UK Power & Natural Gas Derivatives

Margining and Risk

v.2.3

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1 Introduction

This description covers the margining solution for the UK Power and Natural Gas Derivatives markets (GBP Contracts). The main areas covered are Collateral Calls, margin components, margining method and parameters. The audience is current and new Clearing Members and System Vendors.

In this document we refer to Greenwich Mean Time (GMT), including daylight saving time, as defined in the Clearing Rules appendix 'Definitions':
http://www.nasdaqomxcommodities.com/clearing/clearingrulebook/ .

Please also refer to the margin calculation descriptions and examples available at:
http://www.nasdaqomxcommodities.com/clearing/riskmanagement/margining/

1.1 Document Version Handling

Version	Date	Comment
1.0	February 23, 2010	First Draft
1.1	May 5, 2010	Second Draft
1.2	May 10, 2010	Third Draft
1.3	June 15, 2010	Fourth Draft
2.0	July 19, 2010	Final
2.1	November 22, 2010	Mainly Update of section 2.6 and update of web links
2.2	January 12, 2011	Update of section 2.6 (Margin Calls and Collateral on Holidays)
2.3	November 14, 2011	Inclusion of UK Natural Gas Market and various updates

2 Margining Method Overview

As a clearinghouse, NASDAQ OMX Stockholm AB ('the Clearinghouse') enters into a trade as central counterparty vis-à-vis the initial buyer and seller. In order to handle the counterparty risk, the Clearinghouse calculates a daily margin call for each Clearing Member, General Clearing Member and Clearing Client (we will use the joint expression 'Member' throughout this document) covering risk in open positions and pending settlements.

2.1 Daily Margin Call

The Daily Margin Call represents the expected cost of closing out the Member's positions and consists of two margin components: the Initial Margin and the Variation Margin (also called 'contingent variation margin' or market value in other markets).

The Initial Margin is the maximum potential loss for a portfolio over a pre-defined close-out horizon and is calculated for futures contracts in the trading and delivery period.

The Variation Margin is the cost for liquidating the portfolio at the prevailing market price and is calculated for futures contracts in the delivery period.

2.2 Daily Market Settlement

During a futures contract's trading period a Daily Market Settlement (called 'Variation Margin' in other futures markets) based on mark-to-market of the contract is calculated and settled on a daily basis.

Please see http://www.nasdaqomxcommodities.com/clearing/downloads/ for further details on the Settlement and Bank Solution.

2.3 Base Collateral Call

The Clearinghouse requires a Base Collateral Call to cover overnight risk.
In determining the Base Collateral Call the Clearinghouse takes into account factors such as the Member's internal risk rank based on an external or internal credit rating, the expected open interest, historic clearing activity and more. Should there be significant changes in i.e. the trading pattern or the risk rank, the Clearinghouse could revise the amount of the Base Collateral Call.

The Base Collateral Call must be covered before any trading activity may commence.

The Base Collateral Call is set in the Margin Currency (see 3.9.) chosen by the Member, currently either GBP or EUR.

2.4 Extraordinary Margin Call

In exceptional cases, the Clearinghouse reserves the right to issue a separate Extraordinary Margin Call. Once issued this must be covered within a short notice period. Instances that could lead to an Extraordinary Margin Call being issued includes major price fluctuations and higher credit risk towards the counterparty. The Extraordinary Margin Call can be issued to individual counterparties or to the Market as a whole.

2.5 Collateral Call

The Collateral Call is the total margin call to be covered by the Member and is defined as follows:

Collateral Call = Base Collateral Call + Daily Margin Call + Extraordinary Margin Call

where;
the Daily Margin Call is included as a negative number or zero
the Collateral Call, Base Collateral and Extraordinary Margin Calls are expressed as negative numbers

The Daily Margin Call is based on the previous Clearing Day's positions and closing prices, and is issued in the morning. If the Daily Margin Call has a negative value, it needs to be covered by Collateral no later than 10:00 (Final Collateral Time) each Clearing Day.

