

Margin Calculation Methodology

Electricity Spot Market

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¹ The Change log is only used for final versions.

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1. Introduction

CCP.A as a Central Counterparty is responsible for the financial clearing and risk management of all day-ahead electricity spot market transactions executed on the energy exchange platform EXAA. In this role, CCP.A assumes and manages the settlement and default risk for all trades and thereby contributes to the market stability and efficiency. CCP.A has implemented a solid risk management system, one key element of which is margin computation.

CCP.A calculates and collects margins to cover its credit exposures from its clearing members on a regular basis. For the clearing of electricity spot market transactions executed at EXAA, CCP.A has adopted a margin calculation model which corresponds to the complexity of the clearing process and the cleared products. This document describes the methodology, the process and the parameters of the margin calculation for electricity spot market products traded on EXAA.

Chapter 2 of this document describes the margin methodology as well as the determination of the main model parameters:

- Confidence interval
- Time horizon for the calculation
- Look back period
- Anti-procyclicality rules

Chapter 3 describes the margin calculation timing and frequency as well as the procedures for margin calls.

Chapter 4 defines the process for monitoring of position limits utilisation and the algorithm for calculation of estimated prices for exposure valuation.

Chapter 5 refers to the back testing procedures of the margin model.

Chapter 6 summarises all model parameters, which are subject to review by the risk committee on a regular basis.

The collateral management of CCP.A (eligible collateral, concentration limits, etc.) is described in the "*Collateral Policy Electricity Spot Market*".

2. Margin Methodology

CCP.A calculates the margin requirement of a clearing member on the basis of its net payment positions. Netting is done per delivery day across the auctions and all electricity spot products for all open (i.e. not yet settled) positions. If the clearing member holds segregated clearing accounts for proprietary and client positions, the netting and the margin calculation are performed separately for proprietary and client account categories.

This chapter describes:

- the characteristics of the products cleared
- how the initial margin is calculated per clearing account
- how this methodology is used to calculate the margin on clearing member level
- CCP.A's parameters for margin calculation
- methods used to avoid procyclicality

2.1. Auctions and Product Characteristics

For the clearing of electricity spot market transactions executed at EXAA, CCP.A has adopted a margin calculation model which captures the risk characteristics of the products cleared and takes into account the settlement period and the interval between the collection of margins.

EXAA is a trading platform for day-ahead (spot) electricity products, where all individual 24 hours, 96 quarter-hours of the day as well as a number of block products are tradable 7 days a week. Electricity spot market products are commodities. Their physical settlement is carried out in the Austrian control area APG or in one of the four German control zones (Amprion, TenneT, TransnetBW or 50Hertz). CCP.A guarantees the fulfilment of the financial settlement between the buyers and the sellers by entering into each trade as central counterparty.

EXAA offers trading of day-ahead products in two auctions per day:

- **10:15 a.m.** – EXAA classic auction
- **12:00 p.m.** – participation in Europe-wide spot auction of all power exchanges coordinated in the MRC (Multi Regional Coupling), EXAA acting as NEMO; without 96 quarter-hours products

During the auctions, the bids for all five control zones are matched and the common prices are determined whereby the maximum quantities are executed. The financial settlement for both auctions takes place in a joint clearing process supported by CCP.A. The risk evaluation takes place during and after each auction.

Since electricity cannot be stored, it is not possible to implement a delivery-versus-payment settlement. Therefore, to minimise CCP.A's counterparty credit risk, the open positions of the clearing members shall be fully collateralised at all times.

2.2. Margin Calculation

In case of a clearing member's default on payment, CCP.A, as a central counterparty to each trade has the obligation to pay the corresponding settlement amount to the clearing member(s) delivering the respective amounts of electricity to the defaulting buyer. Since electricity cannot be stored and subsequently used as collateral, CCP.A bears the full credit risk of the defaulting clearing member. Therefore, the credit exposure of the clearing members shall be covered with collateral at all times.

