NOTICE TO MEMBERS
No. 2015 – 057

May 8, 2015

SELF-CERTIFICATION

AMENDMENTS TO THE RISK MANUAL OF CDCC

CONCENTRATION RISK

On July 14, 2014, the Board of Directors of the Canadian Derivatives Clearing Corporation (CDCC) approved amendments to the Risk Manual of CDCC. CDCC wishes to inform the Clearing Members that this amendments have been self-certified pursuant to the self-certification process set forth in the *Derivatives Act* (R.S.Q., c I-14.01), and approved by the Ontario Securities Commission in accordance with the "Rule Change Requiring Approval in Ontario" process.

The purpose of the proposed amendments is to address the Concentration Risk in the margin requirement requested by CDCC from its Clearing Members.

You will find attached hereto the amendments to be incorporated into the version of the Risk Manual of CDCC that will be made available on the CDCC website at www.cdcc.ca as of May 8, 2015 and set to come into force on May 11, 2015.

If you have any questions or concerns regarding this notice, please contact CDCC's Corporate Operations department or direct your e-mail inquiries to cdcc-ops@cdcc.ca.

Glenn Goucher
President and Chief Clearing Officer

Risk Manual

Glossary

Close-out Period: The required period the Corporation needs to unwind the positions in a particular contract without disrupting the market. This term is similar to the term “number of liquidation days”.

Concentation Risk: This risk refers to the position concentration risk which is the risk of one Clearing Member having a large net position with respect to the total open position in any particular contract leading to a higher Close-out Period for that Clearing Member. The higher Close-out Period will drive an additional margin for concentration risk.

Margin Interval: Parameter established by the Corporation which reflects the maximum price fluctuation that the Underlying Interest could be expected to have during the liquidation period. The Margin Interval (MI) calculations are based on the historical volatility of the Underlying Interest and these calculations are re-evaluated on a weekly basis. If necessary, the Corporation may update the Margin Intervals more frequently. The Margin Interval is used to calculate the Initial Margin of every Derivative Instrument.

Haircut: Percentage discounted from the market value of Securities pledged as collateral for Margin Deposit. The discount reflects the price movement volatility of the collateral pledged. Thus, this reduction assures that even if the collateral's market value declines, there is time to call for additional collateral to adjust its value to the required level.

Initial Margin: The Initial Margin covers the potential losses that may occur over the next liquidation period as a result of market fluctuations. The Initial Margin amount is calculated using the historical volatility of the Underlying Interest return for Options contracts, futures prices for Futures contracts and yield-to-maturity (YTM) of the on-the-run security for Fixed Income Transactions.

Variation Margin: The Variation Margin takes into account the portfolio’s liquidating value (this is also known as the Replacement Cost or RC) which is managed through the Mark-to-Market daily process.

Price Scan Range: The maximum price movement reasonably likely to occur, for each Derivative Instrument or, for Options, their Underlying Interest. The term PSR is used by the Risk Engine to represent the potential variation of the product value and it is calculated through the following formula:

PSR = Underlying Interest Price x MI x Contract Size

Volatility Scan Range: The maximum change reasonably likely to occur for the volatility of each Option's Underlying Interest price.

Risk Array: A Risk Array (RA) is a set of 16 scenarios defined for a particular contract specifying how a hypothetical single position will lose or gain value if the corresponding risk scenario occurs from the current situation to the near future (usually next day).

Combined Commodity: The Risk Engine divides the positions in each portfolio into groupings called Combined Commodities. Each Combined Commodity represents all positions on the same ultimate Underlying Interest – for example, all Futures contracts and all Options contracts ultimately related to the S&P/TSX 60 Index.

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

Active Scenario: The number of the Risk Arrays scenario that gives the largest amount (worst case scenario).

Short Option Minimum: Rates and rules to provide coverage for the special situations associated with portfolios of deep out-of-the-money short option positions. This amount will be called if it is higher than the result of the Risk Arrays.

Liquidity Interval: The Liquidity Interval is calculated based on the historical bid-ask price spread of the Underlying Interest according to the same formula for Margin Interval.

Buckets: All Acceptable Securities of Fixed Income Transactions that behave in a similar manner are grouped together into "Buckets" and each Bucket behaves as a Combined Commodity. Acceptable Securities are bucketed according to their remaining time to maturity and issuer. Due to the nature of the bucketing process, the Acceptable Securities' assignation will be dynamic in that they will change from one Bucket to the other as the Acceptable Security nears maturity.

MTM Price Valuation: The MTM Price Valuation is the difference between the market value of the Security and the funds borrowed. This amount is collateralized and should be credited (or debited) to the Repo Party's Margin Fund and debited (or credited) to the Reverse Repo Party's Margin Fund.

