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**NCC CLEARING BANK RISK METHODOLOGY FOR
MOSCOW EXCHANGE EQUITY & BOND MARKET AND DEPOSIT MARKET**

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1. Terms and definitions

1.1. This Risk Methodology uses the following terms and definitions:

<i>Rollover rate</i>	The repo rate used to settle Trades T+ with an insufficient amount of cash/securities to perform obligations.
<i>Volatility</i>	A measure used to estimate the repo rate or security price variability. Its quantitative estimate is a standard deviation of repo trades rates or a relative deviation of security prices on Moscow Exchange over the Risk Assessment Period.
<i>Risk Parameter Calculation Time</i>	A time point when the risk parameters are calculated in accordance with the Clearing Rules.
<i>Interest Risk Assessment Range</i>	A range of interest rate values used by the Clearing Center to evaluate the interest risk of trades without full collateral required. There are three levels of the Range limits.
<i>Market Risk Assessment Range</i>	A range of security price values used by the Clearing Centre to evaluate the market risks of trades without full collateral required. There are three levels of the Range limits.
<i>Repo Discount</i>	A discount applied to the Security Settlement Price accepted as collateral in repo trades to determine the price of the first leg of the repo transaction.
<i>Repo Rate Band</i>	A range of repo rate values outside which member firm cannot submit orders for repo transactions on the Exchange.
<i>Clearing Center</i>	Bank "National Clearing Centre" (Joint-stock company).
<i>Concentration Limits of the 1st and 2nd levels</i>	Limits determining a net obligation (net claim) of a Clearing Member under a certain settlement code with the 1 st , 2 nd and 3 rd Levels of the Market Risk and Interest Risk Rates applied. Expressed in number of securities.
<i>Risk Assessment Period</i>	A period considered by the Clearing Centre as sufficient to detect and settle cases of a Clearing Member's failure to perform (perform improperly) its obligations under the trade and/or margin claims. There are three levels of Risk Assessment Periods.
<i>Clearing Rules</i>	The Clearing Rules of Bank "National Clearing Centre" (Joint-stock company).
<i>Settlement Repo Rate</i>	A rate determined by the Clearing Center based on repo trades executed during a Trading Day on the MOEX Main Market Sector. It is used to set upper and lower limits of the Repo Rate Interval and upper and lower limits of the Interest Risk Assessment Range. The rate is set individually for every security.
<i>Settlement Price</i>	Price used to set values of the upper and lower limits of the Price Band and upper and lower limits of the Market Risk Assessment Range.
<i>Inter-product spread discount</i>	Reduction in the total value of the Market Risk attributable to securities in the same spread group/umbrella group.

Interest Risk Rate	Possible change of the Settlement Repo Rate over the Risk Assessment Period subject to a given confidence level. There are three levels of the Interest Risk Rate.
Market Risk Rate	Possible change of the Estimated Price over the Risk Assessment Period subject to a given confidence level. There are three levels of the Market Risk Rate.
Trading Day	Trading Day as determined in the Moscow Exchange Trading Rules for securities.
Price Band	The range between which prices of order book and off order book orders can fluctuate. When orders prices approach the Price Band limits, the Market Risk Assessment Range is moved.

- 1.2. Any terms not expressly defined herein have the meanings ascribed to them by the laws and regulations of the Russian Federation, regulations of the Bank of Russia, internal documents of the NCC Clearing Bank, and the Trading Rules of the Moscow Exchange for the Equity and Bond Market.
- 1.3. This Methodology contains the following conventions (any suffixes is referred to as a Trading Day and given on the assumption that the risk parameters are estimated at the Risk Parameter Calculation Time on day i):

No	Parameter	Convention
1	Trading Day during which risk parameters are determined for the next Trading Day (the suffix).	i
	Foreign currency	VAL
2	Number of calendar days between the settlement date of the trade executed on the Central Order Book T+ and current Trading Day (the superscript)	k
3	Settlement price in RUB (for shares, general collateral certificates and bonds). It includes also accumulated interest in case of a bond.	P_i
4	Net settlement price of a bond, in percentage of its face value.	P_{stlmnt_i}
5	Aggregated prices of best bids and best asks at the time of risk parameter calculation. In RUB for shares; % of face value for bonds.	BID_i, ASK_i
5.1	Prices of best bids and best asks with T0 settlement code at the time of risk parameter calculation. In RUB for shares; % of face value for bonds.	$BID0_i, ASK0_i$
5.2	Prices of best bids and best asks on the Central Order Book T+ at the time of the risk parameter calculation. In RUB for shares; % of face value for bonds.	$BIDN_i, ASKN_i$
6	Best rates in orders of cash borrowers and orders of cash lenders at the time of risk parameter calculation. In % per annum.	RR_BID_i, RR_ASK_i
7	Aggregated price of the last trade at the time of risk parameter calculation (the closing price).	P_close_i
7.1	Prices of last trades with T0 settlement code at the time of risk parameter calculation.	PO_close_i
7.2	Prices of last trades on the Central Order Book T+ at the time of risk parameter calculation.	PN_close_i
8	Relative change of settlement price, in %.	r_i
9	Weighing ratio used to calculate Volatility (determined at the moment of risk parameter calculation on day i).	a_i
10	Holiday factor.	G_i
11	Security volatility (in the Risk Assessment Period).	σ_i
12	Tentative Market Risk Rate.	S_i^p
13	Estimated Market Risk Rate.	V_i
14	Weighted average ("net") price of the bond. In % of the face value.	P_wa_i
15	Accumulated interest. In currency of the face value.	$HKД_i$

16	Cash flows from a bond, including coupon payments, amortisation, face amount payment in t years after the risk parameter calculation. In currency of the face value.	$CashFlow_i(t)$
17	Bond liquidity by the end of day i .	l_i
18	Smoothed liquidity of a bond by the end of day i .	L_i
19	Smoothed liquidity of a bond Issuer by the end of day i .	L_{issuer_i}
20	t -year risk-free yield derived from the zero-coupon yield curve for government bonds, by currency of the face value.	$G_i(t)$
21	Trading volume of a bond on day i on the Central Order Book. In settlement currency.	$Volume_i$
22	Z-spread of a bond by the end of trading day i .	Z_{wa_i}
23	Z-spread of a bond issuer by the end of trading day i .	Z_{issuer_i}
24	Theoretical Z-spread of a bond.	Z_{theor_i}
25	Theoretical price of a bond.	P_{theor_i}
26	Settlement Z-spread of a bond.	$Z_{sttlmnt_i}$
27	Modified duration of a bond.	$MDur_i$
28	Modified duration of an issuer's debt.	$MDur_{issuer_i}$
29	G-curve volatility for currency of the face value.	σ_{curve_i}
30	Z-spread volatility.	σ_{z_i}
31	Market risk rate, Level 1 (2, 3), % of the settlement price.	$S_{1(2,3)_i}$
32	Upper limit of the Price Band. In RUB for shares; in % of the face value for bonds.	PcH_i^k
33	Lower limit of the Price Band. In RUB for shares; in % of the face value for bonds.	PcL_i^k
34	Market risk assessment range, Upper limit, Level 1 (2,3). In RUB.	$PtH_{1(2,3)_i}$
35	Market risk assessment range, Lower limit, Level 1 (2,3). In RUB.	$PtL_{1(2,3)_i}$
36	Settlement Repo Rate for T period in VAL currency. % per annum.	$REPOrate(T, VAL)$
40	Rate change.	r_{IR_i}
41	Tentative Interest Risk Rate.	Δ_i^p
42	Estimated Interest Risk Rate.	V_{IR_i}
43	Interest risk upward estimate	$H\Delta_{-J}$
44	Interest rate downward estimate	$L\Delta_{-J}$
45	Upper limit of the Repo Rate Band.	$RRcH_i$
46	Lower limit of the Repo Rate Band.	$RRcL_i$
47	Interest risk assessment range, Upper limit, Level 1 (2,3). In RUB.	$RRtH_{1(2,3)_i}^k$
48	Interest risk assessment range, Lower limit, Level 1 (2,3). In RUB.	$RRtL_{1(2,3)_i}^k$
49	Repo Discount.	$DiscountREPO_i$
50	Face value of a bond.	$Facevalue_i$
51	Repo transaction term. It is the number of calendar days between the settlement dates of the 1 st and 2 nd parts of the repo transaction.	$cpokPEPIO_i$
52	Minimum Market Risk Rate, Level 1 (2,3). It is set individually for each security, in % of the settlement price.	$S_{1(2,3)_{min}}$
53	Concentration, Limit 1 (2, 3). In number of shares.	$LK_{1(2)}$
54	Maximum Market Risk Rate for shares.	$S_{max_{eq}}$
55	Minimum Market Risk Rate movement (step).	h
56	Volatility multiplier determining the confidence level for the Market Risk Assessment Range.	q
57	Smoothing coefficient for liquidity factors.	α

