Validation of Haircut Model

A validation of the Haircut Model used by Nasdaq OMX

December 2014
### Revision history

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<th>Date</th>
<th>Version</th>
<th>Description</th>
<th>Author</th>
</tr>
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<td>2014-11-18</td>
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<td>Bengt Jansson</td>
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Validation of Haircut Model

1. Background

1.1 General

NASDAQ OMX Clearing AB (“NOMX Clearing”) provides clearing and Central Counterparty (“CCP”) services. In order to prudently manage these services NOMX Clearing uses a large number of different models. This report is the validation of the Haircut Model.

The purpose of a validation of models is to ensure the theoretical and empirical soundness of the models used by the CCP. The validation report should ensure transparency on the models used by the CCP for the benefit of:

- Board of Directors, NASDAQ OMX Clearing AB.
- Competent Authorities
- Internal Audit and Audit Committee
- Other stake holders

1.2 Legal environment


The Regulation of particular interest for this validation is Delegated Regulation No 153/2013 “supplementing Regulation (EU) No 648/2012 of the European Parliament and of the Council with regard to regulatory technical standards on requirements for central counterparties”.

2. Input to the validation

2.1 Documentation at NOMX Clearing

2.1.1 Previous validation of Haircut Methodology

In NOMX Clearing’s application for being a authorised as a CCP and to offer services and activities in the Union in accordance with Regulation (EU) No 648/2012 a validation of the Haircut model was amended. This validation will act as an important building block for this new validation. The full document name is: “Validation of Haircut Methodology ver 1.3, 2013”

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1 Usually referred to as “EMIR”
2.1.2 Clearing risk mandate

This is Appendix 1, of the clearing risk mandate approved by the board of Nasdaq OMX Clearing AB. It constitutes the risk appetite basis that controls how collateral should be handled on a very top level. The full document name is: “Clearing Risk Mandate, NASDAQ OMX Clearing AB (140801)"

2.1.3 Instructions for haircut calculations

This is an instruction that describes how collateral values should be calculated from mathematical point of view. The full document name is: “Instructions for haircut calculations, NASDAQ OMX Clearing AB (140128)"

2.1.4 Policies

A lot of policies will be included as input to this validation. The following list will name the most prominent policies in this aspect:

- Policy for the Validation of Models: The starting point for the construction, reporting set up and the content of the validation is the policy for validating model that is approved by the Board of Directors at NOMX Clearing. The full document name is: “Model Validation Policy NOMX (140801)"
- Policy for setting risk parameters: NOMX Clearing has developed policies that regulate how risk parameters should be estimated. The full document name is: “Risk Parameter Policy NOMX (140319)"
- Credit risk policy: The credit risk policy of NASADAQ OMX Clearing AB includes collateral risk in chapter 3. This is the guiding policy for haircuts. The full document name is: “Credit Risk Policy, NASDAQ OMX Clearing AB, (141031)"
- Policy for back testing of models: NOMX Clearing has developed policies that regulate how back testing should be conducted from a theoretical, and very general, point of view. More specific guidelines can be found for specific models. The full document name is: “Back testing Policy NOMX (130513)"
- Policy for stress testing of models: NOMX Clearing has developed policies that regulate how stress testing should be from a theoretical, and very general, point of view. More specific guidelines can be found for specific models. The full document name is: “Stress Test Policy NOMX (140228)"
- Policy for sensitivity testing of models: Nasdaq OMX has developed policies that regulate how sensitivity testing should be from a theoretical, and very general, point of view. More specific guidelines can be found for specific models. The full document name is: “Sensitivity testing and analysis Policy (130909)"

2.2 Numerical analysis of Haircut Methodology

NOMX Clearing has ongoing numerical procedures as place to deliver numerical output from each margin model that its use. The numerical data can be roughly divided into three separate parts:

- Back testing data
- Stress testing data
- Sensitivity analysis data
2.3 Discussions

In any validation a large part of the information received must be thoroughly discussed with the personal at the CCP. The following persons are however prime sources of information to this model validation:

- Henrik Rosén, Risk Management department of NOMX Clearing
- Karl Klasén, Risk Management department of NOMX Clearing

2.4 Special issues

The Haircut methodology has been validated in the year 2013 in connection with the application for being a authorised as a CCP and to offer services and activities in the Union in accordance with Regulation (EU) No 648/2012. Since a margin model must, and should, be validated on a yearly basis each validation will be updated with new issues as:

- New added functionality to the methodology
- New types of instruments or markets added to the group of instruments that is used as collateral
- Changed financial environment as different volatility in the market
- New legislation that changes the rules thereby contradicts assumptions made in the model

A section in the validation will specifically target differences between validations to facilitate reading.