The current Collateral Call presented by the Clearinghouse can be monitored through reports in the Clearing Report Application (CRA). All Members are expected to actively track their current margin requirements though the margin reports.

Please see http://www.nasdaqomxcommodities.com/clearing/clearingsystems/cra/ for detailed descriptions of the clearing reports.

Collateral can be posted as cash in a Cash Collateral Account or as a Bank Guarantee/Letter of Credit. *Please see: http://www.nasdaqomxcommodities.com/clearing/downloads/ for details.*

The Clearinghouse has, among other measures, the right to close positions in the market on the account and risk of the Member, should the Member fail to post collateral within the Final Collateral Time. *Please see http://www.nasdaqomxcommodities.com/membership/legalframework/ for further details.*

3 The SPAN®[1] Method and the Daily Margin Call

The Clearinghouse uses the SPAN® method to calculate the Daily Margin Call. SPAN®, which is an abbreviation for 'Standard Portfolio Analysis of Risk', is a method for calculating margin calls developed by the Chicago Mercantile Exchange. Introduced in 1988, SPAN® is used by exchanges and clearinghouses worldwide.

The starting point for calculating margin call with the SPAN® methodology is the following question:

"How much can the Clearinghouse — acting as contractual counterparty — reasonably expect to lose if a Member cannot meet the collateral requirement for its position and the market simultaneously moves in an unfavorable direction?"

SPAN® calculates the maximum potential loss for a portfolio over a pre-defined close-out horizon. SPAN® simulates how the portfolio's theoretical value will be affected by various market scenarios. The Clearinghouse uses both historical data on price fluctuations and recognized pricing models to perform these calculations.

There are two components in the Daily Margin Call. These are: Variation Margin (market value) and Initial Margin (scenario risk). A Cash Margin may also be calculated as a *proportion of* the Daily Margin Call.

3.1 Group Risk

Derivatives with the same underlying reference price are grouped together to a Risk Group. Peak and base load contracts belonging to the same 'market' (for example UK Power) belong to separate Risk Groups.

A Group Risk is calculated separately per group. The Group Risk is the sum of the Initial Margin and the Variation Margin of the contracts in the group. The separate Group Risks are accumulated into the Daily Margin Call for each Member.

1 "SPAN is a registered trademark of Chicago Mercantile Exchange Inc., used herein under license. Chicago Mercantile Exchange Inc. assumes no liability in connection with the use of SPAN by any person or entity."

3.2 Theoretical Closing Price

For contracts in delivery, a Theoretical Closing Price is used in the calculation of Initial and Variation Margin. The Theoretical Closing Price is calculated as a weighted average of the underlying contracts' closing prices, and the closing prices for the 'longest' available overlapping Product Series are used.

The number of units (hours or therms) used as weights in the calculation of the Theoretical Closing Price is the units left of the Delivery Period at the end of the actual Trading Day. The Theoretical Closing Price from the preceding Trading Day is used in the end-of-day margin calculation on a Bank Holiday.

The daily Theoretical Closing Price of a month contract is equal to the weighted closing prices of week contracts overlapping the remaining Delivery Period, including any overlapping week contract in delivery (where the Theoretical Closing Price equals the Final Closing Price, as described in section 3.3).

Example:
Standing on a Friday, the Theoretical Closing Price calculation includes Product Series and delivery hours (therms for a Natural Gas contract) covering Saturday and Sunday and further out.

3.3 Variation Margin

During the *trading* period futures are subject to a Daily Market Settlement (see section 2.2).

During a futures contract's *delivery period*, a Variation Margin (or market value) is calculated for the not yet settled ('remaining') part of the contract. The Variation Margin is the cost for liquidating the contract in delivery at the prevailing market price.

