% and the Historical P&L Distribution, the Expected Shortfall is determined by averaging the losses exceeding the confidence value.

6.2.4 Margin Buffer Multiplier

The Base Initial Margin for each VaR Risk Group is obtained by applying a Margin Buffer Multiplier to the Expected Shortfall value.

The Margin Buffer Multiplier is based on the ratio of the volatility distribution over a minimum of 10 years and the volatility over a short period of time. CDCC will change the Margin Buffer Multiplier level if it is deemed stable over the reference period. The ratio is then rounded and subject to a floor and a cap value.

The Margin Buffer Multiplier is updated by CDCC from time to time.

6.3 RISK MODEL RECALIBRATION

The Base Initial Margin requirement of each Clearing Member is subject to, when applicable, a Risk Model Recalibration. The recalibration will apply to the risk parameters pertaining to the Base Initial Margin Calculation methodologies.

Objective and Trigger: The Risk Model Recalibration ensures that, following the occurrence of a Risk Model Recalibration Event, CDCC will determine the nature of the recalibration to be made to the risk parameters

for the Base Initial Margin calculation for Options, Futures, Unsettled Item and Fixed Income Transactions described within the Rules.

6.3.1 Risk Model Recalibration Governance

- **Upon the occurrence of a Risk Model Recalibration Event**, and following the determination by CDCC of the nature of the recalibration to be made to the risk parameters, CDCC will promptly report to the Risk Management Advisory Committee (RMAC) the expected impacts of the recalibration on the Clearing Members.

6.3.2 Entry in force

- Clearing Members will be notified in writing of the recalibration of the risk parameters, along with any relevant information including the impact analysis of the recalibration adjustment.

- Risk model recalibrations shall become effective five (5) Business Days following the publication by CDCC of notice to that effect on its Web site.

6.4 RECALIBRATION OF THE EFFECTIVE RATIO

[…]

6.5 OTCI SECURITIES OPTIONS

[…]

6.6 MARGIN INTERVAL

The MI is calculated using the following formula:

$$MI = \ \alpha \times \sqrt{n} \times \sigma$$

Where 'n' is the MPOR, $'\alpha'$ is equal to the confidence level equivalent to a minimum of 99% of the cumulative normal distribution or an equivalence using the cumulative student's t-distribution. 'σ' is the volatility estimator of the contract's returns and is computed using an exponentially weighted moving average (EWMA) approach.

The implemented formula for the estimator at any time *t* is:

$$IM = \ \alpha \times \sqrt{n} \times \sigma$$

$$\sigma_t = \sqrt{\frac{(1-\lambda)\sum_{i=1}^{T}\lambda^{i-1}(R_{t-i} - \bar{R})^2}{(1-\lambda^T)}}$$

Where R is the daily price returns of the Underlying Interests for Options and Share Futures and the daily price returns of the Futures prices for Futures (excluding Share Futures), $\bar{R}$ is the mean return over the specified period and λ is the decay factor.

In addition, CDCC considers a floor for the EWMA volatility estimator defined above. The level of such floor is calculated using the distribution of daily EWMA volatility estimators observed over a minimum of 10 years. CDCC also considers a cap for products whose decay factor used by CDCC is below 0.99. The level of such cap is calculated using the distribution of historical daily price returns over a minimum of 10 years. The volatility estimator that will be used to calculate the MI cannot be lower than the calculated floor, or higher than the calculated cap.