3. Theoretical framework of the model

3.1 Background on Haircut and risk

3.1.1 Correlation

3.1.1.1 General

There are two ways of viewing collateral and the risk it is supposed to limit or mitigate. The first way is to include collateral and the derivatives\(^2\) in the calculations at the same time thus taking a simultaneous view on the risk. This includes as an example covered call strategies. The second way is to totally separate derivatives and collateral. In this case no correlation effects are given between derivatives and collateral based on the same underlying, or highly correlated underlyings.

3.1.1.2 Integrated view on collateral and derivatives

In many ways this is a more advanced and efficient view on the counterpart risk within a CCP. It is of course so that from all practical reasons the CCP has one exposure towards its counterpart. This exposure includes both derivatives and collateral at the same time. It would as an example be very illogical to treat the unwinding of risk and positions for collateral and derivatives as two separate process in the CCP thus ignoring any correlating and hedging effects between them.

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\(^2\) It is of course so that collateral can cover other risk than emancipating from derivatives but in this document the phrase derivatives will be used WLOG.
With this view in mind the parameters applied for derivatives should be the same as for collateral. This would also indicate that both collateral and derivatives should be treated as one portfolio from the CCP. From the viewpoint of margin calculations this would require that the margin calculated must be “positive” i.e. the portfolio must show a positive market value after the calculations.

Three are some practical issues that must be dealt with before this can happen and that is ensuring that the margin model can accommodate the collateral within its algorithm. It must also be perfectly clear from legal point of view that derivatives and collateral can be viewed as one portfolio.

3.1.1.3 Collateral and derivatives totally separated

This is the “traditional” way of handling derivatives and corresponding collateral. From historical reasons the collateral and derivatives was kept in separate systems, there was also different legal status on the two groups that prevented a unified approach.

In this set up the collateral parameters are kept separate from margins. The impact is of course that when margins are challenged in back testing and stress testing the value of the collateral after haircut is kept constant. This implies a need for haircut parameters to be set more conservative than margin parameters.

This is the method that NOMX Clearing uses for derivatives and collateral. This also the reason to why the haircut parameters are much higher than the corresponding margin parameter.

3.1.2 Time frame

VaR model and margin models do try to estimate the development of derivatives (and other financial assets) for a relatively short time called ‘liquidation period’ for CCPs. This means that VaR and margin parameters also tend to describe the development for a very short period of time. VaR model parameters can be calculated almost continuously and in some cases it is difficult to separate the parameters from the VaR model itself. In many cases the parameter estimations are instead processes that are implemented into the VaR model.

A traditional collateral model that is not part of the portfolio from risk calculation point of view must be more conservative since the collateral in case of a default would be used as a buffer and not part of the calculations. This implies that such collateral models should use a longer time span between recalculations to be more stable.

It is also the case that collateral haircuts must be easy to handle from an operational point of view both internally at NOMX Clearing but also externally at members. This also implies that changes to the haircut parameters should be done more seldom than for margin parameters.

3.1.3 Model features

So for a traditional collateral model with recalculations made with longer intervals the basic features can be summarized as this:

- No correlation between collateral and derivatives
- No correlation between the different collateral instruments

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3 Given that the same underlying instrument to the derivative are used as collateral.

4 See Appendix I Definitions for definition of liquidation period
• The actual calculation model should be easy to implement and communicate to stakeholders

• The absolute values of the haircuts should be of significantly size to, within reasonable limits, guarantee the eligible value of the collateral portfolio

It will be shown that NOMX Clearings collateral model do have these features that are required from the current usage of the model.

Do notice that the above list of features for a collateral model is dependent on the usage of the model. If collateral would be included in the risk calculations (margin calculations, stress test calculations etc.) then the requirements would change completely. Using the same model for estimating margin parameters and collateral haircuts would require extensive analysis and consideration before implementing.