Intra-Commodity (Inter-Month) Spread Charge: Underlying Interests' prices, from a maturity month to another are not perfectly correlated. Gains on a maturity month should not totally offset losses on another. To fix this issue, the Risk Engine allows the user to calculate and to apply a margin charge relative to the Inter-Month spread risk in order to cover the risk of these two positions.

Inter-Commodity Spread Charge: The Corporation considers the correlation that exists between different classes of Futures contracts when calculating the Initial Margin. For example, different interest rate Futures contracts are likely to react to the same market indicators, but at different degrees. For instance, a portfolio composed of a long position and a short position on two different interest rate Futures contracts will be likely less risky than the sum of the two positions taken individually.

Clearing Engine: The Corporation uses SOLA® Clearing as its Clearing Engine.

Risk Engine: The Corporation uses the Standard Portfolio Analysis system (SPAN®) as its Risk Engine.

The terms and concepts herein defined, as used in this Risk Manual, are derived from the CME Group proprietary SPAN® margin system, adapted for CDCC's licensed use thereof.

Margin Deposit

The Corporation has three different funds for margining purposes and each serves a specific purpose:

- Margin Fund
- Difference Fund
- Clearing Fund

MARGIN FUND

The Margin Fund is composed of the Initial Margin and the Variation Margin. The Initial Margin covers the potential losses and market risk that may occur as a result of future adverse price movements across the portfolio of each Clearing Member under normal market conditions. Furthermore, in the event of a default, the Corporation is faced with closing out the defaulters' portfolio within a short period (the liquidation period). In a complementary manner, Variation Margin is a daily payment process that covers the market risk due to the change in price since the previous day, ahead of the default of one of its Clearing Members. Variation Margin is settled in cash for Futures contracts and collateralized for Options contracts, OTCI and Fixed Income Transactions. Additional margin for Concentration Risk is also collected in the Margin Fund.

INITIAL MARGIN

As fundamental inputs to calculate the Initial Margin, the Corporation uses the following parameters: 1) confidence level (to reflect normal market conditions), 2) assumed liquidation period and 3) historical volatility over a specific period.

Specifically, the Corporation uses three standard deviations to consider a confidence level over 99% under the normal distribution's assumption. The Corporation also considers a variable number of days as an acceptable liquidation period. The Initial Margin amount is calculated using the historical volatility of the daily price returns of the Underlying Interests for Options contracts, the daily price returns of the F~~f~~utures prices for Futures contracts and the yield-to-maturity (YTM) daily variation of the on-the-run security for Fixed Income Transactions. The historical volatility, combined with the liquidation period and the confidence level gives the Margin Interval (MI) as described below.

MARGIN INTERVAL (MI) CALCULATION

The Margin Interval calculations are re-evaluated on a regular~~ly~~ basis. However, the Corporation may use its discretion and update the Margin Intervals more frequently if necessary. The Margin Intervals are used to calculate the Initial Margin for each Derivative Instrument.

The Margin Interval (MI) is calculated using the following formula:

$$MI = 3 \times \sqrt{n} \times Max\left[\sigma_{20\ days}, \sigma_{90\ days}, \sigma_{260\ days}\right]$$

Where ‘n’ is the number of liquidation days[1], ‘σ’ is the standard deviation of the daily variation over 20, 90 and 260 days, and 3 is equivalent to 99.87% for a one-tail confidence interval under the normal distribution’s assumption.

Additional Margin for Concentration Risk

Default Close-out Periods are set on a product specific basis and depends especially on their liquidity. In addition, the Corporation uses different number of liquidation days (or Close-out Period) for different bulk of positions to address and manage the position Concentration Risk. For every product, CDCC determines a threshold of positions that can be easily liquidated without causing a non-ordinary market impact. CDCC nets all positions of the Clearing Member across all its accounts and the net position is compared to the threshold in order to determine the number of margin runs with their appropriate Close-out Periods applicable to the Clearing Member positions for each specific product. Furthermore, the additional Close-out Period is added to the default one for every product.

For example, let’s assume that CDCC sets a threshold for a specific product with a default Close-out Period of 2 days at 2500 contracts and the Clearing Member net position is 8000 contracts, CDCC will perform a first margin run with a number of liquidation days equal to 2 (the default Close-out Period of this product) for the first 5000 contracts (5000 = 2500 * 2) and a second margin run with a number of liquidation days equal to 3 (the default Close-out Period of this product incremented by one day) for 2500 contracts (i.e. the one day threshold) and a third margin run with a number of liquidation days equal to 4 (the default Close-out Period of this product incremented by two days) for 500 contracts (i.e. the remaining position. 500 = 8000 – 5000 - 2500). The total Initial Margin CDCC charges the Clearing Member

[1] The Corporation uses the following number of liquidation days ‘n’ as follows:

- For Futures contracts and Options contracts n = 2 days;
- For OTCI options n = 5 days;
- For Fixed Income Transactions, where the Underlying Interest is issued by the Government of Canada or a federal Crown corporation n = 2 days; and
- For Fixe Income Transactions, where the Underlying Interest is issued by a provincial government or a provincial Crown corporation n = a + 2 days, where a = number of additional days.