58	Period to estimate Level 1 (2,3) risks. In days.	<i>rh_1(2,3)</i>
59	Market liquidity risk rate for shares.	<i>liq_eq</i>
60	Market liquidity risk rate for bonds.	<i>liq_bnd</i>
61	Maximum Market Risk for bonds.	<i>S_max_bnd</i>
62	Ratio of Price Band to Market Risk Assessment Range.	<i>x_pr</i>
63	Ratio of Repo Rate Band to Interest Rate Assessment Range.	<i>x_IR</i>
64	Minimum movement of the Interest Risk Rate.	<i>h_IR</i>
65	Market liquidity risk rate for repo transactions, in % per annum.	<i>liq_RR</i>
66	Interest risk minimum upward estimate.	<i>MMΔ_1</i>
67	Interest rate minimum downward estimate.	<i>SECΔ_1</i>
68	Rollover Rate for cash in RUB	<i>MONEYRate</i>
69	Rollover Rate for securities	<i>SECRate</i>
70	Maximum approximation of best quotes to the Price Band limit. In share of the Price Band for the instrument.	<i>w</i>
71	Period that meets the following condition: if best quotes are as close as possible to the limit of the Price Band/Repo Rate Band during such period, the limits are to be reviewed at the end of the period during market hours. In minutes.	<i>u</i>
72	Scale factor used to calculate liquidity ratio of a bond.	<i>Scale</i>
73	Scale factor used to calculate the weighting coefficient for the issuer's spread.	<i>DurScale</i>
74	Maximum Rollover Rate.	<i>HSECRate</i>
75	Minimum Rollover Rate.	<i>LSECRate</i>
76	Maximum fluctuations of orders prices (up and down) during a day (proportionally).	<i>PcH_max</i> <i>PcL_max</i>
77	Attribute of order monitoring (True or False).	<i>Monitoring</i>
78	Limit shift coefficient.	<i>Shift</i>
79	Attribute of EWMA used to calculate Market Risk Rates (True or False).	<i>isEWMA</i>
80	Attribute of EWMA used to calculate Interest Risk Rates (True or False).	<i>isEWMA_IR</i>
81	Smoothing coefficient used to calculate liquidity factors for a bond. It is set across bonds of one issuer.	<i>α</i>
82	Scale coefficient used to calculate liquidity factors of a bond. It is set across bonds of one issuer.	<i>scale</i>
83	Scale coefficient used to calculate theoretical Z-spread of a bond.	<i>DurScale</i>
84	Attribute of external theoretical prices (True or False). False by default for all securities.	<i>UseEXTERNAL</i>
85	Assets/groups in the spread group/umbrella group.	<i>Group</i>
86	Discount for an inter-product spread. Applicable to a spread group/umbrella group. In proportion.	<i>Skidka(Group)</i>

2. General provisions

- 2.1. This methodology has been designed in accordance with the Clearing Rules. It sets out how risk parameters used by the Clearing Center to monitor and manage risks are determined.
- 2.2. The methodology is available on the Clearing Center's website.

3. Risk management system parameters

- 3.1. This methodology defines calculation rules for the following risk parameters:
 - Settlement prices (shares and bonds traded without full collateral required, and general collateral certificates);
 - Market Risk Rates;
 - Upper and Lower limits of the Market Risk Assessment Range;
 - Upper and Lower limits of the Price Band;
 - Repo Discount;

- Concentration limits of the 1st and 2nd levels;
 - Settlement Repo Rates;
 - Interest risk rates;
 - Upper and Lower limits of the Interest Risk Assessment Range;
 - Upper and Lower limits of the Repo Rate Band.
- 3.2. Other parameters specified in Clause 1.3 hereof, but not listed in Clause 3.1 hereof, are for the technical purpose in calculation risk parameters indicated in Clause 3.1 hereof.
- 3.3. Parameters 3-50 in Clause 1.3 hereof are dynamic measures with their values calculated every Trading Day at Risk Parameters Calculation Times set out in the Clearing Rules. The dynamic risk parameters may be changes by the Clearing Center.
- 3.4. Parameters 51-86 in Clause 1.3 hereof are statistical measures with their values determined by the Clearing Center and reviewed if necessary.
- 3.5. Initial values of the dynamic and technical parameters indicated in Clauses 3.2-3.3 hereof are set by the Clearing Center with respect to securities under consideration to be admitted to trading without full collateral required, or to T+ trading, or securities with full collateral required.
- 3.6. The Clearing Center may set Individual risk parameters for any Clearing Member as set forth in the Clearing Rules.
- 3.7. Algorithms and parameters given for shares are applicable also to depositary receipts, fund units and ETFs.

4. Basic principles of the Market and Interest Risk Rates calculation

- 4.1. Market and Interest Risk Rates are calculated individually for every security which are cleared without full collateral required.
- Collateral requirements for such trades include market and interest risk rates calculated by the Clearing Center and other parameters and conditions specified in the Methodology and/or Clearing Rules and referred to the collateral size including settlement period and terms.
- 4.2. The Clearing Center may calculate the market risk rate for every security admitted to trading on the Moscow Exchange Equity & Bond Market with full pre-funding.
- Collateral requirements for such securities include market risk rate calculated by the Clearing Center as well as other parameters and conditions specified in the Methodology and/or Clearing Rules and referred to the collateral size including settlement period and terms.
- 4.3. The exponential weighting method is used to estimate Volatility in the calculation of the market and interest risk rates.
- 4.4. The Clearing Center sets minimum and maximum Market Risk Rates as well as Minimum Interest Risk Rates (see Annex 1-2 hereto).
- 4.5. The Clearing Center may decide to announce Market and Interest Risk Rates that are different from their estimated values subject to ancillary market factors.

5. Concentration limits definition

- 5.1. Shares and bonds
- The Level 1 Concentration Limit is the estimated maximum possible position size in a security which can be closed quickly without having a material effect on the security price. The Level 2 Concentration Limit is the estimated maximum possible position size in a security which can be closed within the Level 2 Risk Assessment Period without having a material effect on the security price.
 - Concentration limits are set per groups on the basis of trading volumes and expert judgement from the Clearing Center (see Annex 1-2 hereto).
 - The Clearing Center can adjust concentration subject to ancillary market factors.
- 5.2. General collateral certificates
- Concentration limits are set subject to expert judgement from the Clearing Center.

6. Settlement Price calculation algorithm for shares and general collateral certificates

6.1. Shares

- To determine the settlement price of a share, closing prices (P_{close}), best asks (ASK) and best bids (BID) in VAL currency available on the order book with T settlement date are converted into RUB currency by using the Central Rates and the Central Indicative Rate of swaps:

$$P_{close_i}(T, VAL, RUB) = P_{close_i}(T, VAL) \times [Rc_i(VAL) + SWA Pr ate_i(T, VAL)],$$

$$ASK_i(T, VAL, RUB) = ASK_i(T, VAL) \times [Rc_i(VAL) + SWA Pr ate_i(T, VAL)],$$

$$BID_i(T, VAL, RUB) = BID_i(T, VAL) \times [Rc_i(VAL) + SWA Pr ate_i(T, VAL)],$$

$$VOLUME_i(T, VAL, RUB) = VOLUME_i(T, VAL) \times Rc_i(VAL),$$

where:

$P_{close_i}(T, VAL)$ – the order book closing price with T settlement date and VAL settlement currency;

$ASK_i(T, VAL)$ – the rate of best ask on the order book with T settlement date and VAL settlement currency;

$BID_i(T, VAL)$ – the rate of best bid on the order book with T settlement date and VAL settlement currency;

$SWA Pr ate_i(T, VAL)$ – the Central Indicative Rate of swaps VALRUB on the FX Market for key maturity T (in RUB);

$Rc_i(VAL)$ – the Central Rate for currency pair VALRUB on the FX Market;

$VOLUME_i(T, VAL)$ – trading volume in the instrument with settlement in VAL currency. If either BID or ASK is not available or zero, the parameters given in the formulae above are calculated based on expressions with existing BID and/or ASK. If both BID and ASK are not available or zero, the relevant parameter value is deemed not available.

- The values in RUB are aggregated for every VAL currency and T settlement date:

$$P_{close_i} = \frac{\sum_{VAL, T} \frac{P_{close_i}(T, VAL, RUB)}{1 + \frac{T \times REPOrate_i(T)}{365}} \cdot VOLUME_i(T, VAL, RUB)}{\sum_{VAL} Volume_i(T, VAL, RUB)},$$

$$ASK_i = \max_{VAL, T} \left[\frac{ASK_i(T, VAL, RUB)}{1 + \frac{T \times REPOrate_i(T)}{365}} \right],$$

$$BID_i = \min_{VAL, T} \left[\frac{BID_i(T, VAL, RUB)}{1 + \frac{T \times REPOrate_i(T)}{365}} \right],$$

Where:

$P_{close_i}(T, VAL, RUB)$ – the order book closing price with T settlement date as recalculated into RUB;

$REPOrate_i(T)$ – the Settlement Repo Rate on the order book with T settlement date;

$ASK_i(T, VAL, RUB)$ – the best ask price as recalculated into RUB;

$BID_i(T, VAL, RUB)$ – the best bid price as recalculated into RUB;

$VOLUME_i(T, VAL, RUB)$ – order book trading volume with T settlement date as recalculated into RUB;

- If the attribute of external theoretical prices UseEXTERNAL is set to true for a security, prices of (BID_i) and (ASK_i) are adjusted as follows:

$$BID_i = \max(BID_i; BID_EXT_i),$$

$$ASK_i = \min(ASK_i; ASK_EXT_i).$$

Where the parameters are calculated with external data used, and parameters BID_EXT_i and ASK_EXT_i are given in a currency other than RUB, their values are recalculated into RUB at the rate of the last trade in VALRUB currency pair of the FX Market and Precious Metals Market as at the time of loading data on orders.