To this end, and in order to reduce the number of margin calls during the day, CCP.A collects margins in advance based on the historical fluctuation of net payment positions and their average values. In the calculation, also the clearing calendar is considered with regard to the fact that margin calls are not possible on weekends and on bank holidays.

The margin requirement depends on the trading volumes as well as the credit rating of each clearing member and is calculated separately for proprietary and client positions.

2.2.1. Initial Spot Margin

The margin requirement for electricity spot market products is calculated separately for proprietary and client positions on the basis of the following two trading volume-linked components:

- trading volume fluctuation
- trading volume mean value.

2.2.1.1. Trading Volume Fluctuation

The trading volume fluctuation represents the possible bandwidth of the netted monetary trading volume in the traded instruments (spot market products) per clearing account category of a clearing member (proprietary trading or client trading) for daily transactions during a specified period of delivery days.

The trading volume fluctuation for a clearing member is calculated on the basis of the trading volume in EUR after every auction and clearing of trades with spot products for electric power (only net payments, i.e., after netting all buys and sells, otherwise zero (no credits allowed)) of the respective clearing member (S_i) within an account category during a predefined number of last trading days (look-back period n). For this purpose, the distribution of the clearing member's net payments per account category δS_i is in a first step calculated within the simple lead-time (1 day) (δS_i):

$$\delta S_i = S_i - S_{i-1}$$

Based on the δS_i distribution during the look-back period n or the effective number of delivery days for which trading volumes were generated on the clearing member's accounts during the period, the standard deviation (trading volume fluctuation) is computed as follows:

$$\sigma = \sqrt{\frac{\sum_{i=1}^n \delta S_i^2}{n}}$$

for each clearing member in the respective account category (trading days = trading days with net payments since start of trading or during the look-back period). The fluctuation thus determined (σ) must always attain a minimum value of EUR 1.000 for calculating the collateral in an account category.

If the value calculated is below this minimum fluctuation, it shall be fixed at

$$\sigma_{\min} = \text{EUR } 1.000$$

From these distributions, the respective 99% value of an account category shall be determined (assuming normally distributed trading volumes) (I_{99}) by multiplying the standard deviation σ of the observed distribution with the factor 2,57583 (i.e. the 99,5% quantile of the standard deviation).

$$I_{99} = \sigma * 2,57583$$

I_{99} is therefore the fluctuation bandwidth (in EUR) to which the following applies: 99% of all payment-linked trading volumes in the distribution δS of I in an account category are within the measured value of I_{99} .

2.2.1.2. Trading Volume Mean Value

The mean value (μ) is the average value (in EUR) of the net payments S_i of the respective clearing member in an account category over the look-back period n . For the purpose of calculating the trading volume-linked margin for an account category, the mean in an account category must always attain a value (μ) of EUR 3.000 as a minimum. Where the value computed is below this level, the following is defined for an account category:

$$\mu_{\min} = \text{EUR } 3.000$$

Based on the I_{99} values, the trading-volume-linked margin requirement for an account category is then calculated for a specific clearing member for a period of up to three business days (IM). IM thus covers the liabilities in an account category of the clearing members, which are permitted to have as a maximum uncovered settlement liability for up to three delivery days (Saturday-Monday). In case of bank holidays, a holiday adjustment will be added. The holiday adjustment is only necessary if 1-3 consecutive holidays precede or follow a weekend. In such cases, CCP.A will adjust the time horizon parameter from three to 4, 5 or 6 days accordingly.

$$\text{Initial Margin IM} = \mu * (3+h) + I_{99} * \sqrt{(3+h)}$$

$$\text{Holiday adjustment } h = \{0; 1; 2; 3\}$$

The initial margin IM is always rounded to the next EUR 500:

$$IM_r = \text{Int} \left\{ \frac{IM+500}{500} \right\} \cdot 500$$

2.2.2. Margin Calculation for Green Electricity

The margin component for the green electricity added value due to the late delivery of guarantees of origin for green electricity from qualified production plants (R^{green}) is calculated for the current month based on the product of the average green electricity value of the preceding month and 1.2 times the quantity of guarantees of origin of a clearing member in the preceding month plus the sum of the value of guarantees of origin not yet delivered of a clearing member from the preceding months. The margin requirement for the delivery of guarantees of origin are determined at the time trading starts based on the estimated green electricity added value and an expected sell quantity of the clearing member. In the

case of actually higher quantities sold or a higher green electricity added value, the corresponding higher amount of margin must be deposited without delay upon CCP.A's request.