‘a’ is based on a quantitative and qualitative analysis, established according to the degree of liquidity of the Underlying Interest which is derived from parameters such as but not limited to traded volume, Government of Canada/ provincial yield spreads and international guidelines. For a provincial government or provincial Crown corporation issuer ‘a’ is determined at least once a year and communicated to Clearing Members by written notice.

Furthermore, in anticipation of Remembrance Day (the “Banking Holiday”) the Corporation will add one more day to the number of liquidation days ‘n’. Hence, for Options and Futures contracts where the Underlying Interest is an Equity (i.e. Stock and ETF) or an Index the liquidation period will increase to three Business Days prior and up to the Banking Holiday, and for OTCI options, the liquidation period will increase to six Business Days prior and up to the Banking Holiday. The additional margin amount for the Banking Holiday will be released on the morning of the following Business Day.

for this position is the sum of the three Initial Margins that are calculated for the three margin runs.

For Futures and Fixed Income transactions, the thresholds are determined using an average trading volume of the product over a certain period of time. However for Options, the thresholds are determined using an average trading volume over a certain period of time of the Underlying Interest.

Price Scan Range (PSR) Calculation

In order to calculate the most unfavourable projected liquidation value, the Risk Engine uses the MI of the above formula to calculate the Price Scan Range (PSR) and to run several scenarios through its Risk Array calculation (for a detailed description refer to the section on Risk Arrays below).

A Risk Array is a set of 16 scenarios defined for a particular contract specifying how a hypothetical single position will lose or gain value if the corresponding risk scenario occurs from the current situation to the near future (usually next day).

PSR is the maximum price movement reasonably likely to occur, for each Derivative Instrument or, for Options contracts, their Underlying Interest. The term PSR is used by the Risk Engine to represent the potential variation of the product value and it is calculated through the following formula:

PSR = Underlying Interest Price x MI x Contract Size.

INITIAL MARGIN CALCULATION

To calculate the Initial Margin, the Risk Engine uses the MI which is converted to the Scanning Risk parameter. The Scanning Risk parameter represents the difference between the current market value of a Derivative Instrument (for Exchange Transactions) or of an Acceptable Security (for Fixed Income Transactions) and its most unfavourable projected liquidation value obtained by varying the values of the Underlying Interest according to several scenarios representing adverse changes in normal market conditions. The Scanning Risk is always calculated at the Combined Commodity level.

For contracts belonging to the same Combined Commodity, the Risk Engine adds up the Risk Arrays results of all contracts under the same risk scenario. It should be noted that in the situation where the Risk Engine does not consider other variables, the Scanning Risk is the Initial Margin for the Combined Commodity.

However, in some cases other variables can increase or decrease the Scanning Risk. For example, variables such as the Intra-Commodity (Inter-Month) Spread Charge which tends to increase the Initial Margin and the Inter-Commodity Spread Charge which tends to decrease the Scanning Risk to take advantage of the correlations between the different constituents of the Combined Commodity. Another example is the specific case of short deeply out-of-the-money options wherein the Risk Engine calculates a minimum amount called Short Option Minimum (SOM) which otherwise attracts little or no Initial Margin. Finally, in the case of OTCI with Physical Settlement/Delivery, the Corporation calculates an additional Liquidity Interval and adds it to the Margin Interval.

It should also be noted that, as described in the following sections, the determination of the Initial Margin is slightly different for Options contracts, Futures contracts and Fixed Income Transactions. The following table summarizes the list of variables used to calculate the Initial Margin by cleared product category:

Input variables to calculate the Initial Margin	Options contracts (including OTCI options)	Futures contracts and Share Futures	Fixed Income Transactions
Scanning Risk	●	●	●
Intra-Commodity (Inter-Month) Spread Charge[2]		●	●
Inter-Commodity Spread Charge[3]		●	●
Short Option Minimum (SOM) amount	●		
Liquidity Interval[4]	●		

INITIAL MARGIN FOR OPTIONS CONTRACTS

This section describes how the Initial Margin is calculated for the Options contracts, which include the equity options, index options, currency options, exchange-traded-fund options and options on futures.