- The share settlement price in RUB $P_i(RUB)$ is determined by adjusting the share closing price by (BID_i) and (ASK_i):

$$P_i(RUB) = \text{mid}(BID_i, P_close_i, ASK_i)$$

If there were no trades resulted from order book orders, the closing price is deemed the previous day's settlement price. If only selling orders are available, then

$$P_i(RUB) = \min(P_close_i, ASK_i)$$

If only buying orders are available, then

$$P_i(RUB) = \max(P_close_i, BID_i)$$

Otherwise,

$$P_i(RUB) = P_close_i,$$

where

$\text{mid}()$ – the function to calculate the median,

BID_i, P_close_i, ASK_i – the aggregated price of best bids, closing price and best asks, respectively.

The share settlement price in VAL currency is determined as follows:

$$P_i(VAL) = \frac{P_i(RUB)}{Rc(VAL)},$$

where

$P_i(RUB)$ – the share settlement price in RUB,

$Rc(VAL)$ – the Central Rate of trades in currency pair VALRUB.

- The Clearing Center can set the Settlement Price other than that determined in accordance with the algorithm described above.

6.2. General collateral certificates

- The Settlement Price of a general collateral certificate equals its principal value and set to be RUB 1.

7. Market Risk Rate calculation algorithm

7.1. Shares:

- 7.2. There are the following three levels of the Market Risk Rates for shares (everywhere in this section, the "Rate"):
- 7.3. The First Level Rate (S_1) is applicable to small-sized positions whose size does not exceed the Concentration Limit of the 1st Level (LK_1). It is assumed that such positions can be closed out quickly without having a material impact on the security price. S_1 is calculated based on the 1st level of the Risk Assessment Period (rh_1). LK_1 is calculated on the basis of security liquidity.
- 7.4. The Second Level Rate (S_2) is applicable to medium-sized positions, i.e. whose size is between the Concentration Limits of the 1st (LK_1) and 2nd (LK_2) Levels. S_2 is calculated based on the 2nd level of the Risk Assessment Period (it is assumed that the position can be closed out within the period rh_2).
- 7.5. The Third Level Rate (S_3) is applicable to large-sized positions, i.e. whose size exceeds the Concentration Limit of the 2nd Level (LK_2). S_3 is calculated based on the 3rd level of the Risk Assessment Period (it is assumed that the position can be closed out within the period rh_3).
- 7.6. To determine the Rates for shares, an exponentially weighted moving average (EWMA) volatility estimate is used.
- 7.7. The Rates of the 1st, 2nd and 3rd levels are calculated every Trading Day i at the Risk Parameter Calculation Time.
- 7.8. To calculate the Rates of the 1st Level (S_{1i}):
- 7.9. Percentage change r_i of the Settlement Price is calculated:

$$r_i = \max \left[\left| \frac{P_i(\text{RUB}) - P_{i-2}(\text{RUB})}{P_{i-2}(\text{RUB})} \right|, \left| \frac{P_i(\text{RUB}) - P_{i-1}(\text{RUB})}{P_{i-1}(\text{RUB})} \right| \right],$$

i.e. the maximum of the two following values:

- percentage change of the settlement price over one day;
- percentage change of the settlement price over two days.

- 7.10. Weighting coefficient a_i is determined.
- 7.11. If percentage change r_i of the price is greater than Volatility estimate σ_{i-1} of the previous Trading Day, then $a_i = a_{up}$, or $a_i = a_{down}$ otherwise:

$$a_i = \begin{cases} a_{up}, & \text{if } r_i > \sigma_{i-1}, \\ a_{down}, & \text{if } r_i \leq \sigma_{i-1}. \end{cases}$$

- 7.12. If more than one non-trading day occur between Trading Days $i-2$ and i , weighting coefficient a_i is set to zero. In this Methodology, a non-trading day is:
- - any public holiday in Russia provided that it is a business day in Europe and the US;
 - - a non-trading day for a specific instrument, i.e. a day on which the Central Order Book T+ is closed provided that it is the business day in Russia.
- 7.13. Non-trading day factor G_i is determined in the upcoming Risk Assessment Period:

$$G_i = \sqrt{1 + \frac{m_i}{rh_{-1}}}$$

7.14. The parameter m_i is determined for a specific security as the amount of non-trading days for that security in the upcoming Risk Assessment Period:

7.15. Volatility is adjusted as follows:

$$\sigma_i = \sqrt{(1 - a_i) \cdot \sigma_{i-1}^2 + a_i \cdot r_i^2} \quad (7.1)$$

7.16. If percentage change r_i of the price exceeds Rate $S_{-1_{i-1}}$ and just one holiday occurs between Trading Days i and $i-2$, the following value is also calculated along with volatility calculated as per formula (6.1):

$$\sigma_i^* = \frac{r_i}{q} \quad (7.2)$$

In this case, Volatility σ_i is determined as per formula: $\sigma_i = \max(\sigma_i, \sigma_i^*)$.

In formula (7.2) and everywhere below, parameter q is the volatility multiplier determined through a look back analysis and back testing.

7.17. Tentative Rate S_i^p is determined in accordance with the following algorithm:

if $\text{ceiling}\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h \geq S_{i-1}^p + h$, then $S_i^p = \text{ceiling}\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h$;

otherwise, if $\text{ceiling}\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h \leq S_{i-1}^p - h$ and at least n Trading Days pass since the Tentative Rate changed last time, then $S_i^p = S_{i-1}^p - h$;

otherwise, $S_i^p = S_{i-1}^p$, where ceiling – the function of rounding up to the integer value.

7.18. Minimum Rates, Level 1, 2 and 3 (S_{-1_min} , S_{-2_min} and S_{-3_min}) are determined to: Curb the model risk if the Volatility estimate is excessively low for stress scenarios; Prevent trading halt in the event of a too narrow Price Band.

7.19. Estimated Market Risk V_i is determined subject to its discrete nature and minimum movement h :

$$V_i = \min\left(\text{ceiling}\left(\frac{\max(S_i^p \cdot G_i + liq_eq; S_{-1_min})}{h}\right) \cdot h; S_{-max_eq}\right)$$

7.20. Final Market Risk Rate S_{-1_i} is set to be the value of Estimated Market Risk Rate V_i .

7.21. Values of Rates S_{-2_i} and S_{-3_i} are determined by calculating Volatility in Risk Assessment Periods for risks of 2nd and 3rd levels subject to Minimum and Maximum Market Risk Rates for shares:

$$S_{-2_i} = \min\left(\text{ceiling}\left(\frac{\max\left(\sqrt{\frac{rh_{-2}}{rh_{-1}}} \cdot (S_i^p \cdot G_i + liq_eq); S_{-2_min}\right)}{h}\right) \cdot h; S_{-max_eq}\right)$$

$$S_{-3}_i = \min(\text{ceiling} \left(\frac{\max \left(\sqrt{\frac{rh_{-3}}{rh_{-1}}} \cdot (S_i^p \cdot G_i + liq_{-eq}); S_{-3_min} \right)}{h} \right); S_{-max_eq})$$

- 7.22. If attribute isEWMA is set to false, the Market Risk Rates are set to equal the Minimum Market Risk Rate.
- 7.23. The Clearing Center can set Rates of the 1st, 2nd and 3rd Levels different from their estimated values.
- 7.24. General collateral certificates:

Market Risk Rates for general collateral certificates are set to zero.

8. Gross Settlement Price calculation algorithm for bonds

- 8.1. The weighted average ("net") prices and orders prices are calculated:

$$P_{-wa}_i = \frac{\sum_{VAL,T} \frac{P_{-wa}(T, VAL)}{1 + \frac{T \times REPOrate_i(T)}{365}} \cdot Volume(T, VAL, RUB)}{\sum_{VAL} Volume(VAL, RUB)},$$

$$ASK_i = \max_{VAL,T} \left[\frac{ASK(T, VAL)}{1 + \frac{T \times REPOrate_i(T)}{365}} \right],$$

$$BID_i = \min_{VAL,T} \left[\frac{BID(T, VAL)}{1 + \frac{T \times REPOrate_i(T)}{365}} \right],$$

where

$P_{-wa}(T, VAL)$ – the weighted average ("net") price of a bond in percentage of its face value by the close of order book trading, with settlement date T, in currency VAL,

$REPOrate_i(T)$ – the order book Settlement Repo Rate with settlement date T,

$ASK(T, VAL)$ – the price of best ask on the order book with settlement date T, in currency VAL,

$BID(T, VAL)$ – the price of best bid as recalculated into RUB, on the order book with settlement date T, in currency VAL,

$VOLUME(T, VAL, RUB)$ – the order book trading volume for the instrument with settlement date T and currency VAL, as recalculated into RUB at the Central Rate.