The trading-volume-linked collateral component (IM_{calc}) is calculated in accordance with the following formula, where:

$$IM_{calc} = IM_r + R^{green}$$

2.2.3. Margin Requirement per Clearing Member

To compute the clearing member's total margin requirement, CCP.A sums up the margin requirements calculated separately for the proprietary and the client clearing accounts. This amount is multiplied by an individual Credit Risk Factor "CF" per clearing member, which reflects the different credit risk categories. The risk category is set by CCP.A based on annual member credit assessment and/or on publicly available information on the clearing member and leads to a risk premium ranging between 0% and X%. The second component, which the Credit Risk Factor "CF" is composed of, is the anti-procyclicality margin buffer of 25%.

The Initial Margin "IM" per Clearing Member's is computed according to the formula

$$IM_{CM} = \sum_i (IM_{account_i}) * (1 + CF)$$

Thus, the initial margin calculation formula above involves the two parameters in margining: the individual credit risk premium per clearing member (currently 0% to 10%) as well as the general margin buffer on market level (25%).

2.3. Model Parameters and Input Data

2.3.1. Confidence Level

CCP.A's margin calculation model is calibrated to cover the credit exposure with a confidence level of 99%.

2.3.2. Minimum Requirement

The minimum collateral requirement per clearing account amounts to EUR 40.000. If the amount of margin calculated based on the trading volume according to the previous section is smaller than the minimum collateral amount, then the collateral required for the account given shall amount to EUR 40.000.

$$IM_{account} = \max(IM_{calc}; IM_{min})$$

$$IM_{min} = \text{EUR } 40.000$$

2.3.3. Procyclicality Rules

In the margin calculation, CCP.A takes measures to prevent margin procyclicality – the risk that when volatility rises dramatically, margins rise exponentially in response and this may have an adverse effect on the liquidity of the clearing members.

To limit procyclicality effects, CCP.A applies an anti-procyclicality (APC) margin buffer of 25% on the total calculated margin requirement per margin account. In periods, when calculated margin requirements are rising significantly, this margin buffer can be temporarily exhausted.

CCP.A assesses possible procyclical effects of its margin requirements on a regular basis. For this purpose, the market volatility is analysed. Furthermore, significant short-term as well as on long-term changes of the overall margin requirements of the clearing members are detected and evaluated. When determining the potential procyclical effects, CCP.A also takes the size of its cleared market and the overall capitalisation of its clearing members into consideration.

In case that the margin requirements have increased significantly due to high volatility and have reached the predefined thresholds, CCP.A's General Management will consider to exhaust the margin buffer.

2.3.4. Credit Rating Risk Factor per Clearing Member

CCP.A evaluates the current economic and financial situation of each Clearing Member before and during its participation in the clearing system.

The creditworthiness of Clearing Members is assessed on the basis of their annual reports and information made available by them, and includes the calculation of classical financial ratios. Based on these ratios, the Clearing Member is assigned to a clearing category 1 to 5. Category 1 comprises companies with the highest and category 5 the companies with the lowest credit rating.