The Risk Arrays are obtained by varying the Underlying Interest (eight scenarios) and the option's implied volatility (eight scenarios). The term PSR for Options contracts is calculated through the following formula:

PSR = Underlying Interest Price x MI x Contract Size

For equity options contracts, the contract size is usually equal to 100.

[2] Not applicable to Share Futures Contracts.
[3] Idem 4
[4] Applicable for OTCI options with Physical Settlement/Delivery only

RISK ARRAYS

Each Risk Array scenario represents losses or gains due to hypothetical market conditions:

- The (underlying) price movement: upward (+) and downward (-) with corresponding scan range fraction (0, 1/3, 2/3, 3/3 or 2)
- The (underlying) volatility movement: upward (+) and downward (-) with corresponding scan range fraction (0 or 1).

Since some scenarios consider large movements on the Underlying Interest price, the whole difference (gain and loss) between the new (simulated) theoretical option price and the actual option price will not be considered. For scenarios 15 and 16, since their probability of occurrence is low, only a fraction of 35% of the difference is considered. The purpose of these two additional extreme scenarios is to reduce the problem of short option positions that are highly out of the money near expiration. If the Underlying Interest price varies sharply, these positions could then be in the money.

A scan range is a fluctuation range of the Underlying Interest price and volatility defined for each Combined Commodity.

The Risk Engine calculates 16 Risk Array scenarios as follows:

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

Each Risk Array value is calculated as the current contract price less the theoretical (simulated) contract price obtained for the corresponding scenario by using the valuation model. (The Risk Engine uses different valuation models including Black 76, Black-Scholes, Generic Merton, Barone-Adesi-Whaley (BAW) and others).

However, it should be noted that for the intra-day margin processes, CDCC relies on the previous day's closing prices for those Option contracts for which it has open interest.

However, since the Initial Margin driven by Option contracts is relatively small with respect to the total Initial Margin that includes all cleared products, the Corporation does not consider the Volatility Scan Range (VSR) in its risk model. This means that the Corporation does not vary the option implied volatility up and down (+1 and -1) eight times, but varies only the Underlying Interest price in order to simulate the potential losses for each position. Therefore, the Risk Engine produces eight different scenarios as shown in the table below.

Risk Scenarios	1	2	3	4	5	6	7	8
Underlying Price Variation*	1/3	-1/3	2/3	-2/3	1	-1	2	-2
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%

* Expressed in scan range

For Options contracts belonging to the same Combined Commodity, the Risk Engine first calculates the Risk Arrays for each Option contract and for each one of the eight risk scenarios. The Risk Engine then adds up the Risk Arrays results of all Options contracts under the same risk scenario. For example, for two Options contracts O1 and O2 on the Underlying Interest XX, the same scenarios are performed for each Option contract, and then, they are added up. Therefore, the Risk Array value for O1 under the risk scenario 1 is added up to the Risk Array value for O2 under the risk scenario 1, likewise the Risk Array value for O1 under the risk scenario 2 is added up to the Risk Array value for O2 under the risk scenario 2, and so on. The largest total Risk Array value amongst the eight values is the Scanning Risk of this Combined Commodity. The details of this method are described in the section on Risk Arrays.

For a better explanation of the Risk Engine methodology used by the Corporation, here are the steps to calculate the Initial Margin for an Option contract using the Risk Array:

<u>Example 1:</u>

Let's assume that the price of an Option contract is X_0, its Underlying Interest price is P_0 and its Margin Interval is MI. Using the formula described above, we can calculate the Price Scan Range (PSR) of the option which represents the fluctuation range of the Underlying Interest as follows:

$$PSR = MI \times P_0 \times \text{Contract Size.}$$

Since the contract size of an Option contract is generally 100, the formula becomes:

$$PSR = MI \times P_0 \times 100$$

For the clarity of the table below, please note that the PSR used in the following steps does not include the contract size, i.e. PSR = MI x P_0.

<u>Scenario 1:</u>

Step 1: calculate the Underlying Interest price variation. To accomplish this, the Risk Engine varies the Underlying Interest price by 33% (or 1/3) to the upper range of its

MI. If for example the MI is 30%, the Underlying Interest price moves to the upper range by 33% of the 30% which leads to a 10% increase. Therefore, the Underlying Interest price variation is +33% of the PSR.

Step 2: calculate the new (simulated) Underlying Interest price by adding the Underlying Interest price variation calculated in the last step to the original Underlying Interest price.

Step 3: calculate the new (simulated) theoretical option price with Barone-Adesi & Whaley (1987) model[5] using the new (simulated) Underlying Interest price.

Step 4: calculate the option's gain or loss by subtracting the new (simulated) theoretical option price from the original option price.

Step 5: multiply the gain or loss by the considered weight fraction (the last row of the above table) to get the Risk Array amount associated to the scenario 1.