3.2 Basic Haircut model calculations

3.2.1 General

A haircut model is in reality several models\(^5\) and each underlying collateral type will be investigated separately.

3.2.2 Equities, ETFs and currencies

3.2.2.1 General

Pledging collateral in the form of equities is very common in connection to equity derivatives trading. Since equities do not have the same time issue as interest rate instruments haircut parameters can be calculated easier.

3.2.2.2 The model for equity parameter estimation

For a given period of price data for equity the relative price changes between two consecutive trading days are constructed.

A few definitions:

\[ S_i(t) \]  : Price of equity \( i \) at time \( t \).

\[ \Delta S_i(t) \]  : The percentage difference between the price at time \( t \) and time \( t-1 \) for equity \( i \).

\[ \Delta S_{\text{abs}}(t) \]  : The absolute values of the percentage difference between the price at time \( t \) and time \( t-1 \) for equity \( i \).

\[
\Delta S_i(t) = \frac{S_i(t) - S_i(t-1)}{S_i(t-1)} \quad (1)
\]

\[
\Delta S_{\text{abs}}(t) = \text{abs}[\Delta S_i(t)] \quad (2)
\]

The given period is \( N \) number of days (\( N-1 \) number of differences).

\[
\Delta S_{\text{abs}}(t) : 2 \leq t \leq N 
\]

\(^5\) More of a framework of calculating haircut
The values in the group are sorted in descending order.

\[ \Delta S_{i,n}(t) : 1 \leq n \leq N - 1 : \Delta S_{i,n}(t) \geq \Delta S_{i,n+1}(t) \quad \forall n \]  

(4)

This means that \( \Delta S_{i,n}(t) \) is the largest relative movement during the period in absolute terms for equity \( i \).

3.2.2.3 \hspace{1em} Look back period and close out period

NOMX Clearing AB uses at minimum\(^6\) a ten year look back period for haircut calculations. It is the second largest movement in the look back period that defines the one day parameter (It is actually always 2500 values in the cumulative distribution and therefore always the second largest movement). To get a haircut parameter that reflects the appropriate close out period of \( X \) days the following function is used:

\[ HC_{i,X} = \Delta S_{i,2}(t) \cdot \sqrt{X} \]  

(5)

Close out period is also called “collateral liquidation period” and is minimum\(^7\) 2 business days but normally 5 business days. In all the calculations today it has been 5 business days.

3.2.2.4 \hspace{1em} Minimum haircut adjustments

In addition to the methodology for calculating a haircut per individual instruments there are lower thresholds that ensures that the hair cut levels do not show an inappropriate low level.

- The first threshold is set on collateral type and defines the minimum haircut level for that type of collateral.
- The second threshold is that a collateral instrument cannot have a lower haircut than the margin parameter set on the same underlying instrument when there are cleared derivative based on that underlying.

These threshold holds can be found in “Clearing risk mandate” and for convenience they are included in 7.3

3.2.3 \hspace{1em} Interest rate instruments

3.2.3.1 \hspace{1em} General

Interest rate instruments constitute the bulk of collateral used for all institutions. As indicated in the sections on equities the challenging part of these instruments when it comes to calculations are their time dependencies.

3.2.3.2 \hspace{1em} Prices from real historical curves

For interest rate products it is important to avoid the time issue. As an example on this one can think of constructing a two year time series of daily differences on a bond that has 4 year to expiry today. The time series would show how a 6 year bond behaves in the beginning of the series and a 4 year bond in the end. This illustrates the problem of constructing time series by looking at prices on individual instruments.

There are techniques with “chaining” instruments but NOMX Clearing has gone to the trouble of actual doing a total recalculation of the time series.

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\(^6\) Clearing Risk Mandate, NASDAQ OMX Clearing AB

\(^7\) Clearing Risk Mandate, NASDAQ OMX Clearing AB
Approximately 2500 curve scenarios per issuer has been calculated and stored by NOMX Clearing.

When collateral haircuts is calculation for an instrument i.e. a bond, the characteristic of this bond is used on historical yield curves thus calculating the prices of an exact replicate of today’s bond for each day in the past. This is done by calculating a “Net Present Value”, (NPV) for the cash flows in the instrument that are investigated.

So for each interest rate instrument a theoretical time series is constructed. This time series is then analysed exactly as for equities described in 3.2.2.2.