The Variation Margin is calculated as follows:

$$VM = (TCP - FCP) \cdot POS \cdot UNITS_{REM}$$

TCP: Theoretical Closing Price of the instrument for current date (see section 3.2)

FCP: Final Closing Price (Closing price of the instrument the last trading date)

POS: Net position (bought – sold)

$UNITS_{REM}$*:* Remaining number of units (hours or therms) for the instrument

In practice, the Variation Margin for futures week contracts is equal to zero, since the Theoretical Closing Price is set equal to the Final Closing Price during the week's delivery period. This principle may be altered.

3.4 Initial Margin and Risk Interval

The Initial Margin (scenario risk) states how much the open position in the portfolio can change in value at the least favourable price development within a Risk Interval (scanning range), as a percentage of the closing price. For a given day a unique Risk Interval is calculated for each Product Series (futures or forward) in the portfolio.

The Risk Interval is based on historical daily volatility and reflects the maximum expected price movement for the Product Series during a certain closing horizon and within a certain confidence interval:

*Risk Interval (% of closing price) = Daily Volatility (%) * 3 * SQRT(d)*

where; the *Daily Volatility* is estimated by the Clearing House, the factor '*3*' represents 3 standard deviations (99.7% confidence) and '*d*' is the number of days in the close-out horizon.

The product *3 * SQRT(d)* is the Risk Interval Multiplier and the current value could be found in the clearing reports.

Table 1 below shows an example of the volatility matrix used when determining the Risk Interval based on 'days to delivery' of a Product Series. For a contract with a number of days to delivery falling between the points in the table, weighting is used to determine the Risk Interval.

Days to Delivery	Daily Volatility	Risk Interval
1	2,99%	20,00%
8	2,99%	20,00%
15	2,99%	20,00%
22	2,84%	19,00%
29	2,84%	19,00%
36	2,84%	19,00%
43	2,54%	17,00%
50	2,54%	17,00%
57	2,39%	16,00%
85	2,24%	15,00%
113	2,24%	15,00%
141	1,94%	13,00%
169	1,94%	13,00%
197	1,64%	11,00%
225	1,64%	11,00%
337	1,34%	9,00%
393	1,34%	9,00%
540	1,34%	9,00%
603	1,19%	8,00%
729	1,19%	8,00%
1095	1,05%	7,00%
1500	0,97%	6,50%
1800	0,97%	6,50%

Table 1: *Example of SPAN® Volatility Matrix*

The Risk Interval can also be expressed in absolute terms:

*Risk Interval (absolute) = Closing Price * Risk Interval (%)*

For a Natural Gas Product Series the Closing Price and Risk Interval in Clearing Reports is expressed in 'pence' format.

SPAN® calculates 16 different risk scenarios constituting a 'risk array', based on the Risk Interval for the futures contracts and Implied Volatility scenarios. Only 7 risk scenarios are *in practice* applicable for futures.' Implied volatility up/down' is only applicable for options. The extreme scenarios 15 and 16 are in practice only applicable for out-of-the money option contracts (see figure 1).

Scenario	Price of underlying instrument	Implied Volatility
1	Unchanged	Up
2	Unchanged	Down
3	Up 1/3 of price scan range	Up
4	Up 1/3 of price scan range	Down
5	Down 1/3 of price scan range	Up
6	Down 1/3 of price scan range	Down
7	Up 2/3 of price scan range	Up
8	Up 2/3 of price scan range	Down
9	Down 2/3 of price scan range	Up
10	Down 2/3 of price scan range	Down
11	Up 3/3 of price scan range	Up
12	Up 3/3 of price scan range	Down
13	Down 3/3 of price scan range	Up
14	Down 3/3 of price scan range	Down
15	Up, extreme price move	Unchanged
16	Down, extreme price move	Unchanged

Figure 1: *SPAN® Risk Scenarios in the Risk Array*

The model chooses the scenario that gives the largest potential loss for the net position included in a time spread period (delivery period). The Initial Margin (scenario risk) for the portfolio is the sum of the losses calculated per time spread period.

The potential loss for an option is calculated by 'stressing' both the implied volatility and the price of the underlying contract.