After repeating the above steps for the remaining seven scenarios, the Risk Engine chooses the largest amount of (the weighted) gain or loss as the most unfavourable projected liquidation value (worst case) of the option. This amount is called the Scanning Risk.

Here is the same table as before but with the formulas of each step:

Risk Scenarios	1	2	3	4	5	6	7	8
Underlying Price Variation	1/3 * PSR	-1/3 * PSR	2/3 * PSR	-2/3 * PSR	PSR	-1 * PSR	2 * PSR	-2 * PSR
New Underlying Price	P_1 = P_0 + 1/3 * PSR	P_2 = P_0 - 1/3 * PSR	P_3 = P_0 + 2/3 * PSR	P_4 = P_0 - 2/3 * PSR	P_5 = P_0 + PSR	P_6 = P_0 - PSR	P_7 = P_0 + 2 * PSR	P_8 = P_0 -2 * PSR
New Option Price (BAW)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Gain / Loss	$P\&L_1$ = $X_0 - X_1$	$P\&L_2$ = $X_0 - X_2$	$P\&L_3$ = $X_0 - X_3$	$P\&L_4$ = $X_0 - X_4$	$P\&L_5$ = $X_0 - X_5$	$P\&L_6$ = $X_0 - X_6$	$P\&L_7$ = $X_0 - X_7$	$P\&L_8$ = $X_0 - X_8$
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Risk Arrays Results	RA_1 = 100%*$P\&L_1$	RA_2 = 100%*$P\&L_2$	RA_3 = 100%*$P\&L_3$	RA_4 = 100%*$P\&L_4$	RA_5 = 100%*$P\&L_5$	RA_6 = 100%*$P\&L_6$	RA_7 = 35%*$P\&L_7$	RA_8 = 35%*$P\&L_8$

[5] The Corporation uses BAW (1987) model since most of the listed equity options that are cleared are American style.

The table above shows all details about the Risk Engine method used by the Corporation to calculate the worst potential loss of an Option contract. The last row has the eight Risk Arrays outcomes. The largest amount (positive amount) amongst the eight amounts is the Scanning Risk which will be, in most cases, the Initial Margin of this position.

It is important to note that the above calculations are performed at the Combined Commodity level, implying that when there is more than a single contract with the same Underlying Interest, the Risk Engine method calculates the Risk Arrays for all contracts belonging to the same Combined Commodity and then sums up the Risk Arrays results thus calculated for all contracts for the same scenario. In other words, the RA_1 of the first contract is added up to the RA_1 of the second contract and to the RA_1 of the n^{th} contract that belong to the same Combined Commodity in order to get the Total RA_1 for the same Combined Commodity. Then, the RA_2 of the first contract is added up to the RA_2 of the second contract and to the RA_2 of the n^{th} contract that belong to the same Combined Commodity in order to get the total RA_2 for the Combined Commodity. ~~And so forth for~~ Likewise we obtain~~ing~~ the total RA_3, RA_4, RA_5, RA_6, RA_7 and RA_8. Finally, the Risk Engine considers the largest amount of the eight total Risk Arrays as the Scanning Risk.

Example 2:

Let's assume a portfolio with three different positions: a short position in ten (10) Futures contracts on the S&P/TSX 60 Index, a long position in six (6) call Options contracts on the same index and a short position in three (3) put Options contracts on the same Underlying Interest (the expiry date for these three Options contracts might be the same or different).

In addition, the contract size and the price of the Futures contract are respectively 200 and F_0 and its Margin Interval is MI_F. The price of the call option is X_0, the price of the put option is Y_0 and the contract size of these two Option contracts is 100, whereas the price of the Underlying Interest S&P/TSX 60 Index is P_0 and its Margin Interval is MI_I. The MI_F and the MI_I values are almost the same but not exactly equal since the first is calculated using the historical volatility of the future's returns, whereas the second is calculated using the historical volatility of the index's returns. However, since the index and the Futures contracts are strongly correlated, both Margin Interval values must be almost similar. Using the calculated Margin Intervals, we can calculate the Price Scan Range (PSR_F) of the Future contract, which represents the fluctuation range of the Futures contract and the index Price Scan Range (PSR_I) which represents the fluctuation range of the underlying index as follows:

$$PSR_F = MI_F \times F_0 \times \text{Contract Size}$$

and,

$$PSR_I = MI_I \times P_0 \times \text{Contract Size}$$

Thus, since this Futures contract size is 200 and the contract size of the index option is 100, the previous formulas become:

$$PSR_F = MI_F \times F_0 \times 200$$

and,

$$PSR_I = MI_I \times P_0 \times 100$$

For the clarity of the table below, please note that the PSR_F and the PSR_I do not include the contract size, i.e. $PSR_F = MI_F \times F_0$ and $PSR_I = MI_I \times P_0$.