3.2.3.3 Look back period and close out period

Exactly as in 3.2.2.3

3.2.3.4 Time buckets

For interest rate collateral the individual haircuts are collected in buckets of maturities. An example eon such table look like this:

<table>
<thead>
<tr>
<th>Maturity of collateral</th>
<th>Haircut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5 years</td>
<td>5%</td>
</tr>
<tr>
<td>Between 5 years and 10 years</td>
<td>7%</td>
</tr>
<tr>
<td>Between 10 years and 20 years</td>
<td>12.5%</td>
</tr>
<tr>
<td>Between 20 years and 30 years</td>
<td>20%</td>
</tr>
<tr>
<td>Larger than 30 years</td>
<td>30%</td>
</tr>
</tbody>
</table>

Table 1: Time buckets for interest rate collateral

The different buckets will have at least the value showed by the worst calculated hair cut value in the bucket.

3.2.3.5 Spread adjustments

Especially for Mortgage bond issuer there can be problems with accurate prices to for a time series. In this case NOMX Clearing uses CDS spreads to calculate time series for these instruments.

3.2.3.6 Minimum haircut adjustments

Exactly as in 3.2.2.4

3.3 Credit adjustments

3.3.1 Wrong way risk

This is the risk that collateral securities or bank guaranties issued by a member/customer itself, or by a company within the same group of companies, are used as collateral.

It is clearly indicated from the “Clearing Risk Mandate, NASDAQ OMX Clearing AB” that this is not allowed and that periodical checks will be performed within Risk Management to make sure that the situation is resolved, would it happen anyway.

3.3.2 Maturity of the instrument

It is also the case that maturity is limited on the eligible collateral this avoiding instruments with too short of period to expiry. This limitation does also limit the need for time series change techniques in the numerical calculation of minimum haircut levels.
3.3.3 Concentration risk

This is the risk that collateral securities or bank guaranties issued by a single credit institution/issuer stands for an “unacceptable” large part of the total held collateral.

It is clearly indicated from the “Clearing Risk Mandate, NASDAQ OMX Clearing AB” that maximum allowed part is 25%.

4. Monitoring process

NOMX Clearing do periodically control the appropriateness of the parameters used for haircut calculation. When doing so a new calculation is done for eligible collateral and changes are made in the haircuts if needed.

The following table is an extraction of such an investigation:

<table>
<thead>
<tr>
<th>Name</th>
<th>Haircut</th>
<th>Maturity</th>
<th>Time bucket</th>
<th>Incl.</th>
<th>Type</th>
<th>99.9 par</th>
<th>Breach</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRIA</td>
<td>30,00%</td>
<td>47,43</td>
<td>&gt;30</td>
<td>Y</td>
<td>Government</td>
<td>32,37%</td>
<td>-2,37%</td>
</tr>
<tr>
<td>FINLAND</td>
<td>20,00%</td>
<td>27,85</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>21,37%</td>
<td>-1,37%</td>
</tr>
<tr>
<td>Danmarks Nationalbank</td>
<td>20,00%</td>
<td>25,22</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>20,93%</td>
<td>-0,93%</td>
</tr>
<tr>
<td>SEB AB</td>
<td>20,00%</td>
<td>25,07</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>20,49%</td>
<td>-0,49%</td>
</tr>
<tr>
<td>SEB AB</td>
<td>13,50%</td>
<td>17,56</td>
<td>10-20</td>
<td>Y</td>
<td>Covered</td>
<td>13,64%</td>
<td>-0,14%</td>
</tr>
<tr>
<td>Länsförsäkringar Hyp. AB</td>
<td>10,00%</td>
<td>9,86</td>
<td>5-10</td>
<td>Y</td>
<td>Covered</td>
<td>10,07%</td>
<td>-0,07%</td>
</tr>
<tr>
<td>SBAB Bank AB (publ)</td>
<td>10,00%</td>
<td>9,20</td>
<td>5-10</td>
<td>Y</td>
<td>Covered</td>
<td>9,94%</td>
<td>0,06%</td>
</tr>
<tr>
<td>Länsförsäkringar Hyp. AB</td>
<td>10,00%</td>
<td>9,20</td>
<td>5-10</td>
<td>Y</td>
<td>Covered</td>
<td>9,89%</td>
<td>0,11%</td>
</tr>
<tr>
<td>FINLAND</td>
<td>5,00%</td>
<td>4,84</td>
<td>0-5</td>
<td>Y</td>
<td>Government</td>
<td>4,88%</td>
<td>0,12%</td>
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<tr>
<td>FINLAND</td>
<td>7,00%</td>
<td>9,62</td>
<td>5-10</td>
<td>Y</td>
<td>Government</td>
<td>6,65%</td>
<td>0,35%</td>
</tr>
<tr>
<td>SEB AB</td>
<td>20,00%</td>
<td>27,08</td>
<td>20-30</td>
<td>Y</td>
<td>Covered</td>
<td>19,45%</td>
<td>0,55%</td>
</tr>
<tr>
<td>GERMANY</td>
<td>13,50%</td>
<td>19,85</td>
<td>10-20</td>
<td>Y</td>
<td>Government</td>
<td>12,50%</td>
<td>1,00%</td>
</tr>
<tr>
<td>Danmarks Nationalbank</td>
<td>7,00%</td>
<td>9,21</td>
<td>5-10</td>
<td>Y</td>
<td>Government</td>
<td>5,87%</td>
<td>1,13%</td>
</tr>
<tr>
<td>Länsförsäkringar Hyp. AB</td>
<td>7,00%</td>
<td>4,79</td>
<td>0-5</td>
<td>Y</td>
<td>Covered</td>
<td>5,83%</td>
<td>1,17%</td>
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<td>GERMANY</td>
<td>7,00%</td>
<td>9,34</td>
<td>5-10</td>
<td>Y</td>
<td>Government</td>
<td>5,73%</td>
<td>1,27%</td>
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<td>20,00%</td>
<td>21,52</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>12,61%</td>
<td>7,39%</td>
</tr>
<tr>
<td>Nordea Bank AB</td>
<td>13,50%</td>
<td>12,13</td>
<td>10-20</td>
<td>Y</td>
<td>Covered</td>
<td>5,96%</td>
<td>7,54%</td>
</tr>
<tr>
<td>AUSTRIA</td>
<td>13,50%</td>
<td>10,14</td>
<td>10-20</td>
<td>Y</td>
<td>Government</td>
<td>5,82%</td>
<td>7,68%</td>
</tr>
<tr>
<td>BRITAIN</td>
<td>13,50%</td>
<td>10,02</td>
<td>10-20</td>
<td>Y</td>
<td>Government</td>
<td>5,71%</td>
<td>7,79%</td>
</tr>
<tr>
<td>BRITAIN</td>
<td>30,00%</td>
<td>41,29</td>
<td>&gt;30</td>
<td>Y</td>
<td>Government</td>
<td>22,18%</td>
<td>7,82%</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>20,00%</td>
<td>22,38</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>12,17%</td>
<td>7,83%</td>
</tr>
<tr>
<td>BRITAIN</td>
<td>20,00%</td>
<td>20,02</td>
<td>20-30</td>
<td>Y</td>
<td>Government</td>
<td>12,04%</td>
<td>7,96%</td>
</tr>
<tr>
<td>Svenska Staten</td>
<td>13,50%</td>
<td>10,70</td>
<td>10-20</td>
<td>Y</td>
<td>Government</td>
<td>5,54%</td>
<td>7,96%</td>
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<td>Svenska Staten</td>
<td>13,50%</td>
<td>10,75</td>
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<td>32,28</td>
<td>&gt;30</td>
<td>Y</td>
<td>Government</td>
<td>18,05%</td>
<td>11,95%</td>
</tr>
</tbody>
</table>
5. Conclusions

5.1 Changes from previous validation

The previous validation of the Haircut model used in NOMX Clearing (Validation of Haircut Methodology, NOMX, 2013) was done last year. There has been no new addition to the type of instruments that are eligible for collateral.

The financial market has not changed in any way that would imply a need to change this haircut model.

5.2 Input to the validation

From discussions with key personnel it is evident that the knowledge of the model is good and the risk of misconception in usage of the model when estimating haircut parameters.

There is a lot of different material that describes the model and in general the way it is presented on individual papers is good.