- 8.2. The Z spread Z_{-wa}_i is calculated by the close of trading (provided that the bond is traded on this trading day). It is calculated by solving the following equation:

$$\frac{P_{-wa}_i}{100} \cdot Facevalue_i + HKD_i = \sum_t \frac{CashFlow_i(t)}{(1 + G_i(t) + Z_{-wa}_i)^t},$$

Where

P_{-wa}_i - the weighted average price of the bond calculated as per Clause 8.1;

$Facevalue_i$ - the current face value of the bond in the face value currency;

$CashFlow_i(t)$ – cash flow in the face value currency (coupon payment, amortization, principal payment) in t years after calculation date of the risk parameters;

$G_i(t)$ – the risk-free return of the principal currency for t years.

- 8.3. Liquidity factors for a bond (l_i, L_i) and issuer L_issuer_i are calculated:

$$l_i = \frac{Volume_i}{\exp(scale \cdot abs(Z_wa_i - Z_sttmnt_{i-1}))} \quad l_i = \frac{Volume_i}{\exp(scale \cdot abs(Z_wa_i - Z_sttmnt_{i-1}))};$$

$$L_i = \alpha \cdot l_i + (1 - \alpha) \cdot L_{i-1};$$

$$L_issuer_i = Avg_j(L_{i,j}) \quad L_issuer_i = Avg_j(L_{i,j}),$$

where

Avg_j - the average liquidity of all bonds of the issuer (bonds denominated in different currencies are considered as bonds of different issuers),

$Volume_i = \sum_T VOLUME_i(T, VAL.RUB)$ - the order book trading volume for the instrument with settlement in currency VAL, as recalculated into RUB at the Central Rate on day i ;

α - smoothing coefficient for liquidity factors;

$scale$ – the scale factor.

The modified duration of the issuer's debt is calculated as follows:

$$MDur_issuer_i = \frac{\sum_{IssuerName=Issuer} MDur_{i-1}(IssuerName) \cdot L_i(IssuerName)}{\sum_{IssuerName=Issuer} L_i(IssuerName)}.$$

- 8.4. The issuer's Z spread (Z_issuer_i) is calculated subject to trading volume in every bond issue on day i and the issuer's Z spread on the previous day:

$$Z_issuer_i = \frac{\sum_j (l_{i,j} \cdot Z_wa_{i,j}) + Z_issuer_{i-1} \cdot L_issuer_{i-1}}{\sum_j (l_{i,j}) + L_issuer_{i-1}},$$

Where

\sum_j - summing up across all bonds of the issuer that are traded on day i .

- 8.5. The theoretical Z spread (Z_theor_i) of a bond is calculated as follows:

$$Z_theor_i = \frac{l_i \cdot Z_wa_i + Z_sttmnt_{i-1} \cdot L_{i-1} + Flag \cdot Z_issuer_i \cdot L_issuer_i \cdot DurFactor}{l_i + L_{i-1} + Flag \cdot L_issuer_i \cdot DurFactor},$$

where $Flag = 0$, if $L_i > L_issuer_i$, otherwise $Flag = 1$,

$$DurFactor = \exp(-DurScale \cdot abs(MDur_{i-1} - MDur_issuer_i)),$$

$DurScale$ – the scale factor.

8.6. The theoretical price of a bond is calculated based on the theoretical Z spread (Z_theor_i) and the zero coupon yield curve for government bonds in the principal currency (G curve in the principal currency) as described in Clause 8.2 by substituting Z_wa_i for Z_theor_i .

8.7. The Net Settlement Price (P_stlmnt_i) of a bond is determined by adjusting the theoretical price by prices of (BID) and (ASK), as well as by using external data for BID_EXT and ASK_EXT . Final values of BID and ASK are determined as follows:

$$BID = \max(BID_17; BID_19; BID_EXT)$$

$$ASK = \min(ASK_17; ASK_19; ASK_EXT)$$

If bids and asks are available

$$P_stlmnt_i = \text{mid}(BID_i, P_theor_i, ASK_i),$$

where

mid - the function to calculate the median.

If only asks are available, then $P_stlmnt_i = \min(P_theor_i, ASK_i)$.

If only bids are available, then $P_stlmnt_i = \max(P_theor_i, BID_i)$. Otherwise, $P_stlmnt_i = P_theor_i$.

Orders prices are derived from the Central Order Book T+ data and additional data sources.

If the attribute of external theoretical prices UseEXTERNAL is set to true for a security, then the following values are used instead of P_theor :

- P_wa_i , if any order book trades were executed in the security on day i ;
- P_stlmnt_{i-1} , if no trades were executed.

8.8. The settlement Z spread (Z_stlmnt_i) of a bond is determined based on its Net Settlement Price P_stlmnt_i under the algorithm described in Clause 8.12 hereof, by substituting the weighted average ("net") price P_wa_i for net settlement price P_stlmnt_i . Then, risk parameter Z_issuer_i is recalculated according to the formula given in Clause 8.4 by substituting parameter Z_wa_i for Z_stlmnt_i .

8.9. The Gross Settlement Price of a bond in the principal currency is calculated as follows:

$$P_i = \frac{P_stlmnt_i}{100} \cdot Facevalue_{i+1} + HKД_{i+1}.$$

8.10. The modified duration of a bond is calculated as follows:

$$MDur_i = \frac{1}{\frac{P_stlmnt_i}{100} \cdot Facevalue_i + HKД_i} \cdot \sum_t \frac{CashFlow_i(t) \cdot t}{(1 + G_i(t) + Z_stlmnt_i)^{t+1}}$$

8.11. When the Gross Settlement Price in RUB is determined for a bond denominated in foreign currency, spot rates and forward rates of the relevant foreign currency against RUB are taken into account.

8.12. The Gross Settlement Price in RUB is calculated as follows:

$$P_i(RUB) = P_i(VAL) \cdot Rc_i(VAL),$$

where

$P_i(VAL)$ – the gross Settlement price of the bond denominated in VAL,

$Rc_i(VAL)$ – the Central Rate of transactions in VAL with settlement in RUB.

- 8.13. The Clearing Center can set the gross Settlement Price in RUB different from its value calculated through the algorithm given above.

9. Market Risk Rate calculation algorithm for bonds

- 9.1. To determine the Market Risk Rate for bonds (everywhere in this section, the "Rate"), the Interest Rate Volatility should be estimated. The Interest Rate Volatility is the sum of EWMA (exponentially weighted moving average) estimates of the Volatility of the zero-coupon yield curve and Volatility of the Z spread.

- 9.2. Volatility of the G curve (σ_curve_i) in the principal currency is calculated similar to the EWMA calculated volatility for shares with a variable r_i substituted for a variable r_curve_i which is recalculated at the close of trading every day as follows:

$$r_curve_i = \max_j (abs[G_curve(\theta_j)_i - G_curve(\theta_j)_{i-1}]; \\ abs[G_curve(\theta_j)_i - G_curve(\theta_j)_{i-2}]),$$

Where the maximum value is determined from different terms θ_j of the G curve in the principal currency.

- 9.3. Volatility of the Z spread (σ_z_i) is calculated similar to EWMA calculated volatility used to calculate volatility of shares prices with a variable r_i substituted for a variable r_z_i , which is recalculated at the close of trading every day as follows:

$$r_z_i = \max(abs[Z_stlmnt_i - Z_stlmnt_{i-1}]; abs[Z_stlmnt_i - Z_stlmnt_{i-2}]),$$

where Z_stlmnt_i - the settlement value of the Z spread by the end of day i .

- 9.4. Bond volatility (σ_i) is determined as follows:

$$\sigma_i = MDur_i \cdot (\sigma_curve_i + \sigma_z_i),$$

where $MDur_i$ - the modified duration of the bond.

- 9.5. To determine the Rate of the 1st Level:

- The tentative Rate S_i^p is calculated using the following algorithm:

if $ceiling\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h \geq S_{i-1}^p + h$, then $S_i^p = ceiling\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h$; otherwise

if $ceiling\left(\frac{q \cdot \sigma_i}{h}\right) \cdot h \leq S_{i-1}^p - h$ and minimum n Trading Days have passed since the

Tentative Rate was changed, then $S_i^p = S_{i-1}^p - h$;

otherwise $S_i^p = S_{i-1}^p$, where $ceiling$ – the rounding function, round up to the nearest integer.