This is the Risk Arrays table of this example:

Risk Scenario	1	2	3	4	5	6	7	8
10 Index Futures Contracts								
Futures Price Variation	10 x 200 x 1/3 x PSR_F	-10 x 200 x 1/3 x PSR_F	10 x 200 x 2/3 x PSR_F	-10 x 200 x 2/3 x PSR_F	10 x 200 x PSR_F	-10 x 200 x PSR_F	10 x 200 x 2 x PSR_F	-10 x 200 x 2 x PSR_F
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total Weighted Profit and Loss	$P\&L_{F1}$ = 2000 / 3 x PSR_F	$P\&L_{F2}$ = -2000 / 3 x PSR_F	$P\&L_{F3}$ = 4000 / 3 x PSR_F	$P\&L_{F4}$ = -4000 / 3 x PSR_F	$P\&L_{F5}$ = 2000 x PSR_F	$P\&L_{F6}$ = -2000 x PSR_F	$P\&L_{F7}$ = 1400 x PSR_F	$P\&L_{F8}$ = -1400 x PSR_F
6 Index Call Option Contracts								
Index Price Variation	1/3 x PSR_I	-1/3 x PSR_I	2/3 x PSR_I	-2/3 x PSR_I	PSR_I	-PSR_I	2 x PSR_I	-2 x PSR_I
New Index Price	$P_1 = P_0 + 1/3 * PSR_I$	$P_2 = P_0 - 1/3 * PSR_I$	$P_3 = P_0 + 2/3 * PSR_I$	$P_4 = P_0 - 2/3 * PSR_I$	$P_5 = P_0 + PSR_I$	$P_6 = P_0 - PSR_I$	$P_7 = P_0 + 2 * PSR_I$	$P_8 = P_0 - 2 * PSR_I$
New Call Option Price (BAW)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total (6 x 100) Weighted Profit and Loss	$P\&L_{X1}$ = 600 x ($X_0 - X_1$)	$P\&L_{X2}$ = 600 x ($X_0 - X_2$)	$P\&L_{X3}$ = 600 x ($X_0 - X_3$)	$P\&L_{X4}$ = 600 x ($X_0 - X_4$)	$P\&L_{X5}$ = 600 x ($X_0 - X_5$)	$P\&L_{X6}$ = 600 x ($X_0 - X_6$)	$P\&L_{X7}$ = 210 x ($X_0 - X_7$)	$P\&L_{X8}$ = 210 x ($X_0 - X_8$)
3 Index Put Option Contracts								
New put Option Price (BAW)	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total (-3 x 100) Weighted Profit and Loss	$P\&L_{Y1}$= -300 x ($Y_0 - Y_1$)	$P\&L_{Y2}$= -300 x ($Y_0 - Y_2$)	$P\&L_{Y3}$= -300 x ($Y_0 - Y_3$)	$P\&L_{Y4}$= -300 x ($Y_0 - Y_4$)	$P\&L_{Y5}$ = -300 x ($Y_0 - Y_5$)	$P\&L_{Y6}$= -300 x ($Y_0 - Y_6$)	$P\&L_{Y7}$ = -105 x ($Y_0 - Y_7$)	$P\&L_{Y8}$= -105 x ($Y_0 - Y_8$)
Combined Commodity Risk Arrays Results	RA_1 = $P\&L_{F1}$ + $P\&L_{X1}$ + $P\&L_{Y1}$	RA_2 = $P\&L_{F2}$ + $P\&L_{X2}$ + $P\&L_{Y2}$	RA_3 = $P\&L_{F3}$ + $P\&L_{X3}$ + $P\&L_{Y3}$	RA_4 = $P\&L_{F4}$ + $P\&L_{X4}$ + $P\&L_{Y4}$	RA_5 = $P\&L_{F5}$ + $P\&L_{X5}$ + $P\&L_{Y5}$	RA_6 = $P\&L_{F6}$ + $P\&L_{X6}$ + $P\&L_{Y6}$	RA_7 = $P\&L_{F7}$ + $P\&L_{X7}$ + $P\&L_{Y7}$	RA_8 = $P\&L_{F8}$ + $P\&L_{X8}$ + $P\&L_{Y8}$

The largest amount (positive number) of the eight Risk Arrays results is the Scanning Risk which will be the Initial Margin of a portfolio with these three positions.

By convention, Risk Array values are given for a single long position. For a short position (as for the short Put option of the previous example), the calculated profit and loss is multiplied by the negative sign (-1). Losses for long positions are expressed as positive numbers and gains as negative numbers.