5.3 Theoretical framework of the model

The methodology is purely numerical and makes no assumptions on distribution. The drawbacks with all similar types of methodologies (as historical simulation) are that movements that have not happened cannot happen. This means that no matter how high the probability level is set on the numerical cumulative distribution it can never exceed the largest movements in the look back period.

For currency and equity this could be a problem for equities with low volumes and short time from introduction to today. Since NOMX Clearing only uses the larger equities as eligible for collateral this is less of a problem.

Interest rate products are valued using historical yield curves rather than the actual price movements of the individual products. This minimizes the challenge with short historical data. It should also be emphasised that this is a very nice way of avoiding the challenge of adjusting for interest rate instruments that moves in time when constructing time series.

The methodology have attached safety points to it to prevent low volatility periods (minimum haircut levels), high risk on individual credits (concentration limits) etc. These points regulates the usage of collateral thus preventing NOMX Clearing to find itself in an undesirable position when it comes to pledged collateral in case of a default.

It should for clarity be noted that no portfolio calculation is performed when deducting haircuts. This means that any observed historical correlation between different collateral instruments is not given credit for. The haircuts are simply estimated for one instrument at a time.

5.4 Monitoring process

NOMX Clearing estimates parameters on regular basis and changes to the environment of the model will quickly be picked up.

| Country     | Eligibility | Mean | Median | Probability | Type of Collateral | Probability |
|-------------|-------------|------|--------|-------------|-------------------|-------------|-----------|
| GERMANY     | 30,00%      | 31,97| >30    | Y           | Government        | 17,23%      | 12,77%    |
| NETHERLANDS | 30,00%      | 32,39| >30    | Y           | Government        | 15,90%      | 14,10%    |
| BRITAIN     | 30,00%      | 30,41| >30    | Y           | Government        | 15,80%      | 14,20%    |

Table 2: Collateral investigation
5.5 Recommendations

There are two areas where NOMX Clearing could improve in this area:

The documentation is good on individual document level. It is however hard to get a full picture on how the CCP treats haircuts for different collaterals. It would be worthwhile to put higher focus in this area and have one document that describes this rather than present rather scattered situation.

Secondly a larger effort should be made to produce similar numerical data as margin models in NOMX Clearing currently have. The connection between counterpart and collaterals should be more investigated with the aid of numerical data.
6. Information

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6.2 References
Validation of Haircut Methodology, NOMX. (2013). Validation of Haircut Methodology ver 1.3.
7. Appendices

7.1 Appendix 1 Definitions

To facilitate reading the definitions of COMMISSION DELEGATED REGULATION (EU) No 153/2013, CHAPTER I, GENERAL, Article 1 Definitions is included in this appendix to the validation.

For the purposes of this Regulation, the following definitions apply:

1) ‘basis risk’ means the risk arising from less than perfectly correlated movements between two or more assets or contracts cleared by the central counterparty;

2) ‘confidence interval’ means the percentage of exposures movements for each financial instrument cleared with reference to a specific lookback period that a CCP is required to cover over a certain liquidation period;

3) ‘convenience yield’ means the benefits from direct ownership of the physical commodity and is affected both by market conditions and by factors such as physical storage costs;

4) ‘margins’ means margins as referred to in Article 41 of Regulation (EU) No 648/2012 which may include initial margins and variation margins;

5) ‘initial margin’ means margins collected by the CCP to cover potential future exposure to clearing members providing the margin and, where relevant, interoperable CCPs in the interval between the last margin collection and the liquidation of positions following a default of a clearing member or of an interoperable CCP default;

6) ‘variation margin’ means margins collected or paid out to reflect current exposures resulting from actual changes in market price;

7) ‘jump to default risk’ means the risk that a counterparty or issuer defaults suddenly before the market has had time to factor in its increased default risk;

8) ‘liquidation period’ means the time period used for the calculation of the margins that the CCP estimates necessary to manage its exposure to a defaulting member and during which the CCP is exposed to market risk related to the management of the defaulter’s positions;

9) ‘lookback period’ means the time horizon for the calculation of historical volatility;

10) ‘testing exception’ means the result of a test which shows that a CCP’s model or liquidity risk management framework did not result in the intended level of coverage;

11) ‘wrong-way risk’ means the risk arising from exposure to a counterparty or issuer when the collateral provided by that counterparty or issued by that issuer is highly correlated with its credit risk.
7.2 Appendix 2 On-demand commercial bank guarantees

Since on-demand guarantees are a little bit special this type of collateral is described in this appendix. This appendix is in large part taken from the “Credit Risk Policy”.