3.5 Time Spread Credit due to Correlation

The Time Spread Credit determines to what extent the Initial Margin (scenario risk) can be reduced due to the correlation between Product Series within the *same* Risk Group with *different* delivery periods and opposite positions.

A correlation between two delivery periods close to 1 means that the periods correlate almost completely and that a change in the closing price in one of the delivery periods is reflected by almost exactly the same percentage price change in the other delivery period.

As mentioned in the section above, contracts are divided into time spread periods, and for portfolios with opposite exposure in *different* time spread periods belonging to the same Risk Group, SPAN® will take the correlation into account when determining the Group Risk. Parameters are defined to determine to which degree net crediting shall take place, given the correlation between two time spread periods. Figure 2 below shows an example of a correlation matrix which has the same observational points (days to delivery) as the volatility matrix.

Days to Delivery →	0	1	8	15	22	29	36	43	50	57	85	113	141	169	197	225	337	393	540	603	729	1095	1500	1800
1	1	0,388	0,455	0,401	0,381	0,228	0,376	0,374	0,490	0,386	0,380	0,370	0,371	0,389	0,366	0,482	0,288	0,250	0,280	0,390	0,322	0,244	0,244
8		1	0,976	0,966	0,969	0,944	0,934	0,938	0,940	0,900	0,900	0,793	0,772	0,788	0,688	0,605	0,605	0,490	0,432	0,390	0,300	0,353	0,353
15			1	0,980	0,988	0,980	0,965	0,942	0,940	0,900	0,900	0,844	0,838	0,789	0,680	0,655	0,654	0,490	0,455	0,390	0,366	0,355	0,355
22				1	0,980	0,980	0,969	0,943	0,940	0,920	0,915	0,843	0,843	0,780	0,676	0,658	0,654	0,574	0,491	0,389	0,365	0,354	0,354
29					1	0,981	0,981	0,980	0,941	0,921	0,921	0,843	0,843	0,822	0,670	0,665	0,654	0,610	0,545	0,456	0,387	0,372	0,372
36						1	0,988	0,988	0,971	0,940	0,922	0,843	0,843	0,826	0,681	0,679	0,655	0,625	0,623	0,487	0,387	0,388	0,388
43							1	0,992	0,978	0,940	0,922	0,844	0,844	0,835	0,682	0,687	0,678	0,645	0,647	0,489	0,400	0,391	0,391
50								1	0,993	0,943	0,931	0,887	0,860	0,841	0,688	0,700	0,680	0,678	0,670	0,490	0,467	0,433	0,433
57									1	0,976	0,940	0,896	0,861	0,840	0,688	0,743	0,692	0,668	0,672	0,492	0,477	0,445	0,445
85										1	0,945	0,940	0,841	0,843	0,722	0,756	0,759	0,689	0,680	0,543	0,491	0,465	0,465
113											1	0,943	0,942	0,855	0,733	0,784	0,760	0,690	0,688	0,598	0,521	0,487	0,487
141												1	0,944	0,857	0,812	0,800	0,767	0,711	0,691	0,655	0,625	0,523	0,523
169													1	0,896	0,886	0,800	0,800	0,734	0,721	0,678	0,700	0,592	0,592
197														1	0,899	0,828	0,832	0,766	0,764	0,732	0,778	0,645	0,645
225															1	0,842	0,843	0,834	0,811	0,766	0,802	0,742	0,742
337																1	0,855	0,847	0,823	0,882	0,886	0,881	0,881
393																	1	0,900	0,897	0,932	0,928	0,954	0,954
540																		1	0,922	0,951	0,961	0,972	0,972
603																			1	0,981	0,980	0,991	0,991
729																				1	0,991	0,998	0,998
1095																					1	1,000	1,000
1500																						1	1,000
1800																							1

Figure 2: *Example of SPAN® Correlation Matrix*

'Couples' of time spread periods are sorted according to the most favourable time spread, i.e. the delivery periods with the highest correlation are netted first. For a pair of correlating delivery periods the volume credited is maximized to the energy volume (number of lots*lot size) for the period with the smallest exposure.