In the case of all the eight Risk Arrays values being negative (i.e. all corresponding to a gain) or zero (no risk), the Scanning Risk amount is set to zero.

The number of the Risk Arrays scenario that gives the largest amount (worst case scenario) for the option is called the Active Scenario. If two scenarios have the same figure, the one with the lowest scenario number is the Active Scenario. For example, if scenarios 5 and 7 give the largest and similar results, scenario 5 will be defined as the Active Scenario.

The Risk Engine calculates the Initial Margin for each Combined Commodity, for each member's account and sub-account. Thus, the Initial Margins calculated for each Combined Commodity account and sub-account are then sent to CDCS in order to be aggregated at the Clearing Member level.

Risk Arrays values are denominated in the same currency as the specific contract.

The Corporation's Risk Arrays file is published every day on the Chicago Mercantile Exchange (CME) website.

Short Option Minimum

In the event of a sharp variation of the Underlying Interest price, short option positions can lead to significant losses. Therefore, the Risk Engine calculates a minimum amount called Short Option Minimum (SOM) for short positions in each Combined Commodity. This amount will be called if it is higher than the result of the Risk Arrays.

In order to determine the appropriate SOM for every group of products, CDCC considers Out of The Money (OTM) call and put Options for every Underlying Interest.

After shocking the Underlying Interest price by its appropriate stress scenario, as set forth in the relevant notice to members, CDCC re-calculates the price of all OTM call and put Options using the new Underlying Interest price and the same other parameters of the Options. The difference between the actual Option price and the new Option price represents the potential loss of the Option. Then, the average of all Options' losses is calculated to determine the potential loss for every Underlying Interest. Finally, the average of the potential losses for all Underlying Interests of the same group of products is calculated to determine the potential loss of the Combined Commodity, which represents its SOM. The latter is then translated in a percentage of the Price Scan Range (PSR).

This SOM calculation is reviewed on a regular basis, at least annually, and communicated to Clearing Members by written notice.

OTCI TRANSACTIONS FOR WHICH THE UNDERLYING INTEREST IS A SECURITY

The Initial Margin calculation process for OTCI Transactions for which the Underlying Interest is a Security is the same as for listed options, except that the Corporation uses a theoretical price calculated using an in-house program, instead of the contractual option price.

Theoretical Price Calculation

The Corporation uses the Barone-Adesi and Whaley (BAW) model to evaluate the

Options that have an American style and the Black and Scholes (BS) model to evaluate the Options that have a European style. In order to evaluate the Option price, we need to determine the implied volatility to be used. For this, two different methodologies are used depending whether the Option is an Exchange traded Option.

If the Option contract is an Exchange traded Option, the Corporation uses the Option's data (the entire Option series for one expiry month) available at the Exchange and builds a Smile Volatility Curve using a Cubic Spline function. After building the Smile Curve, the Corporation determines the implied volatility that corresponds exactly to the strike price of the Option to be assessed. If the expiry date of the Option does not correspond to the ones of the listed series, the Corporation builds two Smile Volatility Curves, one using the Option series with an expiry date that is right after the one of the assessed Option and one using the series of Options with an expiry date that is right before the one of the assessed Option to be evaluated.

Then, the volatility that corresponds to the strike price of the Option to be evaluated is determined on each curve. Finally, a linear interpolation is done to determine the volatility that corresponds to the strike and to the expiry date of the Option to be evaluated. However, if the expiry date of the Option to be evaluated is before (after) the first (last) expiry date of the listed Options series, the Corporation uses the volatilities of the Smile Volatility Curve of the first (last) expiry date of the listed Option series.

If the Option is not listed and no data is available for it, the Corporation uses the yearly historical volatility of the Option's Underlying Interest price as a proxy for the implied volatility.

DIFFERENCE FUND

As defined in Section 8.2 of the Operations Manual, the Difference Fund is Margin Deposits held by the Corporation as discretionary margin, such as: (1) Unsettled Items Margin, (2) Daily Capital Margin Monitoring, (3) Advance calls for settlement of losses, (4) OTCI Additional Margin, and (5) Intra-Day Margin. The Corporation accepts Deposits to the Difference Fund in the same form and proportion as for the Margin Fund, as set forth in Section A-709 of the Rules.

Despite the fact that the Difference Fund is used to cover all the above elements, the sub-section regarding the Daily Capital Margin Monitoring intends to capture the credit risk. Consequently, this sub-section is described in details thereunder.

Daily Capital Margin Monitoring:

The Corporation measures the credit exposure to its Clearing Members on a daily basis through the Daily Capital Margin Monitoring Calls (DCMM~~the Difference Fund~~). The capital level is derived from regulatory reports received on a monthly basis in a timely manner (and on a quarterly basis if it is a Bank Clearing Member).