The credit rating of Clearing Members is assessed on the basis of their annual financial reports and includes the calculation of the following classical financial ratios:

- Equity ratio
- Return on investment
- Cash flow pursuant to the Company Reorganisation Act in percentage of operating income (from sales)
- Fictitious debt redemption period pursuant to the Company Reorganisation Act

According to the result of the credit rating, each clearing member is designated to a rating category. CCP.A applies a risk premium on the computed margins for each risk category:

| Risk category | Risk premium |
|---------------|--------------|
| 1 - 3 | 0% |
| 4 | 5% |
| 5 | 10% |

2.3.5. Look-back Period

In order to reflect the seasonal exposure fluctuations, CCP.A calculates the trade volume linked margin for the lookback period of

365 delivery days

Thus, the initial margins for spot market cover at least the exposures resulting from historical volatility calculated based on data covering the latest 12 months.

2.3.6. Time Horizon for Calculation

During regular weeks the longest settlement period for payments is 3 days. According to the clearing calendar the settlement of payments for transactions with delivery days on Sunday, Monday and Tuesday are settled on Tuesday.

Example Regular Week:

| 10:15 a.m. auction | | | 12:00 p.m. MC auction | | | Time horizon for margins = 3 days + holiday adjustment |
|--------------------|--------------|------------|-----------------------|--------------|------------|--|
| Trade Day | Delivery Day | Value Date | Trade Day | Delivery Day | Value Date | Days |
| Monday | Tuesday | Tuesday | Monday | Tuesday | Tuesday | 3+0 = 3 |
| Tuesday | Wednesday | Wednesday | Tuesday | Wednesday | Wednesday | 3+0 = 3 |
| Wednesday | Thursday | Thursday | Wednesday | Thursday | Thursday | 3+0 = 3 |
| Thursday | Friday | Friday | Thursday | Friday | Friday | 3+0 = 3 |
| Friday | Saturday | Monday | Friday | Saturday | Monday | 3+0 = 3 |
| Friday | Sunday | Tuesday | Saturday | Sunday | Tuesday | 3+0 = 3 |
| Friday | Monday | Tuesday | Sunday | Monday | Tuesday | 3+0 = 3 |
| Monday | Tuesday | Tuesday | Monday | Tuesday | Tuesday | 3+0 = 3 |

Therefore, the standard time horizon used for calculation of margins is three days.

However, on bank holidays, such as Easter Monday, Christmas and other official holidays, the cumulated exposure can increase up to six days. This will occur if 1-3 consecutive holidays precede or follow a weekend, or if 3 consecutive holidays start on Tuesday. In such cases, CCP.A will adjust the time horizon parameter from three to 4, 5 or 6 days accordingly.

Example Christmas Holidays:

| 10:15 a.m. auction | | | 12:00 p.m. MC auction | | | Time horizon for margins = 3 days + holiday adjustment |
|--------------------|--------------|------------|-----------------------|--------------|------------|--|
| Trade Day | Delivery Day | Value Date | Trade Day | Delivery Day | Value Date | Days |
| Mon, 22/12 | Tue, 23/12 | Tue, 23/12 | Mon, 22/12 | Tue, 23/12 | Tue, 23/12 | 3+3 = 6 |
| Tue, 23/12 | Wed, 24/12 | Mon, 29/12 | Tue, 23/12 | Wed, 24/12 | Mon, 29/12 | 3+3 = 6 |
| Tue, 23/12 | Thu, 25/12 | Tue, 30/12 | Wed, 24/12 | Thu, 25/12 | Tue, 30/12 | 3+3 = 6 |
| Tue, 23/12 | Fri, 26/12 | Tue, 30/12 | Thu, 25/12 | Fri, 26/12 | Tue, 30/12 | 3+3 = 6 |
| Tue, 23/12 | Sat, 27/12 | Tue, 30/12 | Fri, 26/12 | Sat, 27/12 | Tue, 30/12 | 3+3 = 6 |
| Tue, 23/12 | Sun, 28/12 | Tue, 30/12 | Sat, 27/12 | Sun, 28/12 | Tue, 30/12 | 3+3 = 6 |
| Tue, 23/12 | Mon, 29/12 | Tue, 30/12 | Sun, 28/12 | Mon, 29/12 | Tue, 30/12 | 3+3 = 6 |
| Mon, 29/12 | Tue, 30/12 | Tue, 30/12 | Mon, 29/12 | Tue, 30/12 | Tue, 30/12 | 3+0 = 3 |

3. Margin Calculation Process

3.1. Timing and Frequency

In order to stay close to the real risk, CCP.A computes the margin requirements upon each change in open positions leading to change in clearing members' exposures. Thus, the margin requirements are calculated immediately after each auction, currently twice per day.