Only participants qualifying as “non-financial counterparties” as defined in Regulation (EU) no 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories (EMIR), are entitled to provide an On-Demand Bank Guarantee as Collateral. Such On-Demand Bank Guarantee shall be approved by NOMX and be issued by a bank accepted by NOMX.

On-Demand Bank Guarantees shall be submitted to, and lodged with, NOMX Clearing. In the event that a Bank Guarantee or the issuer of such Bank Guarantee would fail to meet any requirement of the Clearinghouse on such Bank Guarantee or such issuer or is not compliant with EMIR or any other law or regulation, then the participant must provide alternative Collateral to the Clearing House immediately upon request by the Clearinghouse, unless the Clearinghouse decides in its discretion to allow more time in specific cases. On-Demand Bank Guarantees can only be posted as collateral in respect to positions relating to:

a) Derivatives relating to electricity or natural gas produced, traded or delivered in the Union;

b) Derivatives relating to the transportation of electricity or natural gas in the Union

Clearing Risk Management shall produce an exposure report for bank guarantee on a monthly basis, which should be distributed to the CRO and to the CCO if necessary. The report shall show the exposure per bank guarantee issuer and participant. The report shall include the total exposure for those banks that are issuing guarantees and are also participants at NOMX Clearing. The total exposure includes the guarantee amount and the total margin requirement per bank. In the report, Clearing Risk Management shall also calculate the guarantee amount issued by banks with a rating lower than A- (S&P) and/or A3 (Moody’s). The amount issued by banks with this rating shall not be higher than 15% of the total guarantee amount.

Issuers of bank guarantees must have a rating as specified below:

| Bank Guarantee issuer domicile | Minimum rating
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scandinavia (Sweden, Norway, Denmark, Finland)</td>
<td>BBB- (S&amp;P) and/or Baa3 (Moody’s)</td>
</tr>
<tr>
<td>EU (Excluding Peripherals)</td>
<td>BBB- (S&amp;P) and/or Baa3 (Moody’s)</td>
</tr>
<tr>
<td>Peripherals and OECD</td>
<td>A- (S&amp;P) and/or A3 (Moody’s)</td>
</tr>
</tbody>
</table>

Table 3 : Bank guarantees and minimum rating

---

8 If an issuer is rated by both agencies, the lower of the two should be used
9 Greece, Spain, Portugal, Italy and Ireland
10 Excluding countries in the EU and Scandinavia (the country of domicile for a bank guarantee issuer must be within an OECD country)
7.3 **Appendix 3 Collateral limits**

There are several restrictions for collateral above the actual volatility calculated haircut parameters. This table describe such top limits.

<table>
<thead>
<tr>
<th>Collateral type</th>
<th>Min. credit rating (LT)</th>
<th>Concentration limits</th>
<th>Minimum Haircut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sovereign debt</td>
<td>Aa1 (Moody’s), AA+ (S&amp;P)</td>
<td>No limit</td>
<td>3%</td>
</tr>
<tr>
<td>Covered bonds</td>
<td>Aaa (Moody’s), AAA (S&amp;P)</td>
<td>95% of total collateral per MRA</td>
<td>5%</td>
</tr>
<tr>
<td>Large Cap Shares</td>
<td>From the main Nordic indices (OMXS30, OMXC20, OBXH25, OBX25)</td>
<td>70% of total collateral per MRA</td>
<td>25%</td>
</tr>
<tr>
<td>Kommuninvest bonds</td>
<td>Aaa (Moody’s), AAA (S&amp;P)</td>
<td>95% of total collateral per MRA</td>
<td>5%</td>
</tr>
<tr>
<td>Exchange Traded Funds (ETF)</td>
<td>NASDAQ OMX listed. Approved on an ISIN by ISIN basis.</td>
<td>70% of total collateral per MRA</td>
<td>25%</td>
</tr>
<tr>
<td>Cash (Transfer of title)</td>
<td>N/A</td>
<td>No limit</td>
<td>-</td>
</tr>
<tr>
<td>Haircut for Collateral in other currency than base currency</td>
<td>N/A</td>
<td>N/A</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

Table 4: General collateral limits