As prescribed in Section A-710 of the Rules, the Corporation may call for a contribution in the Difference Fund from Members that are undercapitalized in relation to their respective Initial Margin. The Corporation compares the Clearing Member's capital amount to the Initial Margin[6] on a daily basis and requires, if applicable, that the Clearing Member makes up any difference in the form of acceptable Deposits. Each Clearing Member's capital is analyzed and updated on a monthly basis.

In order to determine the contribution to the Difference Fund of Clearing Members, the Corporation uses the Net Allowable Assets (NAA). The Net Allowable Asset is a more restrictive type of capital, since it is the net result of the financial statement capital less the non allowable assets. Non allowable assets are composed of less liquid assets like capitalized leases, Investments in and Advances to Subsidiaries, etc. For Bank Clearing Members, the Corporation uses the Net Tier 1 capital.

The Corporation has access to the Clearing Member's financial statements from the CIPF (Canadian Investor Protection Fund), and the OSFI (Office of the Superintendent of Financial Institutions Canada) for Bank Clearing Members.

In addition to the monthly update of capital numbers, the Corporation performs a qualitative analysis of the financial statements of each member. The Corporation has defined specific thresholds to analyze the profitability, the margin required, the liquidity and the capital level. The Corporation could ask Clearing Members for more clarifications, if necessary.

Indeed, Investment Industry Regulatory Organization of Canada (IIROC) evaluates the financial condition of its Members. If an IIROC Member, who is also a Clearing Member, fails the tests designed to detect the risk of insolvency, the Corporation will be notified by IIROC. The Clearing Member itself shall also advise the Corporation

[6] The Initial Margin used for DCMM calculation does not include the additional margin for Concentration Risk.

immediately if it enters in an early warning level situation. IIROC may issue two types of warning, early warning level 1 or 2. This is function of the severity of the financial deficiency. The Corporation will be informed by IIROC and will closely monitor the situation. IIROC may impose sanctions or restrictions against the Member. The Corporation will judge if it is necessary to take any additional actions and will report the situation to the Risk Management and Advisory Committee (RMAC).

CLEARING FUND

The Clearing Fund deposits are set out in Rule A-6.

These provisions aim to cover extreme but plausible market events. The Clearing Fund is a reserve fund put in place to respond to the deficit that may occur when the Margin Fund and the Difference Fund of a defaulting Clearing Member no longer cover his market exposure. The Clearing Fund is an obligation shared by all the Clearing Members and this Fund is structured to mitigate the Uncovered Residual Risk ("URR"). The URR accounts for the fact that extreme market conditions could generate a major loss for certain Clearing Members, causing the potential default of a Clearing Member.

As it is indicated in Section A-603 of the Rules, the required Clearing Fund contribution of each Clearing Member is composed of Base Deposits plus a Variable Deposit specific to each Clearing Member. Clearing Fund Base Deposits and Variable Deposit could be modified by the Corporation. Clearing Members will be notified of any change pursuant to Section A-604 of the Rules. In accordance with Section A-611 of the Rules, whenever a Clearing Member ceases to be a Clearing Member of the Corporation, the balance of the Clearing Fund owed to the former Clearing Member will be paid to that former Clearing Member, thirty days after all outstanding items have been fulfilled from the Clearing Member's accounts, with the Corporation.

MEMBER CONTRIBUTION

For the purposes of application of Rule A-6, the Corporation issues an amount of Deposit to each Clearing Member on a monthly re-evaluation basis of the following elements:

- Each Clearing Member's contribution is based on his Uncovered Residual Risk (URR), which represents the difference between his stress margin and base margin[7], as shown in the below formula. The stress margin is calculated using a stressed Margin Interval which is equal to the Margin Interval times a stress factor. The two calculations are based on open positions on the preceding day of the calculations.

  URR = Stress Margin – Base Margin

- The last sixty business days are used to determine the average URR of each Clearing Member.

[7] The Base Margin used for Clearing Fund calculation does not include the additional margin for Concentration Risk.

$$\mu_{URR^i}^{60} = \frac{\sum_{t=1}^{60} URR_t^i}{60}$$

- The Corporation determines the size of the Clearing Fund (Ω) based on the maximum average URR amongst all Clearing Members.

$$\Omega = \underset{i=1}{\overset{n}{Max}}\left(\mu_{URR^i}^{60}\right)$$

- Each Clearing Member’s contribution (C) to the Clearing Fund is determined according to the weight of his respective average URR, with respect to the sum of all the average URRs of all Clearing Members.

$$C^i = \Omega \cdot \frac{\mu_{URR^i}^{60}}{\sum_{i=1}^{n} \mu_{URR^i}^{60}}$$