After each margin run, margin calls are generated in the clearing system. Immediately after each margin run, the clearing members can view their updated margin and collateral values in the GUI. The below time data are benchmarks, when clearing members will receive the details of performed margin runs. CCP.A reserves the right to perform further IM-runs if necessary.

- **1st margin run at 10:40 a.m.** – after 10:15 a.m. auction
 - ♦ including all new trades concluded in the first auction
- **2nd margin run at 13:15 p.m.** – after 12:00 p.m. market coupling auction
 - ♦ including all new trades concluded in the second auction

3.2. Margin Call Procedures

After each margin run, the margin requirement is compared with the pledged collateral. The reconciliation ends in one of the following results:

- Preliminary Margin Call
 - where margin requirement represents more than 100% of the pledged collateral after the **1st margin run at 10:40 a.m.**
- Final Margin Call
 - where margin requirement represents more than 100% of the pledged collateral **2nd margin run at 13:15 p.m.**
- Margin Surplus
 - where margin requirement < 100% of the pledged collateral

3.2.1. Margin Call

A margin call is created, if

margin requirement - pledged collateral > 0.

The margin calls resulting from the 1st margin run (1st auction) are considered as **preliminary** and shall not be required to be covered by the clearing member accordingly – only for information purposes.

The margin calls resulting from the 2nd margin run (2nd auction) are considered as **final** and shall be required to be covered by the clearing member accordingly.

In case of a final margin call, the clearing member has to deposit additional collateral to fully cover the margin requirement. Margin Calls have to be fulfilled in the timeline² specified in the *GTC Electricity Spot Market* published on CCP.A's website.

3.2.2. Margin Surplus

A margin surplus is created after each margin run, if

$$\text{margin requirement} < \text{pledged collateral}$$

Up to the amount of the surplus, the collateral can be released upon request after the 2nd margin run. CCP.A does not automatically release collateral surpluses.

² Usually Margin Calls have to be covered until 9:30 a.m. on next bank business day.

4. Monitoring of Exposure and Position Limits

To ensure that the credit exposure is covered with sufficient collateral at all times CCP.A and EXAA are continuously monitoring the open positions of each clearing member. For this purpose, position limits corresponding to the pledged collateral are set per clearing member's account in the trading system.

4.1. Position Limits 10:15 a.m. Auction

During the 10:15 a.m. auction the participants trade electricity in two bidding zones in Austria and in Germany. EXAA determines the market clearing price for these two market areas on the basis of the supply and demand curves derived from the order books and thus has full price control and can closely monitor the utilisation of the deposited collateral.

Shortly before 10:15 a.m. EXAA calculates the indicative prices per traded product based on the order books and together with all open (i.e. not yet settled) positions checks these against the position limits. In case the position limit is exhausted, EXAA will delete orders entered into the trading system until the portfolio value falls below the position limit.

Alternatively, the trading members can opt for the automatic execution of spread orders. In this case, during the 12:00 p.m. auction the marked position will be closed out at market price.

4.2. Position Limits 12:00 p.m. Auction

The 12:00 p.m. auction utilises a centralised European market coupling algorithm to determine prices, which combines supply and demand curves from several countries and exchanges. For the exposure valuation during the auction, this means that it must be based on estimated prices. The 10:15 a.m. auction prices are used as reference prices and price variation buffers are applied which are calculated based on the historical price spreads between the 10:15 a.m. and 12 p.m. auction for each single hour product.