- The estimated rate V_i is calculated subject to discrete behavior of the Settlement Rate and minimum movement h :

$$V_i = \min(\text{ceiling} \left(\frac{\max(S_i^p \cdot G_i + \text{liq_bnd}; S_{-1_min})}{h} \right) \cdot h; S_{-max_bnd}).$$

- The final value of the Rate of the 1st Level (S_{-1_i}) is set to equal the value of the Estimated Market Risk Rate V_i .

9.6. The Rates of the 2nd (S_{-2_i}) and 3rd (S_{-3_i}) Levels are determined by using Volatility in Risk Assessment Periods with respect to risks of the 2nd and 3rd Levels subject to the established minimum and maximum Market Risk Rates for bonds:

$$S_{-2_i} = \min(\text{ceiling} \left(\frac{\max \left(\sqrt{\frac{rh-2}{rh-1}} \cdot (S_i^p \cdot G_i + \text{liq_bnd}); S_{-2_min} \right)}{h} \right) \cdot h; S_{-max_bnd}),$$

$$S_{-3_i} = \min(\text{ceiling} \left(\frac{\max \left(\sqrt{\frac{rh-3}{rh-1}} \cdot (S_i^p \cdot G_i + \text{liq_bnd}); S_{-3_min} \right)}{h} \right) \cdot h; S_{-max_bnd}).$$

- 9.7. If the attribute isEWMA is set to false, the Market Risk Rate is set to equal its minimum.
- 9.8. The Clearing Center may set the Rates of the 1st, 2nd and 3rd Levels to be different from their estimated values.

10. Calculation of the Upper and Lower Limits of the Market Risk Assessment Range

10.1. Shares and bonds

- The Upper Limit of the Market Risk Assessment Range, Level 1 (2,3) is determined as follows as the Settlement Price in RUB plus the Market Risk Rate, Level 1 (2,3):

$$PtH_{-1_i}(RUB) = P_i(RUB) \cdot (1 + S_{-1_i}),$$

$$PtH_{-2_i}(RUB) = P_i(RUB) \cdot (1 + S_{-2_i}),$$

$$PtH_{-3_i}(RUB) = P_i(RUB) \cdot (1 + S_{-3_i}).$$

- The Lower Limit of the Market Risk Assessment Range, Level 1 (2,3) is determined as follows as the Settlement Price in RUB minus the Market Risk Rate, Level 1 (2,3):

$$PtL_{-1_i}(RUB) = P_i(RUB) \cdot (1 - S_{-1_i}),$$

$$PtL_{-2_i}(RUB) = P_i(RUB) \cdot (1 - S_{-2_i}),$$

$$PtL_{-3_i}(RUB) = P_i(RUB) \cdot (1 - S_{-3_i}).$$

- The limits of the risk assessment ranges and Settlement Prices for shares are rounded to $\text{ceiling}[\log_{10}(\text{LotSize})] + 2$, where LotSize – the lot size on the Central Order Book, $\text{ceiling}[\]$ – the function to round up to the nearest integer.

- The limits of the risk assessment ranges and Settlement Prices in RUB for bonds are rounded to two decimal places.

10.2. General collateral certificates

- The limits of the market risk assessment ranges and Settlement Prices for general collateral certificates is set to one (1) rouble.

11. Calculation algorithm of the Price Band upper and lower limits

11.1. As for bonds, the Price Band upper (PcH_i^k) and lower (PcL_i^k) limits are determined as follows:

If the Monitoring attribute is set to No for a security, then

$$PcH_i^k = \frac{P_i * (1 + PcH_max)}{FaceValue_i} * 100,$$

$$PcL_i^k = \frac{P_i * (1 - PcL_max)}{FaceValue_i} * 100.$$

If the Monitoring attribute is set to Yes for a security, then

$$PcH_i^k = \min \left[\frac{P_i * \left(1 + \frac{S - 1_i}{x_pr}\right) * \left(1 + RRcH_i * \frac{k}{36500}\right) - Carry_i^k - HKД_i^k}{FaceValue_i^k} * 100; \frac{P_i * (1 + PcH_max)}{FaceValue_i} * 100 \right],$$

$$PcL_i^k = \max \left[\frac{P_i * \left(1 - \frac{S - 1_i}{x_pr}\right) * \left(1 + RRcL_i * \frac{k}{36500}\right) - Carry_i^k - HKД_i^k}{FaceValue_i^k} * 100; \frac{P_i * (1 - PcL_max)}{FaceValue_i} * 100 \right],$$

Where $Carry$ is calculated as follows for every day k in the range from 1 to DateTN-DateT0:

$$Carry_i^k = \sum_{t=DateT0+1}^{DateT0+k} CashFlow(t) * \left(1 + REPOrate_i * \frac{DateT0+k-t}{36500}\right),$$

11.2. As for shares, the Price Band upper and lower limits are determined as follows:

If the Monitoring attribute is set to No for a security, then

$$PcH_i^k = P_i * (1 + PcH_max),$$

$$PcL_i^k = P_i * (1 - PcL_max).$$

If the Monitoring attribute is set to Yes for a security, then

$$PcH_i^k = \min \left[P_i * \left(1 + \frac{S - 1_i}{x_pr}\right) * \left(1 + RRcH_i * \frac{k}{36500}\right); P_i * (1 + PcH_max) \right],$$

$$PcL_i^k = \max \left[P_i * \left(1 - \frac{S - 1_i}{x_pr}\right) * \left(1 + RRcL_i * \frac{k}{36500}\right); P_i * (1 - PcL_max) \right].$$

- The coefficient x_pr is determined based on statistical data on the relation between 2-day change in the security price and the deviation of intraday prices from the Settlement Price within a Trading Day.

11.3. As for general clearing certificates, the Price Band (the upper and lower limits) are not calculated and set.

12. Repo transactions parameters

12.1. The Repo Discount is set as follows for anonymous CCP-cleared repo transactions:

- Zero (no discount) for general collateral certificates;
- According to the following formula for other securities:

$$DiscountREPO_i = \min \left[0,3; \text{ceiling} \left(\frac{S_{-1}}{\sqrt{2}}, 2 \right) \right],$$

Where $\text{ceiling}(\dots, 2)$ – the function to round up to two decimal places.

12.2. The discount must be within the range $[-\min(0,9;3 \times S_{-1}); \min(0,9;3 \times S_{-1})]$ for negotiated CCP-cleared repo transactions.

12.3. A price of the first part ($REPO_P_i$) is set to be the Settlement Price of the security P_i (RUB) for repo transactions with Y0 settlement date of the first part that is made by the Clearing Center with the firm to roll over the security/cash position.

12.4. As for anonymous and negotiated CCP-cleared repo transactions with Yk settlement date, the price of the first part is determined as follows:

$$REPO_P(Y0) = REPO_P * (1 - DiscountREPO),$$

$$REPO_P(Yk) = REPO_P^k * (1 - DiscountREPO),$$

$$REPO_P^k = REPO_P(VAL) - (FaceValue^k - FaceValue^0) - (HKD^k - HKD^0).$$

13. Settlement Repo Rate calculation algorithm

13.1. To determine Settlement Repo Rates for key maturity T, the end-of-day values (orders and trades prices) of the order book with maturity T and currency VAL are converted into RUB by using the Central Rates and Central Indicative Rate of swaps as set out in the NCC Clearing Center Risk Parameters Methodology for the Moscow Exchange FX and Precious Metals Markets.

13.2. If anonymous CCP-cleared repo transactions were executed in a given security during a trading day, the weighted average Repo Rate in the pertinent currency (REPOrate_wa(T,VAL)) is calculated as follows for that security:

$$REPOrate_wa(T,VAL) = \frac{\sum_j (REPOrate_{i,j}(T) \cdot Volume_{i,j}(T,VAL,RUB))}{\sum_j Volume_{i,j}(T,VAL,RUB)},$$

where $REPOrate_{i,j}$, $Volume_{i,j}$ - the rate and volume of the j^{th} repo transaction in currency VAL for maturity T on day i .

13.3. The weighted average Repo Rate in currency VAL for maturity T is converted into RUB as follows:

$$REPOrate_wa(T,VAL,RUB) = [1 + REPOrate_wa(T,VAL)] \times \left(1 + \frac{365 \times SWAPrate(T,VAL)}{Rc(VAL) \times T} \right) - 1,$$

where

REPOrate_wa(T,VAL) – the weighted average Repo Rate in currency Val for maturity T,

SWAPrate(T,VAL) – the Indicative Rate for swaps VALRUB derived from the FX Market for key maturity T (in RUB),

Rc(VAL) – The Central Rate for currency pair VALRUB.

- 13.4. The volume of repo transactions in currency VAL for maturity T in RUB (Volume(T,VAL,RUB)):

$$Volume(T, VAL, RUB) = Volume(T, VAL) \times Rc(VAL),$$

where

Volume(T,VAL) – the volume of repo transactions in currency VAL for maturity T,

Rc(VAL) – the Central Rate of VALRUB trades.

- 13.5. Aggregated central rates for all currencies are calculated.