3.6 Delta Netting

As mentioned above, the margin methodology allows crediting or netting between two time spread periods with an opposite net exposure. For a futures contract, the delta (sensitivity to price changes) is always 1, which means that it contributes with its entire energy when netting between time spread periods.

For options on the other hand, the delta depends on the price of the underlying instrument.
Delta Netting means that the delta of options are calculated based on a probability weighted average of a set of deltas calculated for the options (a) after the look-ahead time has passed (normally one day) and (b) according to possible price changes for the underlying instrument. The delta found is called the 'Composite Delta'.

3.7 Inter Commodity Spread Credit

The Clearinghouse may also allow for netting of Initial Margin between Risk Groups. The method is called Inter Commodity Spread Credit (ICSC) and builds on the Delta Ratio (mainly the relation between Risk Intervals) and a Credit Factor (in %, based on correlation), which are defined for 'pairs' of time periods (tiers) belonging to different Risk Groups, allowed to be included in the ICSC.

Product Series which are determined to have a large enough correlation are included in the ICSC. *The ICSC is described in depth at:*
http://www.nasdaqomxcommodities.com/clearing/riskmanagement/margining/

The Initial Margin after Time Spread and Inter Commodity Spread Credit is included in the Daily Margin Call.

3.8 Cash Margin

The Cash Margin is a proportion of the Daily Margin Call, which must be covered by cash to assure Daily Market Settlement of the futures contracts in the Trading Period and Spot Reference Cash Settlement in the Delivery Period. *Cash Margin is currently not applied for UK Derivatives.*

3.9 Margin Currency and Currency Conversion

The Collateral Call is calculated in a specific Margin Currency. Each Member should define one (1) Margin Currency (either EUR or GBP) for its clearing account and Collateral Call. Margin for both EUR and GBP contracts is calculated in the Risk Currency (GBP or EUR), which is the basis for the Collateral Call.

SPAN® applies currency scenarios (high/low) based on current exchange rates and a currency Risk Interval, when converting from contract to risk currency.

For Variation Margin the 'high' ('low') scenario is used when converting a negative (positive) number. The Variation Margin is converted per position in the contract series.

For details, please see the following section and the margin calculation examples at *http://www.nasdaqomxcommodities.com/clearing/riskmanagement/margining/*

3.9.1 Currency Conversion in SPAN® - Details

The main audience of this section is software developers or Members, familiar to the SPAN® method.

In the time spread calculation of Initial Margin, the following principles for currency conversion are followed, 'adding' currency scenarios to the 16 price scenarios described in the section 'Initial Margin and Risk Interval':

For each of the two time spread periods, a positional matrix is calculated per position that is contained in the time period. A positional matrix is a matrix of dimension 16 X 2. The first dimension is the scenario point of the risk arrays. The second dimension is currency. First element stands for if the exchange rate between instrument currency and margin currency goes up, while the second element stands for if the exchange rate goes down. If the instrument currency and the margin currency are the same, these two elements will have identical values.

The positional matrix values are calculated as:

1. Start by the risk array value for the scenario point.

2. If the instrument currency and Risk Currency differ, the risk array values are multiplied by the exchange rate between instrument currency and risk currency. Currency risk is also applied to exchange rate going up (first entry) and exchange rate going down (second entry).

3. Multiply the value by net position * position factor

4. For scenario point 15 and 16, the values are multiplied by the risk parameter Extreme Move Coverage

3.9.2 Currency Conversion of Collateral

Currency conversion of Collateral is allowed for certain currencies (please contact the Clearinghouse for details) and the 'low' currency scenario is used in the conversion of the Collateral to the Margin Currency.

Cash Collateral posted in a 'non-Margin Currency' (only EUR or GBP is currently allowed) on a Pledged Account, including any cash used to cover cash margin in a non-Margin Currency, is converted with the 'low' currency conversion factor, and may be used to cover the Collateral Call.