4.2.1. Price Variation Buffer Algorithm

CCP.A calculates the price variation buffers taking into account historic price spread variations (real distribution) and, in addition, the statistic variation following the assumption of normally distributed price spread variations. Both methods are applied by using several sets of parameters (look back period, confidence interval and holding period). Each method and parameter set delivers a respective Risk Factor.

Step 1:

Based on a price history, the price spread variation is calculated by comparing the price of each product in the 10:15 a.m. auction and the 12:00 p.m. auction. The price variations " δP " are defined as follows:

$$\delta P = Price_{10:15} - Price_{12:00}$$

Step 2:

Real distribution approach of price variations: Based on the chosen time series to be analysed (look-back period) and the confidence level (99%) to be covered through the calculation, the number of expected price variations in and out of the confidence interval are set.

Step 3:

After calculating the series of price variations starting with the last available price, they are sorted by their absolute values. From this ordered set the Minimum Price Spread " $Min \delta P$ " (the highest observed variation inside the confidence interval) and the Maximum Price Spread " $Max \delta P$ " (the smallest observed variation outside the confidence interval) is being derived.

Step 4:

Standard distribution approach: In addition to the above analysis, a normal distribution of the price variations is assumed with positive and negative price variations. The standard deviation of the observed distribution " σ " is used to derive the 99 % value of the 'normally distributed' price variations, by multiplying the measured standard deviation " σ " of the observed distribution with the factor 2,57583 (i.e. the 99,5% quantile of the standard deviation). The parameter derived from this analysis is defined as Normal RF " $Norm \delta P$ ".

Step 5:

The Price Variation Buffer " δP -Buffer" per product is then as follows.

$$\delta P - Buffer_i = \max(Max \delta P; Norm \delta P)$$

Step 6:

The price variation analysis is performed simultaneously for each product based on all predefined sets of parameters (e.g. for different look-back periods). The respective resulting Price Variation Buffer is then defined as the maximum of the individual Price Variation Buffers per parameter set.

CCP.A can define a range (a cap and a floor) for the final Price Variation Buffer.

Step 7:

For block products which are traded only in the 12:00 p.m. MC auction, the average Price Variation Buffer of the single 1-hour products which the block contains is applied.

4.2.2. Set of Parameters

CCP.A is currently using the following parameters for price estimation:

| | parameter set |
|---------------------|-------------------|
| Look back period | 365 days |
| Price variation | 10:15am / 12:00pm |
| Confidence interval | 99% |

4.2.3. Price Estimation Algorithm

The estimated prices for open position valuation in the pre-trading phase before the 12:00 p.m. auction are calculated as follows:

- Buy trades $P_{buy} = P_{10:15am} + \delta P\text{-Buffer}$
- Sell trades $P_{sell} = P_{10:15am} - \delta P\text{-Buffer}$

5. Margin Model Validation

In order to assess the reliability and the coverage of its margin model and parameters, CCP.A performs an ex-post comparison of observed outcomes with expected outcomes derived from the use of the margin model.

For this purpose, regular back tests are performed according to the “*Test Policy and Model Validation Electricity Spot Market*”:

- Back tests of calculated margins and position limits vs. open payment positions per clearing account on daily basis
- Back tests of estimated prices for portfolio valuation during auctions and usage of position limits

6. Parameters

| Process | Parameter | effective Value | last update | last review |
|-------------------------------------|-------------------------------------|-----------------------------|-------------|-------------|
| Margin computation | Confidence interval | 99% | | |
| | Look back period | 365 days | | |
| | Time horizon for calculation | 3 days + holiday adjustment | | |
| | Trading volume fluctuation min in € | 1.000 € | | |
| | Trading volume mean value in € | 3.000 € | | |
| | Initial margin requirement min in € | 40.000 € | | |
| Anti-procyclicality on market level | Margin buffer | 25% | | |
| Credit risk factor | Risk premium per rating category | 0-10 % | | |
| Spread Buffer price 12:00 auction | Confidence interval | 99% | | |
| | Holding period | 1 day | | |
| | Look back period | 365 days | | |