The weighted average Repo Rate (REPO_wa) for maturity T for all currencies:

$$REPOrate_wa(T) = \frac{\sum_{VAL} (REPOrate_wa(T, VAL, RUB) \cdot Volume(T, VAL, RUB))}{\sum_{VAL} Volume(T, VAL, RUB)},$$

where

REPOrate_wa(T, VAL, RUB) – the RUB weighted average Repo Rate for anonymous transactions in currency VAL for maturity T

Volume(T, VAL, RUB) – volume of repo transactions in currency VAL for maturity T, in RUB.

- 13.6. The Repo Rate (*REPOrate*) for a given security is determined as per the following formula:

$$REPOrate_i = \min(REPOrate_wa(T), REPOIndex(T), Pclose).$$

where

REPOrate_wa(T) – the weighted average Repo Rate across all currencies for maturity T.

REPOIndex(T) – the Repo Indicator set for every security for maturity T. If the CCP Repo Indicator is not available for key maturity, the relevant indicative rate ROISfix (published on the Bank of Russia's website and at www.roisfix.ru) is applied; or, if not available, its previous day's value).

Pclose – the price of the last anonymous trade with settlement in RUB as of date T.

- 13.7. The Settlement Repo Rate:

- Is set to equal *REPOIndex(T)* for settlement in RUB and key maturity T.
- Is determined as follows for settlement currency VAL (other than RUB) and key maturity T:

$$REPOrate_i(T, VAL, RUB) = \frac{1 + REPOIndex_i(T)}{1 + \frac{365 \times SWAPrate(T, VAL)}{T \times Rc_i(VAL)}} - 1,$$

where

REPOIndex_i(T) – the Settlement Repo Rate for settlement in RUB for a given security;

SWAPrate(T,VAL) – the Indicative Rate for swaps VALRUB executed on the FX Market for key maturity T;

Rc(VAL) – the Central Rate of trades in VALRUB currency pair.

- 13.8. The Settlement Repo Rate for general collateral certificates issued under asset pools GC Bonds, GC Shares and General collateral is set to equal the CCP Repo Indicator for shares, bonds and the average CCP Repo Indicator for shares and bonds, respectively, for maturity T.
- If the CCP Repo Indicator is not available for maturity T of GCC repo, the relevant ROISfix (published on the Bank of Russia's website and at www.roisfix.ru) is used.
- 13.9. The Clearing Center may change the Settlement Repo Rate if necessary.
- 13.10. The Settlement Repo Rates for maturities between key maturity points are determined through linear interpolation. For maturities over the maximum key maturity, the Settlement Repo Rates are set to equal the last key maturity's rate.

14. Interest Risk Rate calculation algorithm

- 14.1. Three levels of the Interest Risk Rates are determined for every security admitted to trading on the Central Order Book T+ and GC certificates when risk parameters are calculated. The First Level Interest Risk Rate is applicable to positions whose size does not exceed the Concentration Limit of the 1st Level. The Second Level Interest Risk Rate is applicable to positions whose size is between the Concentration Limits of the 1st (exclusive) and 2nd (inclusive) Levels. The Third Level Interest Risk Rate is applicable to positions whose size exceeds the Concentration Limit of the 2nd Level.
- 14.2. To determine the Repo Interest Risk Rates, an exponentially weighted moving average (EWMA) volatility estimate is primarily used.
- 14.3. The Repo Interest Risk Rates of the 1st, 2nd and 3rd levels are calculated for every key maturity T at Risk Parameter Calculation Time on every Trading Day i .

- 14.4. To calculate the tentative Interest Risk Rate Δ_i^p , the following algorithm is used:

- The rate change (r_IR_i) is calculated as the maximum of one- and two-day changes of the Repo Rates:

$$r_IR_i = \max(\text{abs}[REPOrate_i - REPOrate_{i-1}]; \text{abs}[REPOrate_i - REPOrate_{i-2}]).$$

- The weighting coefficient a_i is determined.

If the rate change r_IR_i is greater than the previous day's Volatility estimate σ_{i-1} , then $a_i = a_{\text{верхняя}}$, or otherwise $a_i = a_{\text{нижняя}}$:

$$a_i = \begin{cases} a_{\text{верхняя}}, & \text{если } r_IR_i > \sigma_{i-1} \\ a_{\text{нижняя}}, & \text{если } r_IR_i \leq \sigma_{i-1} \end{cases}$$

If more than one public holiday occurs between Trading Days $i-2$ and i , the weighting coefficient a_i is set to zero.

- Volatility is calculated as follows:

$$\sigma_i = \sqrt{(1 - a_i) \cdot \sigma_{i-1}^2 + a_i \cdot r_IR_i^2}. \quad (14.1)$$

If the rate change r_IR_i is greater than the tentative Interest Risk Rate Δ_{i-1}^p and maximum one public holiday occurs between Trading Days i and $i-2$, the following value is calculated along with Volatility calculated as per formula (14.1):

$$\sigma_i^* = \frac{r_IR_i}{q}. \quad (14.2)$$

In this case, Volatility σ_i is the maximum value between (14.1) and (14.2).

The parameter q in formula (14.2) is the volatility multiplier.

- The tentative Interest Risk Rate Δ_i^p is determined through the following algorithm:
if $\text{ceiling}\left(\frac{q \cdot \sigma_i}{h_IR}\right) \cdot h_IR \geq \Delta_{i-1}^p + h_IR$,
then $\Delta_i^p = \text{ceiling}\left(\frac{q \cdot \sigma_i}{h_IR}\right) \cdot h_IR$,
or, otherwise, if $\text{ceiling}\left(\frac{q \cdot \sigma_i}{h_IR}\right) \cdot h_IR \leq \Delta_{i-1}^p - h_IR$ and at least n_IR Trading Days have passed since the last change in the Tentative Interest Risk Rate,
then $\Delta_i^p = \Delta_{i-1}^p - h_IR$,
or, otherwise, $\Delta_i^p = \Delta_{i-1}^p$,
where *ceiling* – the function to round up to the nearest integer.
- To determine the Minimum Upward and Downward Estimates of interest risk, static parameters $MM\Delta_1$ and $SEC\Delta_1$ are set.
- Final Upward and Downward Estimates of interest risk $H\Delta_J$ and $L\Delta_J$, $J = 1,2,3$ of the 1st, 2nd and 3rd Levels are determined as follows:

$$H\Delta_1_i = \text{ceiling}\left(\frac{\max(\Delta_i^p + \text{liq_RR}; MM\Delta_1)}{h_IR}\right) \cdot h_IR,$$

$$H\Delta_2_i = \text{ceiling}\left(\frac{H_1_i \cdot \sqrt{\frac{rh_2}{rh_1}}}{h_IR}\right) \cdot h_IR,$$

$$H\Delta_3_i = \text{ceiling}\left(\frac{H_1_i \cdot \sqrt{\frac{rh_3}{rh_1}}}{h_IR}\right) \cdot h_IR,$$

$$L\Delta_1_i = \text{ceiling}\left(\frac{\max(\Delta_i^p + \text{liq_RR}; REPOIndex - REPORATE + SEC\Delta_1)}{h_IR}\right) \cdot h_IR$$

$$L\Delta_2_i = \text{ceiling}\left(\frac{L_1_i \cdot \sqrt{\frac{rh_2}{rh_1}}}{h_IR}\right) \cdot h_IR,$$

$$L\Delta_3_i = \text{ceiling}\left(\frac{L_1_i \cdot \sqrt{\frac{rh_2}{rh_1}}}{h_IR}\right) \cdot h_IR,$$

where

liq_RR – the market liquidity risk rate regarding repo transactions,

h_IR – the minimum movement of the Interest Risk Rate.

- 14.5. If the EWMA attribute for interest risk rates (isEWMA_IR) is set to false, the Upward and Downward Estimates are determined respectively as follows:

$$H\Delta_1_i = \text{ceiling} \left(\frac{MM\Delta_1}{h_IR} \right) \cdot h_IR$$

$$L\Delta_1_i = \text{ceiling} \left(\frac{REPOIndex - REPORATE + SECA\Delta_1}{h_IR} \right) \cdot h_IR$$

$H\Delta_2$, $H\Delta_3$, $L\Delta_2$ and $L\Delta_3$ are determined similar to Clause 14.4.

- 14.6. Interest Risk Rates for maturities between key maturities are determined through linear interpolation. For maturities over the maximum key maturity, the Interest Risk Rates are set to equal the last key maturity's rate.
- 14.7. The Clearing Center may set Interest Risk Rates of the 1st, 2nd and 3rd Levels different from their estimated values.