3.10 Margin Calls on Holidays

Members may choose a Margin Currency (EUR or GBP) used for the entire Collateral Call.

Members clearing *both* EUR and GBP contracts may have to cover a Daily Margin Call on days when either of the markets is open. For these Members, the Clearinghouse requires an additional Cash Collateral Account in the 'non-Margin Currency' (only GBP or EUR) in order to cover Collateral Calls on clearing days when banks handling their Margin Currency (EUR or GBP) are closed.

The Clearinghouse does not receive any legally binding bank confirmation regarding the cash balance on the EUR accounts on days when the EUR banks are closed.

As mentioned above a Daily Margin Call is calculated on days when either of the markets is open. Prices and positions from the previous Trading Day are used in the end-of-day margin calculation, and the first period included in the calculation is the next Trading Day in the actual market. The example below shows the principles on a EUR Holiday and the following Clearing Day:

Example - 24 May is a EUR Holiday
24 May is a Bank Holiday in the 'EUR market' (EUR Contracts) and the GBP contracts are traded. Friday 21 May is the last preceding Trading Day. The table below shows the input used in the end-of-day margin calculation including prices and positions as of Friday 21 May and Monday 24 May.

Please note that the time period 24 May is not included in the end-of-day calculation for EUR contracts positions 21 May.

Please also note that the Cash Margin (EUR only) is an estimate of the settlement calculated end-of-day the following Trading Day (position date 25 May) and settled the Trading Day following that day (Settlement Date - 26 May).

The 'parameter set date' in the SPAN® Risk parameter file (Record Type 00) is 21 May and the same applies for the file produced 24 May, since the parameter set date follows the EUR contract trading days.

	Margin Calculation with Positions as of:	
	Fri 21 May	**Mon 24 May**
EUR Contracts		
Closing prices & positions	21 May	21 May
First period included	***25 May***	25 May
Cash Margin, position day	25 May	25 May
GBP Contracts		
Closing prices & positions	21 May	24 May
First period included	24 May	25 May
Cash Margin, position day	n/a	n/a

Table 2: *Margining on an EUR Holiday*

3.11 SPAN® Risk Parameter file

The SPAN® Risk parameter files contain data used by members and 3rd party vendors for calculating margin requirements on a daily basis. A daily file including both the current EUR contracts and the GBP contracts is produced and distributed in the evening of the day preceding a trading day of either EUR or GBP contracts. The file includes data referring to the last trading day for each of the markets.

Please note the 'parameter set date' in Record Type 00 shows the last trading date of the EUR contracts and that Natural Gas prices and Risk Intervals in Record Type 01 and 02 are in pence format. Record Type 02 contains a 'Price Quotation Multiplier' which indicates if the quotation format (e.g.: pence) differs from the contract currency (e.g.: GBP).

The risk parameter file also contains currency rates used in the currency conversion of margins and collateral (Record Type 06).

Full description and downloads of the current 'production' SPAN® file:
http://www.nasdaqomxcommodities.com/clearing/riskmanagement/spanparameterfiles/

3.12 Routines for Revising the SPAN®-parameters

The SPAN® parameters are continuously evaluated and revised by the Clearinghouse when needed[2].

Variable parameters as standard deviation (volatility) and correlation are calculated for the most relevant period. The Clearinghouse conducts an evaluation of these against existing observations continuously and decides if an update is needed. Essential differences in the observations or incidents in the market may result in a change. The Clearinghouse does not operate within absolute limits for essentials in this context, but conducts a total evaluation from time to time.

According to the Clearing Rules, all parameters may be changed within one hour's notice. As a rule, changes in the SPAN® parameters will be made as a consequence of an extraordinary increase in the volatility.

[2] All parameters used in calculating margin requirements, such as the price scanning range, the volatility range, and the choice of theoretical pricing models for options, are determined by the Clearinghouse.