15. Calculation of the Upper and Lower Limits of the Interest Risk Assessment Range

- 15.1. The Upper Limit of the 1st (2nd, 3rd) Level Interest Risk Assessment Range for maturity Ym is determined as follows:

$$RRtH(Ym)_J_i = (REPOrate(Ym) + H\Delta_J(Ym)_i) * \frac{Ym}{36500} * P_i(RUB), J = 1,2,3.,$$

- 15.2. The Lower Limit of the 1st (2nd, 3rd) Level Interest Risk Assessment Range for maturity Ym is determined as follows:

$$RRtL(Ym)_J_i = (REPOrate(Ym) - L\Delta_J(Ym)_i) * \frac{Ym}{36500} * P_i(RUB), J = 1,2,3.$$

- 15.3. Limits of the Interest Risk Assessment Range are rounded to two decimal places for bonds and to the digit position $\text{ceiling}[\log_{10}(LotSize)] + 2$, where $LotSize$ – the lot size on the Central Order Book.

16. Calculation algorithm for upper and lower limits of the Repo Rate Band

- 16.1. The upper and lower limits of the Repo Rate Band are set to curb interest rates in incoming repo orders. The Repo Rate Band is set individually for every security, settlement currency and settlement code Ym/Yn .
- 16.2. The upper ($RRcH_i$) and lower ($RRcL_i$) limits of the Repo Rate Band for a security "asset" is determined as follows for every settlement code "Ym/Yn" in currency "VAL":

$$RRcH(Ym/Yn, asset, VAL) = \left(\frac{36500 + REPOrate(Yn, asset, RUB) * Yn - REPOrate(Ym, asset, RUB) * Ym}{36500 + SWAPCRate(Yn, VAL) * Yn - SWAPCRate(Ym, VAL) * Ym} - 1 \right) * \frac{36500}{Yn - Ym} + \frac{H\Delta_1(asset)}{x_IR}$$

$$RRcL(Ym/Yn, asset, VAL) = \left(\frac{36500 + REPOrate(Yn, asset, RUB) * Yn - REPOrate(Ym, asset, RUB) * Ym}{36500 + SWAPCRate(Yn, VAL) * Yn - SWAPCRate(Ym, VAL) * Ym} - 1 \right) * \frac{36500}{Yn - Ym} - \frac{L\Delta_1(asset)}{x_IR}$$

where

$RRcH(Ym/Yn, asset, VAL)/RRcL(Ym/Yn, asset, VAL)$ – the upper/lower limit of the Repo Rate Band for the security "asset" and settlement code "Ym/Yn" with settlement in currency "VAL";
 $REPOrate(Yn, asset, RUB)$ – the settlement repo rate (in per cent per annum) for the security "asset" and date "Yn" (with settlement in RUB);

$SWAPCRate(Yn, VAL)$ – the Central Indicative Swap Rate (in %) for date "Yn" (settlement currency VAL);

x_IR – the coefficient of relation between the Repo Rate Band and the interest risk assessment range;

Yn / Ym – calendar days in the settlement code Yn (Ym);

The final upper and lower limits of the Repo Rate Band for the settlement code Y1/Y0 are determined subject to the following conditions:

$$RRcH_i = \min(RRcH(Y0/Y1, asset, VAL); MONEYRate)$$

$$RRcL_i = \max(RRcH(Y0/Y1, asset, VAL); LSECRate)$$

- 16.3. The coefficient x_IR is determined based on statistical data on the relation between 2-day change in the Repo Rate for a security and the deviation of Repo Rates of trades executed based on book orders from the Settlement Repo Rate over a Trading Day.
- 16.4. The lower limit of the Repo Rate Band for GC certificates have positive values. Non-positive values of such limit obtained under Clause 16.2 are changed for the minimum price step established for the relevant trading regime.

17. Price Band and Repo Rate Band limits move during market hours (widening of the bands)

- 17.1. The limits of the Price Band and Repo Rate Band (the "Band Limit") are moved during market hours with regard to any security if the system automatically alerts for the Band Limit move except cases described in Clause 17.3. Alerts are not applicable to securities with the parameter *Monitoring* is set to false.
- 17.2. The Band Limit is not monitored and alerts do not appear for CCP-cleared repo transactions with settlement in foreign currency.
- 17.3. The Clearing Center can chose to remain the Band Limit unchanged upon receiving an automatic alert if it has been informed that the market environment remained mainly the same and there were no representative volume of orders and trades.
- 17.4. An alert to move the Price Band limits to ensure orderly pricing of securities on the market is triggered by one of the following events:
- For any period k , best bid prices on the order book queue have approached the upper limit of the Price Band by the value that is less than $w^*(PcH_{i-1}^k - PcL_{i-1}^k)$, and such market situation has continued for a period determined by the risk parameter u ;
 - For any period k , best ask prices on the order book queue have approached the lower limit of the Price Band by the value that is less than $w^*(PcH_{i-1}^k - PcL_{i-1}^k)$, and such market situation has continued for a period determined by the risk parameter u .
- 17.5. An alert to move the Repo Rate Band limits by period k to ensure orderly pricing of repo transactions to raise/place cash for period k is triggered by one of the following events:
- Rates of best orders of cash borrowers on the order book queue have approached the upper limit of the Repo Rate Band by a value that is less than $\frac{MM\Delta_1 \cdot w_IR}{x_IR}$ and such market situation has continued for a period determined by the risk parameter u ;

- Rates of best orders of cash lenders on the order book queue have approached the lower limit of the Repo Rate Band by a value that is less than $\frac{MM\Delta_{-1} \cdot w_{-IR}}{x_{-IR}}$ and such market situation has continued for a period determined by the risk parameter u .
- 17.6. If the automatic alert does not go off and the price of a security/OTC repo rate for the security is outside the Band Limit or is approaching it by a value that is less than $\frac{MM\Delta_{-1} \cdot w_{-IR}}{x_{-IR}}$, the Clearing Center may move the Band Limit.
- 17.7. When the decision has been made to move the upper (lower) limits of the Price Bands to ensure orderly pricing of securities on the market, such limits are recalculated as per formula in Clause 11.1 subject to the increase of parameter S_{-1} by $2 \cdot Shift \cdot S_{-1_{i-1}}$. If the recalculated upper (lower) limit is greater (less) than $P_i(RUB) \cdot (1 + PcH_{-max})$ ($P_i(RUB) \cdot (1 - PcL_{-max})$), then it is set to equal $P_i(RUB) \cdot (1 + PcH_{-max})$ ($P_i(RUB) \cdot (1 - PcL_{-min})$).
- If the limit(s) calculated in this manner are negative, they are set to zero.
- 17.8. When the decision has been made to move the upper (lower) limit of the Repo Rate Band by period k :
- The Interest Rate Assessment Range limits are recalculated as per the algorithm given in Section 19.
 - The Repo Rate Band limits are recalculated as per formulae given in Clause 16.2 by using parameters determined under the algorithm described in Section 19.

18. Moving the Market Risk Assessment Range limits during market hours

- 18.1. When the upper (lower) limit of the Price Band of the relevant instrument trading in the T+ Central Order Book is moved, the upper (lower) limits of the 1st, 2nd and 3rd Level Market Risk Assessment Range are also shifted. Price limits and risk limits for shares and bonds are moved in all trading regimes (for any period k) after an alert goes off that such moves have took place for order book trading. The limits are moved by

$$\Delta = \frac{2 \cdot Shift \cdot S_{-1_{i-1}} \cdot P_{i-1}(RUB)}{x_{-pr}},$$

where

$PtH_{-1_{i-1}}$, $PtL_{-1_{i-1}}$ – the upper and lower limits of the 1st Level Market Risk Assessment Range on day $i-1$.

- 18.2. New values of relevant upper limits of the market risk assessment range are calculated as follows:

$$PtH_{-1}^{new} = PtH_{-1} + \Delta,$$

$$PtH_{-2}^{new} = PtH_{-2} + \Delta,$$

$$PtH_{-3}^{new} = PtH_{-3} + \Delta,$$

where

PtH_{-1} , PtH_{-2} , PtH_{-3} – upper limits of the the 1st, 2nd and 3rd Level Market Risk Assessment Range valid at the time of moving.

- 18.3. New values of relevant lower limits of the market risk assessment range are calculated as follows:

$$PtL_{-1}^{new} = PtL_{-1} - \Delta,$$

$$PtL_2^{new} = PtL_2 - \Delta,$$

$$PtL_3^{new} = PtL_3 - \Delta,$$

where

PtL_1, PtL_2, PtL_3 – lower limits of the the 1st, 2nd and 3rd Level Market Risk Assessment Range valid at the time of moving.

- 18.4. If the limit(s) calculated in this manner are negative, they are set to zero.

19. Moving the Interest Risk Assessment Range limits during market hours

- 19.1. When an alert goes off that the upper (lower) limit of the Repo Rate Band with settlement codes Ym\Yn has been moved, additional parameters are recalculated for key maturity Yn:

$$NewH\Delta_J(Yn) = H\Delta_J(Yn) + shift * (RRcH - RRcL),$$

$$NewL\Delta_J(Yn) = L\Delta_J(Yn) + shift * (RRcH - RRcL).$$

- 19.2. Additional parameters for maturity Yk being different from the key maturities are recalculated through linear interpolation.
- 19.3. The Interest Rate Assessment Range limits are recalculated as per formulae given in Clauses 15.1-15.2.

20. Rollover Rate calculation algorithm

- 20.1. The rollover rate for RUB is the static parameter *MONEYRate* set to be the same for all securities.
- 20.2. The rollover rate for securities is calculated as follows:

$$SECRate = \min(RRcL, HSECRate),$$

HSECRate – the static parameter to cap the rollover rate. It can be changed during market hours.

- 20.3. To roll over a repo position in securities, SECRate for that security at the moment the repo transaction (sale-buy transaction) is executed at the rollover rate, is used.

21. Acceptance of foreign currency as collateral on the Equity & Bond Market and Deposit Market

- 21.1. Foreign currency and claims/obligations in foreign currency are treated in the assessment of collateral sufficiency according to the Clearing Rules by using risk parameters described in the FX Market Risk Parameter Methodology.
- 21.2. If the risk parameters are changed before or during market hours on the MOEX FX Market, the new values are applied to assess collateral sufficiency on the Equity & Bond Market and Deposit Market.

22. Establishing balancing trades prices on the Equity & Bond Market and Deposit Market

- 22.1. Where the Clearing Center and a non-defaulting clearing member make a balancing trade to treat the default and there is no market data on trades and/or orders in a security, the fair market price of the security is the Settlement Price set by the Clearing Center in the last mark-to-market clearing session in accordance with Sections 6 and 8 hereof.
- 22.2. The price determined in clause 22.1 may be adjusted for interest payments for the security as established by the Clearing Center on the basis of public information on corporate events, or for other value set by the center on the basis of other information on corporate actions that may influence the security price, including information on:
- The date when a person must be on the issuer's records in order to be eligible for receiving money or other assets including dividends, interest or principal payments from the issuer or an entity granting the security (the record date);
 - The date when a person must be on the issuer's records in order to be eligible for early redemption of a bond;

- The date when holders of securities are recorded for a mandatory buyback offer pursuant to the Federal Law "On Joint Stock Companies".

22.3. Prices determined in Clauses 22.1 and 22.2 and used by the Clearing Center to execute balancing trades with non-defaulting clearing members, are published on the Clearing Center's website.

APPENDIX 1

Example of calculation of the main static parameters for shares

1) Input data:

- Close prices on the Central Order Book for 2010-2012
- Historical trading volumes for 6 months (all exchange-traded shares)
- Historical number of trades for 6 months (all exchange-traded shares)

2) Calculation of Market Risk Rate (the 1st iteration)

For every risk horizon τ (2, 5 and 10 days), $VaR_{99,5}(\tau)$ is calculated based on historical close prices (last trade prices) P_t as the 99.5 percentile of the sample for the random variable

$$\xi_t = \max_{i=1, \dots, \tau} \left[\frac{P_{t+i}}{P_t} - 1 \right].$$

Tentative rates of the 1st, 2nd and 3rd levels (Sp_1 , Sp_2 , Sp_3) are deemed to equal $VaR_{99,5}(2)$, $VaR_{99,5}(5)$ and $VaR_{99,5}(10)$, respectively.

3) Calculation of Concentration Limits (the 1st iteration)

By liquidity factors

- Medium number of trades;
- Number of days on which at least one trade was executed on the Central Order Book;
- Median trading volume in RUB;
- Median trading volume in units.

The liquidity score $Lscore$ is calculated for every security through the principal component analysis and normalization from 0 to 1.

Tentative concentration limits (Lp_1 , Lp_2) are set to equal

$$Lp_1 = 10\% * \min \left[midVolume; Lscore * \frac{Volume_{avg}}{Lscore_{avg}} \right],$$

$$Lp_2 = 5 * 10\% * \min \left[midVolume; Lscore * \frac{Volume_{avg}}{Lscore_{avg}} \right],$$

Where

$midVolume$ - the median trading volume in RUB of the security;

$Lscore$ - the liquidity score of the security;

$Volume_{avg}$ - the average trading volume of the whole sample of securities;

$Lscore_{avg}$ - the average liquidity score of the whole sample of securities.

The first iterations results:

Code	Rate 1	Rate 2	Rate 3	Limit 1, RUB	Limit 2, RUB
SBER	14%	20%	27%	805,000,000	4,025,000,000
GAZP	10%	15%	18%	723,000,000	3,615,000,000

Table 1

Code	Rate 1	Rate 2	Rate 3	Limit 1, RUB	Limit 2, RUB
VTBR	12%	17%	19%	226,000,000	1,130,000,000
LKOH	12%	15%	18%	329,000,000	1,645,000,000
ROSN	12%	17%	19%	236,000,000	1,180,000,000
GMKN	10%	14%	17%	222,000,000	1,110,000,000
SNGS	10%	16%	18%	75,000,000	375,000,000
SBERP	12%	17%	25%	83,000,000	415,000,000
URKA	16%	24%	32%	88,000,000	440,000,000
FEES	14%	22%	27%	54,000,000	270,000,000
HYDR	12%	16%	20%	59,000,000	295,000,000
CHMF	16%	24%	26%	80,000,000	400,000,000
NVTK	14%	17%	19%	23,000,000	115,000,000
TRNFP	18%	25%	37%	43,000,000	215,000,000

4) Calculation of Rates and Concentration Limits (2nd iteration)

Securities are divided into four groups by liquidity for which final concentration limits are determined by rounding up limits from the 1st iteration to 100 million roubles (in some cases, to 200 million roubles as the rounding step is determined by expert opinion).

Table 2

Code	Rate_1	Rate_2	Rate_3	Limit_1, RUB	Limit_2, RUB
SBER	16%	21%	29%	1,000,000,000	5,000,000,000
GAZP	12%	16%	20%	1,000,000,000	5,000,000,000
VTBR	16%	18%	23%	400,000,000	2,000,000,000
LKOH	14%	16%	20%	400,000,000	2,000,000,000
ROSN	16%	18%	23%	400,000,000	2,000,000,000
GMKN	12%	15%	19%	400,000,000	2,000,000,000
SNGS	14%	17%	22%	200,000,000	1,000,000,000
SBERP	16%	22%	29%	200,000,000	1,000,000,000
URKA	22%	28%	38%	200,000,000	1,000,000,000
FEES	20%	26%	33%	200,000,000	1,000,000,000
HYDR	16%	19%	24%	200,000,000	1,000,000,000
CHMF	22%	25%	32%	200,000,000	1,000,000,000
NVTK	18%	19%	23%	200,000,000	1,000,000,000
TRNFP	22%	32%	41%	100,000,000	500,000,000

Final rates of the market risk of the 1st and 2nd levels are derived from the rates of the 1st iteration by modelling the weighted average rate for a position of **Limit_1 (Limit_2)** at rates and concentration limits from Table 1. The rates of the 3rd level are derived from tentative rates by increasing thereof by an increase of the 1st level rates compared to the relevant tentative 1st level rate

$$S_{_3} = Sp_{_3} + (S_{_1} - Sp_{_1}) \cdot$$

APPENDIX 2

Example of calculation of the main static parameters for bonds

To be admitted to trading without full collateral required, a security must have a minimum BBB- or similar credit rating from international rating agencies and the minimum offer size of RUB 5 billion.

1. Concentration limits

A. The liquidity factor L_{ef} is calculated as the effective average trading volume. To this end, the average daily trading volume over six months is calculated and adjusted for ET.

$$ET = \frac{1}{\log_{0.01}(1 - w_d * w_{ord})}$$

where w_d and w_{ord} - share of trading days with trades and share of trading days with active selling/buying orders at the close of the market, respectively.

The multiplier ET is derived from the relation $(1 - p)^{ET} = 1\%$, that assumes the sale of the security over the prescribed period with a probability of 99%.

B. All securities are divided into three groups by L_{ef} :

Group	L_{ef}
1	>5,000,000
2	>1,000,000, but <=5,000,000
3	<= 1,000,000

C. Concentration limits of the 1st level are determined for every group as per the following formula:

$$Lp_1 = \min[2\% * IssueSize; MaxGroupVolume],$$

Where $IssueSize$ – the offer size of the security, $MaxGroupVolume$ – the max average daily trading volume amidst securities of one liquidity group.

D. The concentration limits of the 2nd level are determined as follows

$$Lp_2 = 5 * Lp_1.$$

2. The market risk rates

A. Securities are divided into three groups by modified duration

Group	Modified duration
1	<=1 year
2	>1 year, but <=3 years
3	>3 years

B. For every group, the weighted average volatility of the intraday yield change is calculated. Historical volatility of the yield change σ was calculated as the median of the sample of absolute values for 1-3 years (subject to the date the security started trading).

C. The market risk rates of the 1st and 2nd levels are calculated as follows:

$$Sp_i = t * \sigma * MDur * \text{squareroot}\left(\frac{Lp_i}{V_{group}}\right),$$

where t - the volatility multiplier, $MDur$ - the maximum modified duration of the group, V_{group} - the average daily trading volume of the group.

D. The market risk rate of the 3rd level is determined as follows:

$$Sp_3 = Sp_2 * \text{squareroot}(2).$$